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THE ULTRA-VIOLET RAYS.

The engineering profession at large, and persons who have had no occasion to investigate the subject, appear to regard the rays of light as the only manifestation of the disturbance in the ether which causes the human eye to perceive and distinguish colors; this is not correct, as of late many other varieties of "rays" have been isolated and found to possess qualities vastly different from light rays. Among the latter to be isolated and examined are the ultra violet rays which have their sphere of motion at the extreme violet end of the spectrum.

The rays which are commonly called "light" are composite, being formed of seven rays which move with a sufficient relaxation to affect the optic nerves; these seven are red, orange, yellow, green, blue, indigo and violet.

The first important manifestation of these auxiliary rays were noticed by Professor Roentgen. This gentleman, not understanding their characteristics, gave them the now familiar name of X rays. As is well known, the feature of these rays which causes them to be so useful, is that of piercing many substances opaque to ordinary light rays. The X ray, however, moves at such an astounding speed as to be entirely unnoticed by the optic nerves, and in order to retard this enormous speed a screen of basium platinocyanide is placed between the object pierced and the human eye. These rays, in common with ordinary light, cast well defined shadows.

Prof. Roentgen, in his original memoir on "A New Kind of Rays," remarks that a kind of relationship between the X rays and light rays appears to exist; at least the formation of shadows, florescence, and the production of chemical action point in this direction. It has been known for some years that, in addition to the transverse vibrations which account for the phenomena of light, it appears that longitudinal vibrations may exist in the ether, and, according to the view of certain physicists, must exist. It is granted that their existence has not yet been made clear, and their properties are not experimentally demonstrated. It is a question if the new rays should not be ascribed to longitudinal waves in the ether.

The next discovery of importance in this direction was made by the Curies when they reached the source of certain radiations in discovering and isolating radium. Although these persons are justly credited with discovering and isolating the salts of radium, they cannot be credited with the prior discovery of the radiations. This honor must go to Prof. Henri Becquerel, who was following up the work of Prof. Roentgen when he became aware, accidentally, that certain inorganic substances, supposedly uranium, were capable of evolving emanations which conducted themselves in a degree, similar to the X rays. Subsequent investigation by Prof. and Madame Curie disclosed the fact that these emanations proceeded from certain impurities previously unknown, which were regarded as a residue in the distillation processes to which the uranium and salts of that element were subjected. These impurities were later found to be three undiscovered elements, and were given the name of polonium, actinium, and radium. Of these radium is by far the most active.

Professor and Madame Curie have determined the atomic weight of radium and find it to be 225. Radium, although considered an element, has not, up to recently, been isolated in the elementary condition; all experiments are carried out with the chloride or bromide.

The radiations from radium appear to possess the property of disintegrating organic tissue. A small quantity of radium introduced beneath the skin of a mouse near the spinal column, produced speedy death from paralysis. However, although this action is known, it is safe to say that no definite concise understanding of the destructive or medicinial properties of this element have been acquired.

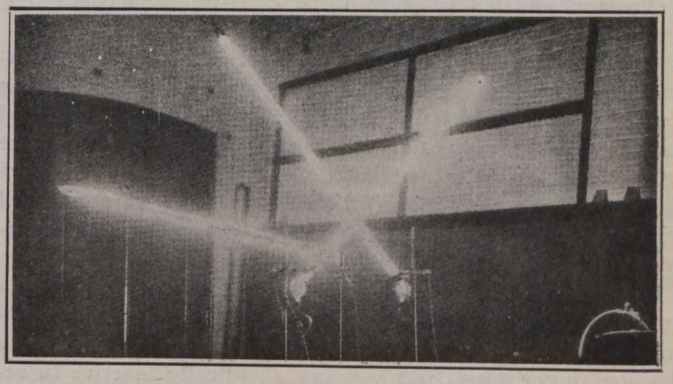


Fig. 1.

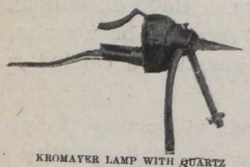
Through the development of the mercury vapor lamp it was found possible to produce ultra-violet rays in such a form that they could be experimented with. The lamp which is generally used in a modification of the Copper Hewitt lamp illustrated in Fig. 1. In this apparatus a small quantity of mercury is confined in a glass tube, which is exhausted of air to a considerable extent. Metal electrodes protrude at the extremities, and when the current is led to the lamp the tube is tilted, allowing the mercury to strike an arc, the heat and flash which follows vaporizes the mercury or a portion of it. From the mercury in the vaporous condition come the ultra violet rays, so deadly to bacteriological and low forms of organic life.

The light is deficient in the longer wave lengths, or red. The lack of the longer wave lengths results in an unpleasant distortion of color. The ordinary glass tube allows the blue and violet rays to pass, but is entirely absorbent of the extreme violet (ultra violet) rays. To bring these rays outside, the tube must be constructed of quartz.

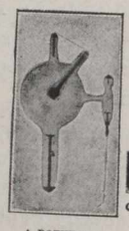
To construct a piece of physical apparatus of fused quartz is an extremely difficult operation, owing primarily to the enormous heat necessary—2,000° C. (3630° F.)—and the difficulty of procuring a substance that will manufacture into a suitable crucible.

Quartz is found in nature in the crystalline and amorphous conditions, the former variety being known as rock crystal and quartz sand, and the latter is found as opals and other precious stones. On a piece of rock crystal being heated in an open flame it cracks, and when the fragments are melted in the electric furnace a compact amorphous mass is produced which is absolutely insensitive to temperature influences and shows other properties entirely different from rock crystal.

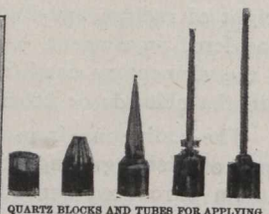
In 1903 Dr. J. Frank Bottomley commenced in a small experimental works erected at Wallsend, near Newcastle-on-Tyne, Scotland, a series of investigations with the object of developing a method suitable for the manufacture of large size silica apparatus. In spite of the many difficulties encountered in this connection, the experiments after three years were sufficiently advanced to commence working on a commercial basis.



KROMAYER LAMP WITH QUARTZ EXTENSION.



A ROENTGEN TUBE.



QUARTZ BLOCKS AND TUBES FOR APPLYING ULTRAVIOLET RAYS, WITH PRESSURE, TO VARIOUS PARTS OF THE BODY.

As it was intended to obtain a relatively cheap product, a raw material less expensive than rock crystal had to be looked for, and a very pure form of silver sand containing over 99½ per cent. of silica was used.

Electric arcs as well as various forms of resistance furnaces were used in connection with these experiments, but the arc method was found not to be practical on account of the difficulty of regulating the temperature, and the risk of the material being contaminated by fragments expelled from the electrodes. Far more satisfactory results were obtained with resistance furnaces using carbon or graphite as resistance material.

Another difficulty is due to the silica volatizing readily at temperatures a little above the melting point. The difficulty of finding a material sufficiently refractory to serve as the containing vessel, while being chemically inactive in regard to silica, was overcome by allowing the sand itself to form its own containing vessel, which method shows the additional advantage of providing an excellent heat insulating material for the lagging of the furnace. As the surface of the silica farthest from the heating resistance is not thoroughly fused, it should be subjected wherever necessary to a subsequent glazing process. As silica, even at very high temperatures, never becomes really fluid, but attains a consistency like that of tar, it cannot be made transparent. However, in this plastic condition the material is capable of being worked into shape either by blowing or by mechanical pressure. It is, for instance, quite possible to draw a length 60 feet or more of ¾-inch tubing. At the works of the Thermal Syndicate, Wallsend, where the Bottomley process is used, fusions of over 70 pounds can be made, and worked into shape, and it is hoped to increase this considerably.

The most valuable feature of these goods is their remarkable insensitiveness to temperature changes, which even allows iron ore platinum to be sealed into quartz crucibles without the latter losing their shape, their transparency to the ultra violet rays, and their insulating properties, which, though decreasing somewhat with rising temperatures, is even at the temperature of electrical furnaces quite sufficient to make the quartz an electric insulator. This feature is the more welcome, as most oxides used in industry will become conductive to electricity at high temperatures. Quartz is therefore an extremely suitable material for making electric radiators. As quartz tubes are fairly pervious to heat rays, they can, in fact, be used also for the transmission of heat. For a similar reason quartz plates are extremely practical as refractory protective mantles, undergoing a relatively immaterial heating even on being radiated upon intensely.

It would be a difficult task to name the discoverer of the ultra violet rays, but should one be inclined to search out the names of the responsible parties, certain it is that the name of Prof. Niels R. Finsen, of Copenhagen, Denmark, would occupy a prominent position on the list; in fact to that gentleman must go the honor of the pioneer work in the treatment of disease by photo-therapeutics. Prof. Finsen proved that the therapeutic properties of light in the treatment of bacterial diseases of the skin, especially lupus vulgaris, or tuberculosis of the skin, was due chiefly to two properties of the light employed, the violet and ultra violet rays; also their power to penetrate the skin and their destructive action on bacteria.

In Finsen's apparatus, the radiation from an arc lamp was filtered through water, (pure water is a conductor of the ultra violet rays) which absorbs most of the ultra red, or "heat," rays, and was concentrated upon the skin by lenses of quartz (which does not, like glass, absorb much of the ultra violet radiation, and which aids in absorbing the ultra red rays). The Finsen lamp, for the use of physicians in private practice, consists of a 20-ampere direct-current arc lamp, a "concentrator" and a "compressor." The apparatus is so mounted on an iron stand that it can be turned in any direction. The concentrator is a wide metal tube, containing a number of quartz lenses, through which a current of

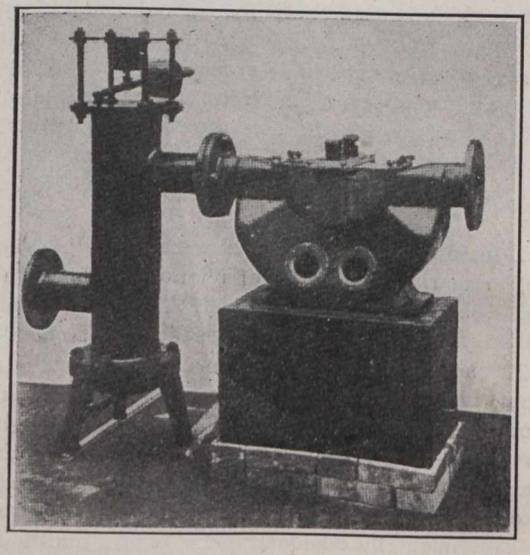


Fig. 2

cold water flows continuously. The compressor is attached to the end of the concentrator and consists of a short brass cylinder, closed at each end with a plate of quartz and filled with the circulating cold water. The terminal quartz plate is pressed against the diseased portion of the skin, which is cooled by the stream of cold water so thoroughly that a very concentrated beam of light, possessing great heating power, can be employed without danger. A still more important function of the compressor is to drive the blood from the skin and thus to make the skin more permeable by the rays. The treatment is applied for at least 45 minutes at a time. The management of the apparatus is not easy, but the method provides a sure cure for lupus and leaves no visible scars. In Copenhagen a great institution, the Finsen Institute, has been established, which receives from the Danish government an annual subsidy of 25,000 crowns (about

$6,700) in return for the free treatment of poor lupus patients.

Within the last few years many arc lamps with metallic electrodes have been invented, which emit a far larger proportion of violet and ultra violet rays than the ordinary carbon arc lamp produces, chief among which is the mercury vapor lamp.

The Kromayer lamp, which is a modification of the Couper-Hewitt lamp and finds considerable employment in light treatment of disease, contains a tube of fused quartz, two-thirds of an inch in diameter, having the form of an inverted V. The air is completely removed from the tube, the ends of which form mercury cups, which constitute the electrodes and are connected to the lighting wires. This luminous tube is inclosed in a globe, which is also made of fused quartz, and the globe is inclosed in a water-tight case of nickled brass, provided with a quartz window, which can be pressed directly against the skin of the patient. The

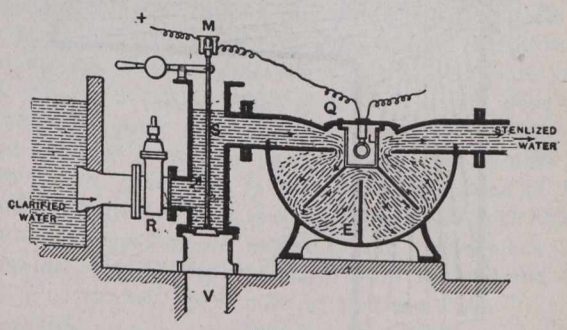


Fig. 3.

space between the quartz globe and its metal case is filled with cold water, which enters continuously through a tube at the bottom of the case and flows out through a tube at the top. The lamp is ignited by tipping it and thus causing a thin stream of mercury to flow along the tube and establish connection between the electrodes. When the lamp is righted and the thread of mercury is broken a powerful luminous arc is formed in the mercury vapor which fills the tube. Local treatment, with or without pressure, can be applied very conveniently with this lamp, but great care must be taken to avoid burning the skin. This treatment is efficacious in all forms of eczema, carbuncles and ulcers of the legs and various parts of the skin and mucous membranes, but especially in "wet" eczema and in circular baldness. Treatment with pressure is employed especially in lupus and burns.

When science had demonstrated her ability to cope with the diseases of men through these mystic rays, mankind in turn bethought himself of using this agency for the purification of his water supplies. The first serious attempt at this appears to have taken place at Marsailles, France. A description of the apparatus used and some details were given in the pages of this journal in the issue of July 13th, 1911, page 47. However, some further details will be of interest at present.

In order to find the best solution of the problem, the municipal council of Marsailles organized a concourse of sterilizing apparatus. Such a plant was required to deliver 200 cubic metres (261.5 cubic yards) of water per 24 hours, and was to be run continuously for one month. The inspection committee included some of the leading specialists in hygiene, mining and civil engineers, and professors of universities. The results of the tests showed that the ultra-violet-ray process was undoubtedly the best for municipal use, as it has none of the defects mentioned below. It uses a small amount of current, and this has now been lowered in the new apparatus. Neither taste nor smell is given to the water, and the sterilizing is very effective. At the same time the process is easy to carry out and the apparatus needs but little attention. The first cost of the plant is low, and it occupies but a small space.

There seems to be a great future in store for the new method, seeing that it has none of the drawbacks which are found with the other processes when it comes to using it on a large scale.

In the sand-filtering method, for instance, the filters occupy a large surface of the plant, and when not properly operated the results are very imperfect. Besides, the first cost of installing the filtering plant is high. Chemical products added to the water for sterilizing have the disadvantage of giving a bad taste to the water, and the method is not much favored for that reason. One of the best methods, to recent date, for municipal plants has been the ozone process, it has been used in some large cities. However, it gives a certain taste to the water which disappears but slowly, and on the other hand there must be a great care taken in the ozone production in order to avoid forming any nitrogenous products, which would vitiate the water. Hence the process is somewhat difficult to carry out, or at least needs great care and attention.

The ultra violet ray apparatus was used in connection with a Puech-Chabal filter in order to act upon clear water, and this was necessary from the fact that the Duvance water is very heavily charged with impurities which render it turbid. After leaving the filter it passes at a continuous rate through the ultra violet ray apparatus.

Fig. 2 shows the appearance of the Marseilles apparatus and Fig. 3 the sectional view. In the former apparatus, the lamps were placed above the surface of the water upon floats, so that all of the radiation from the lamp could not be used, and in fact there was only one-third of the rays actually employed for the sterilizing. A means was sought of utilizing greater proportion of the rays without changing the manner of working the arc. Ii is recognized that the working of the lamp depends essentially upon the temperature of the electrodes and the luminous tube, so that if we cool the lamp too much we will not obtain the same yield in ultra violet rays as before, and to reach the same yield, the current must be considerably increased. For instance, if we immerse the quartz lamp in the water itself, according to Messrs. Courmont and Nogier's method, we are obliged to double the current in order to obtain the same yield as in air.

A great improvement is obtained by the Marseilles apparatus in this respect, as it allows of utilizing more than three-quarters of the rays given by the lamp, and here the lamp burns in air at its best conditions of working, and immersing it in the water is avoided. The lamp is placed in a rectangular case whose three sides lying parallel to the lamp tube are formed of quartz plate. The tight box Q containing the lamp L is placed in a semi-circular apparatus having five partitions in the inside. The water is taken from a tank of filtered water and passes through a gate valve and a cylinder chamber S, then entering the main tank E. It follows around the path which the arrows indicate, and in this way it is exposed for some time to the action of the ultra violet rays, so that we have a powerful sterilizing effect. It is found best in practice to use an automatic valve at the water inlet and it operates in the chamber S. A valve in the lower part of the chamber is normally closed and is held up in this position by an electro-magnet M which attracts an armature mounted on the end of the valve rod. A counterweight is used to give the proper adjustment of the weight. The electro-magnet is connected in series with the lamp, so that when current passes in the lamp circuit the magnet acts and the valve is held closed. Should the current fall or the lamp break, the magnet allows the valve to

drop, and the water now passes directly out of the apparatus by V into the sewer or elsewhere and no water will be delivered into the sterilizing chamber. Thus there is no danger of having unsterilized water flowing through the apparatus in case the current should fail. During the tests which were made at Marseilles, a quartz lamp of the Westinghouse-Cooper Hewitt type, with a current of 22 volts and 3 amperes was used, and the apparatus was run from August 19th until the end of September, working day and night without stopping. It gave an output of 60 cubic meters (78.5 cubic yards) per 24 hours, or 32¾ cubic yards per hour. During that time there were made eighteen bacteriologic tests of the incoming and outgoing water. Before entering the apparatus the (impure) water contained 30 to 300 germs per cubic centimeter (0.061 cubic inch) and 50 to 1,000 coli bacillus per liter (1.057 quarts). After sterilizing, on the average one germ per cubic centimeter and no coli bacillus in any case.

Following the foregoing synopsis of this recent art (photo therapeutics) it would be well to return to the rays themselves and consider them in more detail.

For a correct conception of the therapeutic value of these rays, it must be borne in mind that ultra violet rays are readily absorbed by most substances. Very few bodies are transparent to them. They even pass through air with difficulty, but they traverse without appreciable absorption quartz, Iceland spar, pure water and a variety of glass called Uviol, invented recently by Schott of Jena. Both the ultra violet and the visible rays are distinguished among themselves by their wave-lengths, which stand in an intimate though complex relation to their indices of refraction, or to the relative positions occupied by the different rays after refraction by a prism. The unit of measurement of wave-length is the micron, equal to 1/1,000 millimeter, or 1/25,000 inch. The Angstrom unit, equal to 1/1,000 micron, is also employed.

Up to the present the mercury vapor arc has been employed as a source for these penetrations, several forms of

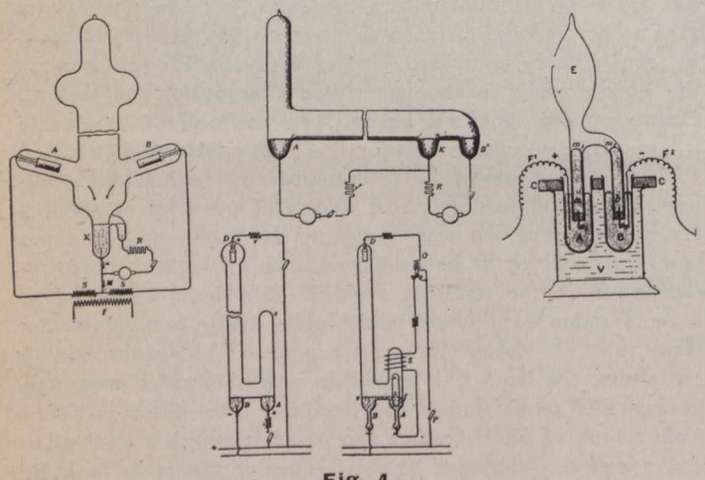


Fig. 4.

which are shown in Fig 4. All these lamps operate on the same principle, viz., metallic and carbon electrodes and a pool of mercury which is allowed to flow in a stream toward (generally the positive) electrode, thus completing the circuit and striking an arc.

The use of this lamp is attended with certain inconveniences, among which are the mechanical devices necessary to strike the arc, the high wattage and the uncertainty of maintenance. The bactericidal effect of the ray is due solely to the radiations themselves and not to any ozone or hydrogen dioxide that may be formed, for the production of an appreciable quantity of these substances requires several hours, but the sterilization is instantaneous. Bordier and Nogier and other physicists have proved that air exposed to the radiations of a quartz mercury vapor lamp acquires an odor resembling that of phosphorus, which was at first attributed to the production of ozone, but it is impossible to detect the least trace of ozone in this air, and the same odor is produced in nitrogen and other gases which contain no oxygen. In reality the odor is of physiological or subjective origin, and is due to the excitation of the olfactory nerves by the ionized and electrified air. If the gas is passed through a metal tube connected with the ground and thus deprived of its electrical charge, the odor dsappears.

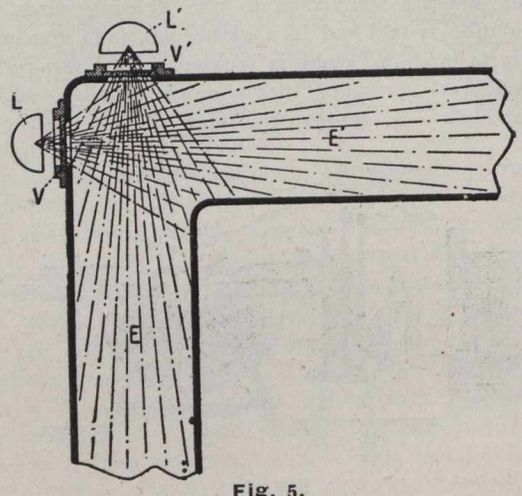


Fig. 5.

New researches by Courmont, Nogier, and Henri confirm the view that ozone and hydrogen dioxide play no part in the sterilization produced by these lamps, which is due to the direct action of the ultra violet rays. Water sterilized by this process retains its dissolved air, since it has not been heated. It remains fresh and its flavor is not changed in any way.

For municipal water service the sterilization may be effected in the water mains (Fig. 5). In order to avoid breakage of the lamps by the pressure and flow of the water they are placed outside the mains and their radiations are transmitted through windows or bull's eyes of quartz.

Some experiments are under way in the City of Toronto with the "hyper ultra violet rays." It was originally intended to generate this rays from iodine and mercury, but subsequent investigation and research showed a method of treating certain common inorganic gases with electric discharges in such a manner as to produce a volume of ultra violet rays 2,500 per cent. in excess of the mercury arc lamp. This lamp is almost devoid of luminosity under operation. Some account of the experiments and further information will be given regarding this lamp in a future issue.

SEWER SECTIONS.

Economical sewer sections have been the subject of study by Mr. Alberto Schreiner, assistant engineer in charge of design for the Bureau of Sewers, Borough of Queens, New York City. The experience in that office has led to the general conclusion that it is desirable, from the standpoint of low cost and ease of construction, to use vitrified pipe on all lines up to 24 in. in diameter. For sewers having diameters between 24 in. and 4 ft. plain concrete is believed to be the most economical type of construction but for diameters greater than 4 ft. it has been found that reinforced concrete may be used to best advantage.

HISTORY OF TAR-CONCRETE PAVEMENTS IN ONTARIO.*

By W. A. McLean, Provincial Engineer of Highways, Ontario.

Tar-concrete, or more popularly, "tar-macadam" pavements have been in service in several cities of Ontario, Canada, for a number of years, and the history of the earlier of these, while not accompanied by all desirable data, presents features of interest, in view of the growing use of bituminous materials for country highways.

Reference has, from time to time, been made in the technical press to the tar-concrete pavements of Hamilton, Ont., and it is the purpose of this paper to include also the experience of Toronto, Ont., London and other cities. In all cases the pavements have been laid by the mixing process, and coal gas tar (supposedly) was employed.

The beginning of tar-concrete roadways in Ontario was in the year 1880, when the Gas Company of Hamilton laid a short section (Mulberry Street) about 1,300 square yards, in that city. No further work of this class was done until 1891, when the same company laid 2,983 square yards at a contract price of $1.50 per yard; and in 1893 another area of 3,768 square yards was laid at a contract price of $1.75 per yard. Experience with these roadways was such that, in 1899 when a considerable extent of old cedar block pavement needed renewal, "tar macadam" was selected and about ten miles of roadway were built of that material.

Hamilton.—The following is the specification under which the later pavements (since 1899) were laid in Hamilton:—

(1) "All earth or other material above the sub-grade shall be excavated, so as to conform to the level of the sub-grade, which will be twelve inches below the finished surface of the roadway; and should the sub-grade be above the level of the natural ground, then earth shall be deposited until the level of the sub-grade is reached. The sub-grade shall be shaped to the profile and cross-section which will be furnished by the city engineer.

(2) "After the sub-grade has been formed to the proper camber of the road, generally one-half inch per foot, or six inches for a 24-foot roadway, to be thoroughly rolled with the steam roller, and if by this means soft spots are revealed, they shall be filled with good solid material.

(3) "The first six inches shall be made in the ordinary way for a macadam or telford roadway thoroughly rolled. If so required it may be made of hard broken stone, furnace clinkers, or brick rolled smooth and finished to the required camber of the road. Upon this shall be placed the tarred stone. The first layer, three inches of hand-broken stone to pass through a 2-inch ring, then a 2-inch layer of machine-broken stone, the whole smoothed off with a hand roller, and after top dressing is applied, thoroughly rolled with a steam roller. On this a layer of fine gravel and quarry clippings, mixed in equal proportions, three-quarters inch thick, shall be placed, and well rolled in so as to fill all interstices. Before finishing, a dressing of stone screenings, for the purpose of coloring, shall be scattered broadcast to be worked in by the traffic. All layers, including the coloring layer, shall be thoroughly compacted by rolling.

(4) "The stone to be tarred shall, if moist, be heated on an iron floor, under which are flues from a fire, until the moisture is driven out. The material in its heated state is then thoroughly mixed with a sufficient quantity of tar. The broken stone in warm weather may be sun-dried, but in all cases the finer course must be artificially dried. At the same time care must be taken not to get this material too hot. The tar should be boiled in iron kettles holding one hundred imperial gallons. Eight imperial gallons should be added to each cubic yard of the coarser material or more if required to completely cover the stone, and seventeen to eighteen gallons to the finer kind of stone.

(5) "The tar must be pure coal tar free from all foreign substances, and containing not more than 5 per cent. of water, and shall contain upon analysis not less than 56 per cent. pitch.

(6) "The work must be done in the summer months, and all work must be suspended during wet weather."

The tar-concrete was used to replace cedar block pavement, and the preliminary work consisted in the removal of the old cedar blocks. As these were ten inches in depth, it was necessary to remove two inches of sand upon which they were placed, to make room for the twelve inches of macadam, and bring it to the proper elevation with respect to the curb.

The cedar blocks and surplus sand having been removed, the sub-grade was thoroughly rolled with a 15-ton steam roller.

Care was taken in forming the sub-grade, and in laying each layer of stone, to bring the surface in each case parallel to the finished crown of the roadway. The first six-inch foundation course, referred to in section 3 of the specification, was made up of flat stones, from 6 to 12 inches in greatest dimension, laid roughly by hand on their natural beds. On this, smaller stones were placed and broken into the interstices, so as to keep the bottom course in place.

The next two courses of tarred stone were then applied. Large kettles were hung close to the work, and in them the tar was kept at a workable temperature. Convenient to the kettles, the stone to be tarred was placed on mixing boards. with a dipper attached to a wooden handle, the tar was then applied to the stone, being scattered over it by a swinging motion of the dipper.

With shovels kept hot to facilitate the work, the stone was turned over twice after the first application of tar. More tar was then scattered over the stone, and the stone again turned over. These operations of tarring and turning the stone were repeated until each stone was seen to have a coating of tar, there being no bare spots on the stone. One part of tar to 22 parts of stone was specified for this course.

As soon as the stone had been tarred, it was shovelled into wheelbarrows, placed on the road to the desired depth, and raked to the required cross-section. It was found of advantage to roll the tarred stone immediately after being placed on the road, since, if left two or three days, it would not consolidate as perfectly.

The top course of fine tarred gravel was mixed in the proportion of about 20 gallons of tar to one cubic yard of gravel; or one part of tar to 8 or 9 parts of gravel. The gravel, before mixing, was screened through a ¾-inch mesh. This material was prepared in an asphalt mixer, being brought hot to the road, and carefully raked to the required grade and cross-section. This having been rolled, stone screenings from the crusher were scattered over the surface to harden it, and improve the appearance.

The cost of the various pavements varied considerably. In 1899 the average was about 79 cents a square yard, but labor then cost 15 cents an hour, and coal tar f.o.b. Hamilton $2.60 per barrel (50 U.S. gallons). The average in 1900 advanced to about 88 cents a square yard; with labor at 17 cents an hour and coal tar at $3.75 a barrel. With the

* Paper read before the American Association for the Advancement of Science.

advancing cost of labor and materials the cost in 1901 averaged nearly $1.08 per square yard exclusive of curb—about 30 cents per yard more than in 1899. Plain macadam laid in 1901 averaged 53 cents a square yard.

None of the pavements were constructed by contract, all work being done by corporation labor. The stone used was a hard limestone quarried within the city limits, the average haul to the work being 1½ miles.

Toronto. — Following the experience of Hamilton, the City of Toronto in 1900 laid an experimental tar-concrete roadway on Woolsley Street, of three blocks, or approximately, a quarter of a mile in length. This roadway did not have the heavy foundation, characteristic of the Hamilton pavements, but after the sub-grade had been carefully prepared and rolled, a course of broken limestone 4-inch in thickness, was spread. This consisted of stone not less than 1¾-inch or more than 3-inch in length or breadth. This was filled with sand, was flushed, and thoroughly rolled. On this course was spread a layer of tarred stone, which was required to be as uniform in size as possible, and not less than 1½ inches or more than 2 inches in size. This surface was evenly raked and rolled. Then a layer of ¾-inch in thickness of fine granite chips thoroughly tarred, was evenly spread over the whole surface and rolled. Before finishing, a dressing ½-inch in thickness of approved pea gravel was spread over the entire surface of the roadway, to be worked in by traffic. The specifications for mixing tar were very similar to those employed in Hamilton. Additional pavements were laid in 1901 and 1902. For two or three years, these pavements were most favorably regarded as being smooth, noiseless, sanitary and dustless, but in 1903 marked signs of disintegration began to appear, and under specifications prepared for 1904, it was then provided that there should be a foundation course 5 inches in thickness. The intermediate course of tarred stone was eliminated, and a wearing surface 3 inches in thickness was provided. Three sizes of broken stone were used in this tarred surface, viz., 1½-inch, ½-inch, and screenings. A mixture of these three sizes of stone in the proportion of two parts of 1½-inch stone, one part of ½-inch stone, and one part of screenings, was found to give a dense aggregate. During the period 1900 to 1906, there were laid in all, 7.16 miles of tar macadam roadway on the streets of Toronto.

Work carried on in 1905 required a foundation course five inches in thickness after rolling, this to be of coarsely broken stone, the surface interstices to be filled with 1½-inch stone, and covered with a layer of hot bitumen using not less than one gallon per square yard. The specification provided that:

"Upon the above foundation course is to be laid a surface course, or wearing surface thoroughly saturated with the bituminous composition. This course shall be composed of good, hard and tough limestone, samples of which must be approved by the engineer before any is delivered on the ground, and shall be equal as to quality, size and fineness to the samples which may be seen in the office of the city engineer.

"Of this mineral aggregate:

"(1) 30 per cent. shall be such as will pass a No. 40 sieve.

"(2) 12 per cent. shall be such as will be held on a No. 40 sieve and pass a number 8 sieve

"(3) 10 per cent. shall be such as shall be held on a No. 8 sieve and pass a number 4 sieve.

"(4) 18 per cent. shall be such as shall be held on a No. 4 sieve and pass a ½-inch sieve.

"(5) 30 per cent. shall be such as shall be held on a No. 12 sieve and pass a ¾-inch sieve.

"These different sizes of stone shall be heated to a temperature of at least 225 degrees Fahrenheit and not to exceed 275 degrees Fahrenheit. The No. 1, 2, 3 sizes of stone shall then be measured in accurate proportions by volume, and thoroughly mixed with a twin-pug or other mechanical mixer, the previously prepared mixture of tar and pitch shall then be added together with sizes No. 4 and 5 of the broken stone, and the whole mass mixed until the stone dust has become saturated with the mixture of tar and pitch, and is thoroughly mixed through the whole mass, and has a uniformly black appearance.

"This aggregate shall then be spread over the entire roadway to the required depth so as to produce a thickness of not less than three inches after being rolled and consolidated. The surface shall be evenly raked, rolled, repaired, brought fully up to grade and true to cross section wherever required and then rerolled until firm, compact and true.

"A flush coat of California asphalt, oxygenized asphaltum, or other equally good and suitable asphalt, in the engineer's opinion, having a melting point of about 170 degrees Fahrenheit shall be flushed over the entire surface at a temperature of at least 250 degrees Fahrenheit, so as to fill all interstices, and present a smooth, perfectly unbroken surface. A sufficient layer of good approved limestone chips, no particle of which shall be more than ½-inch in greatest dimension, shall then be spread over the whole surface and thoroughly rolled. More limestone chips shall be added where and as required from time to time, as the rolling progresses so that the whole surface is completely and evenly covered with a uniform coating of limestone dust when finished, of not less than ⅛-inch, nor more than ¼-inch in thickness after rolling has ceased.

"On commencing work a measured quantity of tar and any quantity of pitch shall be heated in separate kettles of at least 100 imperial gallons capacity. When the pitch is melted a sufficient quantity shall be added to the heated tar to make a mixture as previously determined by laboratory tests from time to time, and the whole (constantly agitated to ensure a perfectly uniform mixture) ready for use. As more is needed, measured quantities of melted pitch and tar are added in the proportions which shall be determined by laboratory test, and brought to a temperature of at least 200 degrees Fahrenheit, and not to exceed 250 degrees Fahrenheit. Reliable thermometers shall be used to determine temperatures.

"Paving pitch to have the following characteristics:—Tenacious, not relatively brittle at ordinary temperatures, insoluble in water, specific gravity of about 1.150, and have a melting point not under 200 degrees Fahrenheit.

"Tar is to be coal gas tar, should be quite thick at 70 degrees Fahrenheit, have a specific gravity of 1.200, and be entirely free from water and the lighter hydrocarbons. To ensure the above characteristics, the crude tar should be previously heated to 250 degrees Fahrenheit.

"Tar that has been refined to the desired consistency may be substituted for the mixture of tar and pitch specified. This refined tar shall have the following characteristics: Tenacious, insoluble in water, all carbonaceous matter soluble in ordinary tar menstrus, free from water and the lighter hydrocarbons. It shall have a flowing point, as determined in a dry oven, of 120 degrees Fahrenheit, and shall be similar in consistency to the standard sample which may be obtained by the manufacturer at the city engineer's office."

London.—The City of London in the year 1900 laid a tar macadam pavement on Queen's Avenue, one of the important streets of that city, of which the specification in part provided that, on the usual construction of sub-grade

should be laid a 6-inch foundation of clean coarse gravel, to conform with the cross section and finished grade of the street. Upon this foundation of gravel when thoroughly rolled was then placed 3 inches of tarred stone capable of passing through a 2½-inch ring, 20 per cent. of which being fine crushed and capable of passing through a 1½-inch ring. This crushed stone was heated on a steel platform or pans to 120 degrees, and tar composition then poured until the stone was thoroughly covered. Tar was heated to boiling point (212 F.) and pitch to about 240 degrees, and the whole thoroughly mixed. After mixing it was placed on the street and graded evenly to the required depth, then rolled with a horse roller, after which it was rolled with a steam roller. A second course 2 inches in depth of crushed stone passing through a 1½-inch and 1-inch ring respectively, mixed in the same manner, was placed and rolled with a horse roller. On this second course was then spread the finishing coat 1 inch in thickness, composed of a thorough mixture of sand, pitch and tar. The sand was thoroughly dry and heated to at least 120 degrees Fahrenheit. This coat was applied while hot, spread evenly to the proper thickness, and rolled with horse roller, after which the whole pavement was rolled with the steam roller and sanded with dry sand ½-inch in depth. Traffic was to be kept off for a period of at least one week. Tar was to be heated to 212 Fahrenheit and pitch to 240 Fahrenheit, and properly mixed in the ratio of ten gallons of tar to one gallon of pitch per cubic yard of crushed stone, and eleven gallons of tar to one of pitch per cubic yard for the top coat. Tar was required to be clear coal gas tar containing no water gas tar; the pitch also to be the best of its kind manufactured from pure coal gas tar.

Guelph.—The City of Guelph in 1908 laid one block of tar macadam. This consists of a foundation of rough stone, 8 inches in depth. On this was laid a 3-inch layer of 3-inch stone. Then followed a 3-inch layer of 2½-inch tarred stone; then a 1-inch coat of ½-inch stone tarred. Both stone and tar were heated, the hot tar being poured over the dried stone. Several other streets, aggregating 27,016 square yards have since been similarly paved. The tar is produced at the municipally-owned gas works. For both coats of stone, the amount of tar used averaged 2½ gallons per square yard.

These roadways are giving satisfaction, and show very little sign of wear. In the years 1910 and 1911 concrete foundations on tar macadam roadways were found to be cheaper than stone. In laying the surface the concrete base was flushed with hot tar. The 2-inch broken stone was then spread to a thickness of three inches, and rolled once or twice with a 15-ton roller. The stone was then sprinkled with hot tar sufficient to coat most of the stone, but not enough to fill the voids. For the surface, half-inch stone free from dust, was dried on plates and mixed on a mixing board with hot tar, then spread and rolled until well compacted.

In laying the earlier roadways the tar was boiled in ordinary tar kettles, but this method was too slow. The city now uses an old steam boiler set in brick work in the ordinary manner. The tar is emptied into the boiler from an elevated platform, and after being boiled is drawn off by a pipe from the bottom into a tank wagon, and immediately taken to the street. The only refining is by boiling. A slow fire is necessary and constant stirring to prevent boiling over. The tar is frequently tested by cooling a little in water, and the boiling is continued until the tar becomes of the desired consistency.

Ottawa.—Tar-concrete pavements were first laid in Ottawa in the year 1902, and the total length laid has been 5.15 miles. In construction, the roadway was excavated to the required sub-grade, which was then rolled with the 15-ton roller if soft or loose, until thoroughly compacted. Upon this the spalls were placed to a depth of from 8 to 10 inches, and the top spalls broken up by hammers and made to conform to the shape of the roadway. On the spalls was placed a layer of 2-inch stone, 3 inches thick and well rolled. The next layer consisted of 2-inch tarred limestone, 3 inches thick, and put down while hot and rolled at once until cool. Great care was taken with this layer to see that it conformed to camber and grade in crown and gutter. The last coat or wearing surface consisted of a 1-inch layer of ⅝-inch tarred limestone, laid down while hot and rolled until it presented a hard, smooth surface. This surface was then dusted over with limestone dust to fill up any interstices and render it water-tight. The amount of crown on these pavements varied according to the width from 7½ inches to 8½ inches, being reduced in amount as the longitudinal grade increased.

Chatham.—One block of tar macadam was laid in 1898, but this has not been satisfactory, owing, apparently, to the surface of the tar macadam being destroyed by a coating of clay brought by the wheels of vehicles from unimproved streets. In 1910 it was sufficiently intact, however, to be used as the foundation for a bitulithic pavement.

The specifications for the tar macadam required:—An excavation 12 inches below the finished grade of the pavement; an 8-inch layer of broken stone; a 4-inch layer of tarred stone; a ¾-inch layer of fine tarred surface coating.

The stone to be tarred was spread on an iron floor, under which were flues from a fire, and heated until the moisture was driven off. The stone in its heated state was then mixed thoroughly with tar. The tar was previously boiled in an iron kettle holding 50 imperial gallons, to which was added a bucketful of pitch. Eight imperial gallons were added to each cubic yard of coarse stone, and from ten to twelve gallons to the fine stone. The cost of the tar macadam was $1.23 per square yard.

Results.—The tar-concrete roadways described, have been made from commercial tars. The work was principally by day labor under corporation foremen and engineers. Reference to proprietary tar products has been purposely avoided. The writer is not personally familiar with the first tar pavements laid, but has observed construction and results in numerous cases since the year 1900. The general history of these pavements has shown much similarity. For the first three years the surface has been all that could be desired, but about the end of that period a disintegration of the top coat has commenced. At the end of five years a mottled condition has become general, where the seal coat has chipped away, exposing the coarser bed of tarred stone. At the end of ten years the surface has become generally disintegrated, but the foundation has rarely, if ever, broken through, and a portion of the tarred surface course remains in place. Sections of the Mulberry Street pavement in Hamilton, laid in 1880, can still be seen. In no case has it been found that adequate attention has been given to the repair of these pavements by tar painting, or patching with tarred stone.

In the cities of Hamilton and Toronto, both of which have municipal asphalt plants, the tar pavements have been restored by giving a complete surface of sheet asphalt. The greater part of the tar-concrete roadways in Hamilton laid since 1899, have been treated in this way at the end of ten years, and results have been very gratifying. James Street south, in Hamilton, with central lines of car tracks, has been treated in this way, and is indicative of results under heavy traffic. Dupont Street in Toronto, constructed as a tar macadam in 1903, was surfaced with a coat of sheet asphalt one inch in thickness in 1908, and the pavement is to-day (1912)

in good condition. This was put on the tar macadam merely as a seal coat. A section taken from the pavement shows the tar to be in a plastic condition. The cost in Hamilton for the asphalt surface was 75 cents a square yard, where a binder course was required; and about 45 cents a square yard where such binder course was omitted.

Under the later Toronto specifications, in which the tarred material was proportioned for greatest density of aggregate, superior results were obtained, as for example, on Hawthorne Avenue, a street of light residential traffic. This street, paved in 1905, is now in excellent condition, and shows very little sign of surface disintegration.

The tar used was supposedly in all earlier cases, the commercial coal gas product, crudely heated to drive off water and volatile oils. In every case difficulty was found in obtaining a uniform quality, and no doubt much of the disintegration was due to the use of inferior tar. In view of the fact that in English practice a desirable tar contains not over 2 per cent. of water, or 5 per cent. of volatile oil, that it shall have at least 80 per cent. of pitch, it is apparent from the specifications quoted in this paper, that earlier Canadian construction was very indefinite in this regard and permitted the use of a quality of tar not now sanctioned.

The tar pavement in Chatham is interesting from the fact that its more rapid disintegration apparently resulted from clay being tracked on from adjacent streets, and would corroborate the experience suggested by the State Highway Engineer of Maryland, that clay would appear to have an emulsifying effect on bituminous binders.

A side-light is thrown on the use of tar by experience with foot-walks of tarred gravel. Early in the history of tar pavements, sidewalks were used, but have now been almost entirely displaced by the more durable, but less agreeable, cement concrete walks. These walks were laid by first putting down a foundation layer of gravel, which was well consolidated by pounding. On this was spread a three-inch layer of tarred gravel, well rammed, and this finally given a paint coat, and sprinkled with clean, coarse sand. The tar used is the ordinary commercial gas tar, merely heated to permit mixing with sub-dried gravel. Enough tar is used to coat each particle of gravel, about one part of tar to eight or nine parts of gravel. It is considered of primary importance to obtain a firm and unyielding foundation, and to thoroughly consolidate the tarred material. In Richmond Hill a hamlet near Toronto, these walks, for example, were first laid in 1886; the earlier and more experimental were not a success, but others laid in 1889 are still in use. These, every two or three years, are given a paint coat of tar, gritted with clean, sharp sand. Made of gravel, there is a tendency for the crown to flatten not apparent in pavements of crushed stone.

Owing largely to the reduced price of asphalt, the use of tar (other than proprietary forms of construction) has been discontinued in Hamilton and Toronto, these having municipal asphalt plants. Ottawa has stopped the use of tar for this reason, and also because of the uncertain results which have attended its use there. The city of Guelph, having a municipal gas plant, continued the construction of tar concrete roadways, using some care, however, in refining the tar to remove water and volatile oils.

Were exact data available as to the quality of material used, and variations from the prescribed specifications, numerous positive conclusions might be deduced from the tar concrete work described. Under the circumstances, while reasonably positive in certain particulars, other factors are merely suggested. It may, the writer believes, be concluded that tar of uniform quality, and of composition within certain range of proportions, while susceptible to extremes of temperature, becoming brittle and slippery in cold weather, and soft under midsummer extremes of heat, is not debarred by climatic or other conditions, as a useful road material; that best results require a dense mixture, preferably proportioning the aggregate for maximum density, in order that internal deterioration will not occur from moisture or atmospheric action; that some doubt may be attached to the complete durability of bituminous surfaces made by the penetration process, in which density of aggregate is lacking, and suggesting that the grading of stone in this method, rather than having a uniform size, is desirable; that a moderately coarse aggregate should be brought to the surface, as far as practicable, to overcome slipperiness and take up wear; that tar-concrete is less durable under concentrated wear than is sheet asphalt, wearing rapidly when laid along street car tracks where traffic is confined to narrow lines, but is more resistant to moisture as indicated by the greater durability of tar in gutters; that broken stone will provide a more stable structure than will water rounded gravel when bonded by tar; that a paint and grit coat is necessary as a preservative as frequently as signs of surface wear or oxidation appear; and it is probable that such treatment will add to the durability of any bituminous pavement, restoring necessary oil, and not merely repairing the worn surface but gradually increasing its thickness.

MINE ACCIDENTS IN CANADA.

Statistics recently compiled by the Commission of Conservation show that the death rate in Canadian coal mines is much higher than in any other civilized country. In 1902, the year of the Fernie disaster, the death rate per 100 men employed (above and below ground), reached the maximum rate of 13.25. The average rate for the ten years preceding 1910, however, was 4.79. The United States comes next with an average rate for the same period of 3.43. Perhaps the worst aspect of the situation is the fact that the death rate from coal mine accidents has been steadily on the increase in Canada for a number of years. The minimum rate of 1.83 was reached in 1897. In 1909 the rate was 4.21. During the same time there has been a steady decrease in all the leading European countries.

It would, of course, be unreasonable to expect that the loss of life and property could be entirely done away with, but experience has shown that careful investigation of the conditions will point the way to the remedying of many abuses. That the danger inherent in coal mining can be largely eliminated is shown by the low, constant death rates in Belgium and Great Britain. Coal mine explosions are much more frequent in Canada and the United States than in any of the European countries. The following example is exceedingly significant. In 1850 the fatality rate in the Belgian coal mines was as high as the present Canadian death rate, while at the present time it averages the lowest in the world. This decline in the death rate was due to the combined efforts of the mine owners, the workmen and the Administration of Mines. to the diffusion of technical and professional knowledge and to the administrative organization for the scientific study of accidents.

Although the death rate in metalliferous mines in Canada is lower than in the coal mines, it is much higher than in any of the European countries. The death rate in Canada for the period 1900-1909 was 3.82.

With the exception of the Kimberley diamond mines and the Transvaal, where native and Chinese labor are employed, the fatality rate during this period (1900-1909) was considerably lower elsewhere than in Canada. It requires no discussion to emphasize the importance of an inquiry into the whole subject of fatal accidents in the mines of Canada.

WORK OF CANADA'S CONSERVATION COMMISSION.

BY HON. CLIFFORD SIFTON.

During the two years that the Commission of Conservation has been in existence Canada has made substantial progress in the work of conserving her natural resources. That this is so is due largely to the effective co-operation of the general public and of the Dominion and Provincial governments. The Commission is merely an advisory body, and its success, therefore, depends upon the support given it by public opinion and by the various governments adopting its recommendations. The fact that the Dominion and Provincial ministers who administer natural resources are ex-officio members establishes a connection that conduces very largely to effective work.

What has been done in the way of actual accomplishment since the inception of the Commission may best be presented under the head of the different resources. The initial work consists largely in discovering what we have, and in ascertaining the efficiency of our present methods of development. This is particularly applicable to lands. To ascertain the state of agriculture, the committee on lands of the Commission has, with the assistance of the agricultural colleges and the deputy ministers of agriculture of the various provinces, for the past two years conducted a survey of one hundred representative farms in each province. The investigation disclosed the fact that only about nine per cent. of the farmers of Canada followed any effective and intelligent system of crop rotation. After fully considering the data obtained, it was estimated that the quantity of field crops in Canada could be doubled in twenty years by the adoption of such measures as may now be easily taken.

The committee on lands is also conducting experiments with alfalfa in Quebec to find out in what districts and under what conditions this crop can be most profitably cultivated. The experimental plots are located on farms throughout the province, and the operations are being supervised by Prof. L. S. Klinck, of Macdonald College. The plots, in addition to being used for experimental purposes, will also illustrate to the surrounding farmers the best way to grow this important crop.

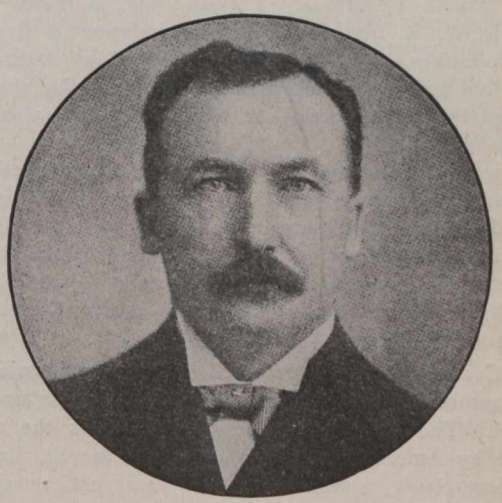
In regard to forestry, attention has been concentrated upon the prevention of forest fires. Investigations conducted in the field by skilled woodsmen showed in 1910 that about thirty-four per cent. of all forest fires for which causes could be assigned were due to railway locomotives. The Commission, therefore, recommended to the Dominion Government that legislation be passed penalizing railways for fires set by them. A conference of the Minister of Railways, the chairman of the Railway Commission and myself was held, and, in the last Parliament, Hon. G. P. Graham had an amendment to the Railway Act passed empowering the Railway Commission to compel the railways to maintain an efficient and properly equipped fire patrol. The law now provides also that railway companies shall be liable for damages caused by sparks from their locomotives, whether it was shown they were guilty of negligence or not, said liability for damages not to exceed $5,000 if modern and efficient fire-preventing appliances were used.

A further recommendation of the Commission was that the eastern slope of the Rocky Mountains be set aside as a permanent forest and game reserve. This reservation was made by an Act of the last Parliament introduced by the Hon. Frank Oliver, former minister of the interior. An area exceeding 14,000 square miles in this part of Canada is thus reserved, constituting an important regulating influence for the water supply of the Prairie Provinces, a great forest reserve, and the largest national park in the world.

The province of Ontario is in the front rank in regard to the setting aside of forest reserves. Under the administration of the Hon. Frank Cochrane, late minister of lands, forests and mines in the Ontario government, certain lumbering rights, both within and without the boundaries of the Algonquin National Park, were extinguished and the park considerably enlarged. The question of still further extending the boundaries of the park is now receiving the attention of the Provincial Government.

New Brunswick last year also made a forward step in its forest policy. Largely through the efforts of the surveyor-general, Hon. W. C. H. Grimmer, the provincial legislature adopted the policy of prohibiting the export in its raw state of pulp-wood cut from Crown lands. There are now four provinces—Ontario, British Columbia, Quebec and New Brunswick—that have stimulated the pulp industry by such measures.

The work done by the Commission of Conservation in connection with mineral resources is summarized in a report issued in 1911. This includes a digest of the mining laws of Canada and an article by W. J. Dick, mining engineeer to the Commission, giving the known extent of our mineral resources, and indicating how waste can be further eliminated in their development. Mine accidents, in which Canada does not hold an enviable record, are also treated in some detail. During the past summer Mr. Dick investigated mining methods in the coal mines of British Columba and the West. The results of this work will be published later.



HON. CLIFFORD SIFTON,
Chairman of the Commission of Conservation, Canada.

In connection with fisheries and game, the aim of the Commission has been to collect information to form a basis for future work. This has been published in a report in 1911. An analysis is given of the British North American Act, showing the jurisdiction exercised over fisheries by the Dominion and each of the provinces; while a digest has been made of federal and provincial fisheries laws and regulations. The report also contains the results of an investigation into the Canadian oyster industry.

The public health division is investigating housing and town-planning conditions in Canada. Information is being compiled showng the park area of each city, and indicating what power, if any, urban municipalities have in determining how areas on their outskirts may be subdivided into lots. From investigations already made it has been ascertained that Canada is face to face with a serious slum pro-

blem, and Dr. C. A. Hodgetts, medical adviser of the Commission, has spent several months in Europe investigating housing conditions and town planning there. A thorough investigation is also being made of infantile paralysis, a disease that has recently become alarmingly prevalent in Canada.

The greater part of the work of the Commission on waters and water power is embodied in a report on the water powers of Canada by Leo G. Denis and Arthur V. White. This is a very exhaustive work, which, after recounting the general economic conditions regarding water resources, gives comprehensive and detailed information respecting the water-powers of each province. The head of the fall, the amount of power now developed, the amount possible of development, and the purposes for which the power is used are given, wherever the information is available, for each known water-power in Canada. In addition, a summary of the laws of each province and of the Dominion governing the disposal of water-powers is included. It is hoped that this information in readily available form will do much to encourage the development of Canadian water-powers.

The available data for the Western provinces was found to be very incomplete, and, accordingly, Mr. L. G. Denis, the hydro-electric engineer of the Commission, and Arthur V. White were detailed to investigate these powers during the past summer. Mr. Denis, last summer, surveyed the powers in northern Alberta, and Mr. White, with several assistants, was engaged in surveys of the water-powers of southern British Columbia. Through the courtesy of the Honourable W. R. Ross, chief commissioner of lands for British Columbia, the information respecting water-powers obtained by provincial engineers employed by the water commissioners in connection with the disposition of water rights was placed at Mr. White's disposal.

Additional information of value on the water resources of the province will be brought out in stream-gauging operations to determine the amount of water available for irrigation purposes. These surveys are being undertaken to comply with the provisions of the British Columbia water-power Act, and are being carried out under the direction of the Hon. Mr. Ross.

The Commission has reported on various projects for the development of water-powers that have come up before parliament. The most important of these was the application made by American capitalists to dam the St. Lawrence at the Long Sault rapids. This power is estimated to be capable of generating 600,000 horse-power, and the projected plans gave a minimum consideration to Canadian interests, it being proposed to develop only one-sixth of the total power on the Canadian side. On grounds of public policy the Commission opposed the application, and thus far successfully. The Commission also reported adversely on the incorporation of the International Waterways Canal and Construction Company, a scheme for canalizing the waterways between Lake Superior and the head waters of the Saskatchewan, which, it was feared, would interfere with public rights. The Nelson River Railway Company sought to gain possession of valuable water-powers, including the Grand Rapids of the Saskatchewan—the most valuable water-power near the settled area between Lake Superior and the Rockies. At the instance of the Commission it was modified so as to be unobjectionable. The Nipigon-Albany Canal and Transportation Company applied for a charter that would have given them control of the powers between the mouth of Nipigon River, on Lake Superior, to the mouth of the Albany, on James Bay. Warned by the fate of the International Waterways, Canal and Construction Company's bill, its promoters withdrew it. Other projects on which the Commission reported were: the St. Lawrence Power Transmission Company, and the application of the Minnesota and Ontario Power Company to export power from Fort Frances, Ontario. In all these cases the Commission has endeavored to follow the policy it has laid down for itself in this regard, viz.:—

That no unconditional titles should be given to water-powers, but that every grant or lease of powers should be subject to the following, among other, conditions:—

1. Development within a specified time.
2. Public control of rates.
3. A rental, with the power to revise same at later periods.

In view of the heavy losses due to the destruction of property from fire in Canada (from seven to ten times as great as in the larger European countries) an investigation is now being made of this subject by Mr. M. J. Patton, assistant secretary of the Commission. If means can be devised to lessen these losses it will mean a large saving both in property and insurance rates.

CONTROLLABLE DUMP BUCKET FOR PLACING CONCRETE IN THIN WALLS.

In the construction of concrete work contractors have often found it difficult with the ordinary drop bottom bucket to place concrete in thin walls, as most of these buckets on the market have uniformly sloping sides or the dumping mechanism is located on the front or discharge side where its operation is often interfered with by the reinforcement rods or forms.

With the idea of overcoming this difficulty a drop bottom bucket has been designed, the section of which is a right-angle triangle, the front or discharge side being vertical. It is evident by this arrangement that there is no interference from the steel reinforcement rods or forms in the operation of the bucket mechanism.

The construction of this bucket is very simple. The drop bottom which is slightly curved is about quarter of the length of the sloping side. It is operated by a handle, on the end of which is a cam bearing on an equal arm lever that connects through another lever to the drop bottom. The discharge of the concrete is readily controlled by the operator, who can let the concrete out in small or large quantities. In cases where thin layers of concrete are desired the operator can control the discharge and move the bucket forward or backward as desired, thus spreading the mass. The shape of the drop bottom is such that with a little experience the operator can throw the concrete through a steel system four to six feet wide.

This new bucket, while it was primarily designed for thin wall construction, discharging concrete readily in narrow forms for walls only 3-inch thick, without any waste of concrete or any extra handling, will be generally useful in all kinds of concrete work, and the shape of this bucket is such that very little scraping is needed after the batch is let out. The vertical face gives a clear fall to the batch of concrete, which draws the concrete down with such force that a scouring is produced on the sloping side and the bucket is cleaned completely. This is a point which means saving of time, and also saves the bucket from the hammering commonly needed to clean so many buckets on the market.

It has been used with success by Contractors J. B. Smith Company, in erecting the inclined concrete abutments for the overhead double track crossing on the Western and Atlantic Railway at McCarty, Tenn. The bucket has just been put on the market by the manufacturers, Ransome Concrete Machinery Company, Dunellen, N.J.

MINING IN BRITISH COLUMBIA.

BY ROBERT R. HEDLEY.

The British Columbia mining industry has made considerable substantial progress during 1911. though the tangible results are not yet very evident. In all directions, there is a promise of more activity throughout the province in the next twelve months, and there is no doubt that the very decided favorable development now assured in many properties will greatly stimulate this.

This development has been quietly proceeded with, by substantial financial companies, and it is not easy to get particulars of results achieved. Coal must in the near future gain for us a great reputation.

Men of high standing in the mining world have said there may be a second Pennsylvania around the headwaters of the Skeena River. Certain it is that there are large areas underlain by several seams of coal of very satisfactory thickness, and of exceptional quality. Authorities class it as high grade anthracite. After the Toronto syndicate the National Finance Company, Limited, of Vancouver, was among the first in the field and secured some very valuable areas. Other Vancouver as well as Ontario and Quebec capital is interested. The importance of the field, and the need of its produce, ensure the speedy providing of transportation. There is, of course, coal distributed through a wide section of the Skeena River country, but it has not received so much attention as that mentioned.

Copper River has an area of great promise which is owned and being developed also by the National Finance Company, Limited. Graham Island, doubtless, has large areas underlain by coal, but though known for the past half century, the only development is at camps Wilson and Robertson, and nothing is very definitely proven. At the present time, however, drilling is in progress by people of weight and experience. It is generally accepted that the quality will vary greatly from anthracite near the eruptives to lignites, also the ash will be a variable figure. On Vancouver Island there has been no material change since the Dunsmuir property changed hands.

The production is about the same as of recent years. At Nicola Valley, the conditions are constantly improving and the field becoming more important. The areas to the south, in the Similkameen, Tulameen district have coal of varying character, but generally low in grade. Development as yet is confined to one property. The Crows Nest and Alberta colliery output has been sadly curtailed by the ill-advised and unfortunate strike now happily settled. Vast new fields are under process of development from Elk River to Northern Alberta, which promise to amply supply the needs of the country tributary to that section, with coal of any variety in any quantity.

At the Coast, the Marble Bay Copper Mine on Texada Island has continued to produce very profitable ore at the rate of from 1,000 to 1,200 tons per month. It is noteworthy that this mine, though operating at a depth of over 1,000 feet below sea-level, still produces the higher sulphides of copper, bornite and chalcocite, and maintains its gold and silver values. The ore shoots have been practically continuous from the surface. The property is owned in Tacoma, Wash.

The Britannia Mine, in Howe Sound, thanks to the faith and persistence of the owners, aided by the unusual energy and capability of their manager, Mr. R. H. Leach, has now an assured future, with a very large tonnage of profitable ore blocked out, and a very much greater quantity, proven by partial development and diamond drilling.

The Hidden Creek group of mines is situated on Goose Bay Observatory Inlet, a branch of Portland Canal. In 1907 this was a prospect pure and simple outcropping as a vast pyritous deposit, offering bluffs of 200 feet in height and width somewhat greater. It was apparent that a large tonnage of ore could be mined to carry from four to five per cent. copper, and that lower grade ore would be developed in great quantity. It impressed me as offering great possibilities for profitable operation if developed and equipped for economical mining and smelting. The character of the ore and its favorable situation were most promising.

Last year this property was purchased by the Granby Consolidated Mining, Smelting and Power Company, who have further developed it, and are now planning the erection of a smelting plant with a capacity of 2,000 tons per day. The measure of their success depends on their metallurgist. There is every reason to expect unusual results in operating costs of a different character, and not yet well developed is the Surf Inlet Gold Mines on Princess Royal Island, now being developed by a local company. In proximity to this, as distances go in the Coast district, Messrs. Martin and Shannon have done much costly and difficult work in tracing a quartz vein, that, so far as proven, has wonderful shoots of high grade copper-gold ore. This is six miles from the head of Khutze Inlet.

It is conservative however, to state that the limited development so far accomplished, indicates probable ore in excess of 100,000 tons, with gold values approximating ten dollars per ton. This should yield a profit, according to the equipment and tonnage treated, of four to five dollars per ton. A force of men will further develop the property this winter under the supervision of Mr. F. M. Wells, to whom with Mr. A. B. Clabon, is due the credit for the resuscitation of this promising property. A grand waterpower of untold capacity and cheaply developed, is an important asset of this company.

At Portland Canal, there has been but little accomplished except for two properties, though there are many properties waiting development that have every promise of winning out. The Portland Canal Mining Company's property is well developed and equipped with a modern concentrator. The margin of profit, however, is not great and the plant too small as yet for substantial results.

The Red Cliff has insufficient development to estimate its ore reserves, or to enable it to enter the producing list. The lower tunnel has cut the ore at a depth of 275 feet below the main outcrop and a raise connects. Development is under progress and the outlook is hopeful.

On the Salmon River are some very promising prospects, indicating large bodies of ore which, though low grade, will probably prove profitable.

There are many excellent opportunities for exploitation, notably some deposits of copper ore similar to that of the Britannia, between the headwaters of Seymour Creek and Howe Sound, and up the Squamish River as far as Green Lake.

Lillooet has in the past two years received increasing attention from prospectors and others, and there are indications that the general condemnation of that district, which followed the Golden Cache fiasco, was unwarranted.

Of the country known generally as the Hazelton district and comprising all that between the Telkwa, Copper and the Babine Rivers, there is little to say and much to expect. This district has much promise of ore of great variety, some of the silver-lead properties seeming to stand the test of development very well.

Of Kamloops, it is still playing the waiting game. Let us hope it will be worth waiting for. I believe it will if properly handled.

The Boundary with its two smelting plants always on the eve of breaking the already low record of costs and high record of production, has this year been handicapped by the failure of the coke supply. Granby thought it unwise to continue to bring coke from Pennsylvania and shut down the mines and plant, while the British Columbia Copper Company worked right through on Pennsylvania coke.

It is extremely gratifying that both these companies are extending their operations to other fields, the Granby having established themselves on the Coast at Observatory Inlet, and the British Columbia Copper are again looking into the copper camp tributary to Princeton, as well as investigating gold property on Slocan Lake.

The Consolidated Mining and Smelting Company of Canada, with their ample plant at Trail, are producing lead, silver, gold and antimony, as refined products, but the majority of their gold still goes with copper matte to the refinery in the United States. This plant, embracing all that is most modern in the copper and lead smelting and in the electrolytic treatment of argentiferous and auriferous lead bullion, draws supplies from a number of its own mines, as well as serving the country as a custom smelter. Among land; St. Eugene, Sullivan, East Kootenay, Molly Gibson and Richmond Eureka in Ainsworth-Slocan, Slocan. Others there are of lesser importance as yet, though the big ledge or deposit of carbonate of lead near Sheep Creek, may ere long be claiming recognition. The recent development of the War Eagle has opened extensive stopes of unusually high grade ore at several levels, including the lowest, an encouraging feature.

Nelson district looks forward to the opening of the Toad Mountain mines, including the old Silver King and Dandy, under new auspices. The capitalists backing this venture are advised by Messrs. C. Nelson Fell and M. S. Davys, both of whom have experience on the Mountain. Sheep Creek has not made as substantial progress as was looked for. The Mother Lode ceased mining to erect a modern mill which is expected to make a handsome profit.

The Mother Lode is the one mine really developed and ready for milling, though the Nugget could probably be rendered so by moderate, judicious expenditure.

In Ymir camp the old Wilcox has changed hands and is being well equipped. Recent development has been satisthese are the War Eagle, Centre Star and Le Roi, of Rossfactory. The Yankee Girl too, has passed from the receiver's hands to those of a strong aggregate of capital, headed by Mr. Bob Mabry, of Spokane. This mine has under the old regime shipped a handsome tonnage of ore to Trail, which has averaged about $20 per ton, chiefly in gold, but at a low margin, owing to lack of proper development and equipment.

Below Salmo, the Arlington at Erie continues to produce a small tonnage of sorted ore with a narrow margin of profit. Conditions are none too favorable and the operators are deserving of great credit.

Nearer Nelson, the Athabasca and Poorman-Granite have rendered a good account, milling steadily a fair tonnage of good grade. Rossland, in addition to the mines owned by the Consolidated, can point with pride to the record of the Le Roi No. 2, which has been a continuous producer of higher grade gold-copper ore, with a handsome profit.

West of the Boundary, though the field is wide and the promising properties are many, the only producer of note is the Hedley Gold Mines at Hedley, on the Similkameen. Under the new management this plant has been remodelled and is now an efficient and modern milling and cyaniding mill. This year's results will in all probability total better than 50,000 tons of $12 ore, and will have something over for surplus after paying $240,000 in dividends.

In the Slocan there is the strongest possible feeling of confidence in the future. Six years ago the Rambler-Cariboo drove a deep level tunnel, 4,000 feet, to tap the ore 1,400 feet below the surface and 600 feet below the lowest workings. Success was not, however, immediate, and it is only this year that they really see their reward. Always a high grade silver lead ore, the ore now developed is greater body and higher grade than ever before. Forest fires in 1910 destroyed the railway, and shipping must wait till transportation is restored. As a result of this deep level success, the Payne Mine, now opened to the eighth level, is to be provided with a deep level about 3,300 feet long, giving 675 feet of virgin ground. This is undertaken on the recommendation of Mr. W. E. Zurickey, manager of the Rambler-Cariboo, and to him will be entrusted the engineering of the project.

The Whitewater Deep has this year connected its deep level tunnel by raise with the upper levels, and exploratory work so far has been very encouraging.

The Slocan Star group under a new company, has also started a deep level which will deliver ore direct to the concentrator. The tunnel will be 2,300 feet long, and give 600 feet of virgin ground on the dip of the vein.

On Slocan Lake, the Standard, recently acquired by Patsy Clark, has in its deep levels, spectacular stopes of over 20 feet of galena practically without gangue, and very extensive bodies of concentrating ore for which a mill is being installed. The Van Roi will this year make a very satisfactory record from its milling operations, treating 100 to 125 tons daily. The development is extensive and good and the ore reserves assure a long life.

The Hewitt-Lorna Doone group of the Silverton Mines, Limited, is well developed by seven levels, several of which pierce the mountain from west to east. No. 6 connects with the upper terminal of the tram, which delivers to the mill on Four-mile Creek.

COST OF BITUMINOUS COAL MINING.

At the Chicago meeting of the American Mining Congress, B. F. Bush gave the following as the averages of answers to questions he had submitted to the leading bituminous-coal operators of the United States:—

1. Capital invested in business. For each ton of coal sold $1.41 is invested in land, machinery and equipment.

2. Average total cost of production, labor cost (mine workmen only), administration and average selling price at mine. Total cost in 1910 averaged $1.07, including 95c. for labor and supplies. Administration cost 12c. per ton, including office and sales expenses, insurance, taxes, legal advice, etc., but not including depreciation, interest nor profit. Average selling price at mine, $1.11 per ton.

3. Estimate of increased cost necessary to meet demand for conservation. Two to 15c. in different fields, averaging perhaps 5 cents.

4. Depreciation per 100 tons daily capacity. About 4c. per ton covers the average depreciation of coal reserves and plant.

5. At what price must coal sell? The increased prices necessary for a fair return on the money invested range from 5 to 25c., averaging 12 cents.

Over-production, over-capacity and ruinous competition were discussed at length. Two possible remedies were suggested.

District sales agencies to control prices and output, under subjection to an interstate coal commission; government assistance in encouraging foreign markets.

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CONTENTS OF THIS ISSUE.

THE UNIVERSITY AND THE RAILWAYS.

The man in the street does not usually see any intimate connection between the work of the Engineering School and the railways. He, of course, appreciates the fact that a great many of the men in executive positions on the railways have had an engineering education. However, the fact that many of the engineering schools have been developing and analyzing many problems of great practical interest to these corporations is not very well known.

Dean Goss, of the Engineering Faculty of the University of Illinois, in a recent address to the St. Louis Railway Club, refers to a number of these problems, which are being solved in that college.

The school of railway engineering and administration is developing on its engineering side many interesting problems. For example, a knowledge of the forces which must be applied to maintain the motion of railway trains is a matter of fundamental importance in many of the problems of the railway. The University of Illinois was almost a pioneer in this field of research. In conjunction with the Illinois Central and the Cleveland, Cincinnati, Chicago and St. Louis, it designed and constructed a series of dynamometer cars, each new design overcoming defects which had appeared in its predecessor. The third car of the series has now been in successful operation for the past three years, and it has served in the development of the most accurate array of data concerning train resistance which has thus far been published.

Another important line of investigation has led to the development of a system, not entirely original, for detecting defects in track bonds on electric lines. An electric test car has been equipped with apparatus designed to record automatically the condition of every bond it passes over. The record gives the electrical resistance of the joint, in comparison with the resistance of a short length of solid rail. The results are registered on a web of paper, which unrolls as the car proceeds, a half-inch length of paper corresponding to a rail length. In action the car is allowed to proceed at a moderate speed, the record for each joint being made automatically as it is passed, while an attendant operating a push-button controls a supplemental record representing the location of the numbered line poles as they are passed. An examination of the record enables one at once to pick out and locate the imperfect bonds. The test-car has the form of an interurban car, the interior being fitted up with the instruments necessary to make it a laboratory. It is designed for the instruction of students and for the solution of problem of interest to the electric traction interests.

The university is giving generous attention to problems underlying the design of railway equipment.

A standard Master Car Builders' drop testing machine has been installed, which is designed especially for use in testing couplers, coupler knuckles and draft gears, but is available for use in testing materials of many different sorts. The machine consists of a hammer weighing 1,640 pounds, sliding in two upright guides 50 feet in height, between which it is allowed to fall upon the test specimen supported by a massive anvil resting upon a foundation through the medium of heavy springs. By the use of this machine students are instructed in the process of making the proof tests of the Master Car Builders' Asosciation, and are enabled to gather impressions concerning the severe treatment which must be withstood by couplers, draft gears, bolsters, axles and other details entering into the construction of freight cars.

Another detail in car design which of late has demanded attention is the brake shoe. There has been installed a brake shoe testing machine possessing equivalent characteristics to those of the original Master Car Builders' machine, but one which in its details is a much more serviceable machine. It consists primarily of a shaft carrying a fly-wheel and standard car wheel, which may be either steel or cast-iron. The shaft is driven at any desired speed by means of an independent engine. By reason of the presence of the fly-wheel there is available at the surface of the car wheel, when in motion, the same amount of energy as is impressed upon one wheel of a 60,000-pound capacity car in service under like speed conditions. The shoe to be tested may be applied to the wheel with any desired pressure up to a maximum of 24,000 pounds. The tangential pull of the shoe, which develops when the shoe is thus applied to the moving wheel, is transmitted to a dynamometer, where it is recorded upon a moving paper chart. By these means the coefficient of friction of any shoe may be determined under different conditions of speed and shoe pressure. The machine likewise serves to permit the determination of shoe wear and wheel wear under any condition that may be prescribed.

The last Legislature appropriated to the university $200,000 for a building and equipment for its college of engineering. The trustees have determined that the building shall be devoted to transportation interests, and in the working out of plans it has seemed best to provide for a group of buildings.

After reading what Dean Goss states is being done for the practical solution of railway problems by the University of Illinois, it appears to us that there are many ways in which our Canadian universities can develop the practical side of their work.

The faculties of engineering in Canada are rapidly increasing their staffs, and a great deal of public money is being invested in laboratories and laboratory equipment. These laboratories and equipment should be used for the public benefit to as large an extent as possible, and for that reason the work done in them should be kept along the lines which will be of benefit to the public. The danger always will be of the laboratory work given in connection with the engineering courses becoming too academic.

EDITORIAL COMMENT.

What has become of the Royal Commission on Technical Education? We would suggest that it is nearly time they handed out their report.

* * * *

The annual meeting of the Canadian Society of Civil Engineers is to be held in Montreal, January 24th, 25th and 26th. The programme of the meeting will be found in this issue of The Canadian Engineer. Every member should make an effort to be present.

THE DINNER OF THE FACULTY OF APPLIED SCIENCE, UNIVERSITY OF TORONTO.

The twenty-third annual dinner of the Faculty of Applied Science and Engineering, University of Toronto, will be held on Thursday, January 18th, in Convocation Hall, at 8 p.m.

Among the speakers expected to be present to address the students are Major R. W. Leonard, chairman of the Transcontinental Commission; the Hon. Adam Beck, chairman of the Hydro-Electric Power Commission; Mr. G. H. Duggan, Chief Engineer of the Dominion Bridge Company; Mr. W. H. Hearst, Minister of Mines of Ontario, and many other prominent men. It is expected that there will be a good turnout of the graduates as well as of the students.

PROGRAMME OF THE TWENTY-SIXTH ANNUAL MEETING, CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting for the election of officers and members of council for 1912, and for the transaction of business, will be held as follows in the rooms of the society, 413 Dorchester Street West, Montreal.

Wednesday, January 24th.—10 a.m. Meeting for the nomination of scrutineers, receiving the report of council reception and discussion of reports of committees, and transaction of the general business of the society.

1 p.m. Adjournment for members' luncheon in the Windsor Hotel, Montreal, to which the visiting members are invited by the members resident in Montreal.

3 p.m. Continuation of the business meeting for the discussion of reports, etc.

4 p.m. An address by the retiring president, Mr. C. H. Rust.

8 p.m. Address by Dr. H. T. Barnes on "Iceberg Detection in Navigation," in the lecture hall of the Chemistry Building, McGill University.

9.30 p.m. Reception by the president and members of council in the Engineering Building, McGill University, and inspection of the laboratories and workshops.

Through the courtesy of the Board of Governors of the University, the building has been placed at the disposal of the society for this evening. Members and ladies accompanying them are invited to the reception and lecture. Cards will not be issued.

Thursday, January 25th.—Two parties will be formed for the purpose of visiting engineering works.

(a) The Angus shops. By the courtesy of the Canadian Pacific Railway Company, a special train will convey this party to the works, leaving the Windsor Station at 10 a.m. Dining cars will be attached to the train, and luncheon will be served during the inspection of the works.

(b) The works of the Dominion Bridge Company and the Canadian Car and Foundry Company. By the kindness of the Montreal Street Car Company, cars will be in waiting at the Windsor Hotel, and will leave there at 10.30 a.m. sharp, for Dominion. The Bridge Company will lunch this party at 1.30 p.m., and the works of the Canadian Car Company will be visited on the return journey.

8 p.m. Annual dinner in the Windsor Hotel.

Friday, January 26th.—10 a.m. Meeting for the reception of reports of scrutineers and conclusion of the business of the annual meeting.

3 p.m. Meeting of council.

By the kindness of the railways of the Eastern Canadian Passenger Association, members and their families who have paid a full one way first-class fare going to the meeting in Montreal, will be returned free on presentation of a standard convention certificate signed by the ticket agent from whom a ticket has been procured at the point of commencement of the journey. The certificate is to be endorsed by the secretary of the society, and to be vised by a special agent of the Passenger Association who will be in attendance at the meeting from 3 p.m. to 6 p.m. on Wednesday and Friday, January 24th and 26th. A fee of 25 cents will be charged by the

Passenger Association in each case. Tickets may be purchased and are available three days before the commencement of the meeting, and the return journey may be made three days after its conclusion.

The Canadian Pacific Railway and the Canadian Northern Railway will grant a further extension of time to persons residing west of Fort William, making this free return available for 15 days after the close of the meeting; the ticket to Montreal having been purchased at any time and receipt obtained therefor on the standard convention form as above.

Tickets to the luncheon may be purchased at the rooms of the society. Prices: Luncheon $1.50 to resident members, dinner $3.00. C. H. McLeod, Secretary.

SILVER AND GOLD MINING IN ONTARIO.

BY H. E. T. HAULTAIN.

During the past year Cobalt has proceeded along the steady course of middle age without any remarkable occurrences. With the good properties the luck has held and new ore bodies have been discovered in proportion to the amount of exploration work carried on. The output has been steady and increasing and the price received for the silver was higher than during the previous year. Perhaps the most noteworthy event has been the completion and successful operation of the mill at the Nipissing designed by Charles Butlers for the treatment without smelting of the high grade ores of that company. No particulars have been made public but apparently the process is mainly amalgamation and lixiviation which recover the silver as bullion and leave the cobalt and arsenic as a tailings product to be subsequently re-treated when the market justifies.

Nothing has developed during the year to raise any reasonable hopes of finding extensive ore bodies below the Huronian. Cobalt camp is a notable example of local geological conditions sharply defining the depth beyond which commercial values are very unlikely to extend. That a young camp in a restricted area should produce sixteen million dollars worth of metal in a year is remarkable, and it is still more remarkable that nearly all this output should come from above the 250 foot level. Nearly all of the final total output of Cobalt is to be expected from these upper levels. If this were not the case, if the lower limits of the ore bodies were indefinite the Cobalt stock market would be in a very different state. The output this year must be practically at the summit and we may expect either no further increase or more probably a decline in annual returns, a decline which at the first will be gradual. The output of silver from Cobalt for 1911 probably exceeded sixteen and a half million dollars in value.

Gowganda, to a limited extent, is slowly recovering from its horrible wild-cat handling. Ore concentration is in steady operation, making regular shipments on a good paying basis. Steady progress with occasional shipments is being made on two or three other properties. Besides these there are several good prospects in this district which may ultimately be saved out of the wreckage. Other camps in the Elk Lake district are quiet.

With a gold camp the conditions are different. It is not a case of shipping a high-grade ore to smelters, but rather a treatment at the mine of a comparatively low-grade ore. This calls for extensive plant which takes money and time to build. As the plant is almost without value when the mine is exhausted, it is a business-like policy to make sure of the quantity and quality of the available ore before commencing work on a reduction plant.

In Porcupine during the past year progress has been remarkable for its character and its extent. Porcupine has done this for Ontario—it has caused experienced miners and mining financiers to flock to the district as they never did before in Ontario. The result is that the district is being properly explored and developed. It is true there have been and are wild-cats, some very rotten ones and some very ordinary, but these are unavoidable. The more important properties are being well handled and there are results to show for the money expended. The awful fires of the summer delayed work, caused a pitiful loss of life and a rather serious loss of money, but the camp itself is in many ways better off on account of it. The fire disaster checked a flaring promotion boom that would have done much harm to the mining industry.

The only gold produced to date has been from small tentative mills. The spring and early summer will see the beginnings of a steady and growing output. Two large mills, to cost when completed, more than half a million dollars, are being erected. Several smaller ones are under construction or have been ordered.

There are several certain successes in the camp and these all lie within a comparatively small area. Outside of this limited area there are many good probabilities and possibilities over a wide section of country, a section that grows as exploration work extends.

Geology has no bad news for Porcupine as it had for Cobalt. The limiting depth to which values will extend is indeterminate. This does not mean that the values will of necessity continue to go down indefinitely to great depths, it simply means that there are no reasons why they should continue or stop; it is a matter of chance just as are the extensions laterally, and the only way to settle the question is to go down and see.

The railway has now reached the heart of the district and this means much in many ways. There ought to be a healthy activity in the farming line, for there is much excellent land along the railway.

Swastika camp to the south-east of Porcupine is giving good promise on a smaller scale, and gold bearing quartz has been reported from many widely different points. Long before Porcupine was discovered it was truly said that there was more gold than silver in Ontario. Gold is scattered very widely, but only in a few localities had it been sufficiently concentrated to pay to work. Porcupine is one of these; there is no reason why there should not be more; the geological conditions are favorable over a wide extent of country.

Larder Lake is again attracting some attention. It has not yet recovered from the mishandling it got in its boom days. There is plenty of gold scattered over a large area in Larder Lake district, but it is hard to find a pay zone. It needs exploration by competent men.

Very interesting and satisfactory results are greeting the experienced men who are tackling some of the old mines and prospects in the Port Arthur district. The methods and men employed in the early days of this district might not only overlook good things but could easily blacken the chances of any good things they did uncover.

Ontario offers a fine field to the prospector. There are large accessible areas open to him. Cobalt and Porcupine show him the possibilities and there has never been time or place better for him in the way of making deals or getting assistance in his development work. On the other hand the absurd figures asked by prospectors for bare prospects have very materially held back some promising districts. The wild-cat promoter has set a fictitious value on prospects.

On the whole the silver and gold mining industry of Ontario is in a very healthy condition.

CONTRACTS FOR THE SUPPLY OF ELECTRIC POWER FROM THE POWER USER'S POINT OF VIEW.

III.

By H. E. M. Kensit, M.I.E.E.

We have now considered the matters of power factor and peak load and the methods of measuring them. (See previous article.) Other points in the same connection that should be provided for in drawing up a contract are as follows:

The power company usually requires a statement as to the maximum power that is likely to be required, in order that they may be prepared for all contingencies; also a guarantee as to the minimum amount that shall be paid for whether taken or not.

This minimum guarantee is reasonable, in that the power company must expend capital for generating plant and transmission lines to provide for the maximum, and must have some guarantee to justify the expenditure.

For the power company's benefit the probable peak load is usually estimated at a safe figure, and, on the other hand, the customer wishes to keep the guarantee as to minimum to be paid for as low as possible.

A margin of say 25 per cent. between the two is a fair business risk to the power company, especially as this risk is usually distributed amongst a number of customers, and the average result usually comes out better than anticipated owing to the growth of business and therefore of output and power taken.

This growth of business may necessitate the use of more power than the user would have felt justified in contracting for at the time of making the contract, and in the case of such contracts for a term of years, the customer should be protected as to any reasonable increase during the term of the contract.

The contract should therefore provide:—

(1) That the customer shall be allowed to exceed the agreed maximum amount of power to be taken by 10 per cent. without previous notice and at the same rate of charge.

(2) That additional power shall be furnished by the power company, under the terms and conditions of this contract, and at any time or times during the life thereof, up to the extent of a total of ..... horse-power, upon receipt by the power company of ..... months' notice in writing as to the additional power required.

The following are some sample clauses on these points from actual contracts:—

(1) "The power company agree to deliver ..... horse-power at the works of the customer by the ..... day of ..... and at the expiration of three months' written notice, which may be given at any time during the continuance of this agreement, to supply from time to time additional power in blocks of not less than ..... horse-power until the total amount so supplied shall amount to ..... horse-power.

"The customer agrees to pay for three-fourths of the amount so supplied or held in reserve whether he actually uses the same or not, and at no time to take more power than the amount so agreed upon and held in reserve by the power company."

(2) "The power company agrees to sell and deliver to the customer and the customer agrees to purchase and take from the power company for a period of ..... years from the ..... day of ..... electric energy to the amount of ..... electrical horse-power. It is further agreed that the power company will supply such additional power as may at any time be required over and above the amounts herein contracted for, and the cost of said power shall be on the same terms and at the same rates as for the amounts aforesaid."

(3) "The producer agrees to furnish continuously from the ..... day of ..... for ..... years, so far as reasonable diligence will enable it so to do, and for the operation of the consumer's industry only, not to exceed ..... horse-power of electric energy.

"The consumer agrees to pay the producer on the ..... day of each month for the energy furnished hereunder during the preceding calendar month, the sum of ..... dollars, and for additional energy taken by permission of the producer at the rate of ..... dollars per horse-power per month."

(4) "The producer agrees to furnish and the consumer agrees to take and pay for a minimum of ..... horse-power for the term of ..... years from noon on the ..... day of ..... The Consumer's maximum demand shall not exceed ..... horse-power without the written consent of the producer.

"The company will make every endeavor to supply any additional energy required, but it shall not be bound to do so upon less than six months' notice in writing, and in no case to supply more than it may have available and unsold from its then existing works."

A point of the first importance in regard to the measurement of the power used is the accuracy of the instruments when installed and their liability to get out of order afterwards. The instruments may have been supplied by a first-class firm and have been in perfect order and adjustment when they left the factory, but may be thrown out of adjustment in transportation or erection, or they may be wrongly connected, or influenced by magnetic fields in their vicinity, and the errors thus introduced may be quite large without the instruments giving any indication that would even lead to suspicion.

Experience has convinced the writer that no such instruments can be depended upon until they have been checked in position against standard instruments, and in his opinion this should be insisted upon as a condition of every contract. But even after this has been done the instruments are liable to alter as to their calibration or to get out of order from time to time, and it would be better still to provide that they should be re-checked in the same manner once a year. This is not an onerous condition. An electrical power company has usually and certainly ought to have the necessary portable standard instruments and can carry out such a test at small expense. Similar original and periodic tests are usually required by law in respect to house service meters, and are even more necessary for the large sums often involved in contracts for power.

Occasions, however, sometimes arise where the customer still has reason to doubt the accuracy of the meters, and is not satisfied to accept the check made by the power company, and to meet such cases it is usual to provide a clause that the customer may instal his own meters as a check and may require the power company to have their meters checked by an independent authority. This checking by an independent authority is expensive, and it is well to define by whom this expense is to be borne.

The following is suggested as a fair clause to cover the checking of meters, subject to modification to meet the conditions of each particular case.

"The necessary measuring instruments shall be installed and maintained by the power company, who shall, before using them as a basis of charge, furnish a satisfactory certificate that the said instruments have been calibrated in position against standard instruments, and who shall also

furnish to the customer tables or diagrams of the said calibrations.

"If requested in writing by the customer this calibration shall be repeated and diagrams furnished once in each year during the continuance of this contract.

"The customer shall be entitled to instal his own meters at his own expense as a check upon the power company's meters.

"The customer may at any time require the power company to have its meter or meters checked by an independent testing authority who shall be mutually agreed upon, or if there is failure to agree then the testing authority shall be named by ....., and on receipt of notice in writing from the customer that this test is desired the power company shall immediately have it carried out.

"Should such tests show the meter to be inaccurate by more than 2½ per cent. either way from absolute correctness over its working range, then the power company shall pay all the expenses of the test and shall adjust the current account for energy accordingly, but if the meter shall prove to be correct within the above limits, then the customer shall pay all the expenses of the test.

"Should the meter cease to record, then the charge shall be the same as that made for the previous corresponding period, plus, if necessary, an additional charge for any additional power used by any additional apparatus that the customer may have installed during the interval."

REPORT ON ELECTROLYSIS IN CHICAGO.

In the annual report of the Commissioner of Public Works of Chicago, just issued, is printed a report by Ray Palmer, consulting engineer, on the electrolytic damage to various underground metallic structures in different parts of the city caused by stray return current from the surface and elevated lines. Surveys made during August and September, 1911, showed excessive stray current in the neighborhood of the Illinois Street and Hill Avenue substations of the Chicago Railways Company, the Forty-second Street substation of the Chicago City Railways and at many points along the elevated railway structures.

The damage is said to include underground water pipes, lead cable sheaths, the metal in structural-steel buildings and the structural steel in bridges used by street railways in crossing the Chicago River. As a remedy for the conditions existing on the elevated structure the report recommends that large negative return cables should be placed on the structure and should be connected to the track rails at intervals of 300 ft. At the present time no return cables are used on any of the elevated structures in the city.

The existing city ordinance relating to the prevention of electrolysis is as follows:

"Ground return wires must be so arranged that the difference of potential between the grounded dynamo terminal and any point on the return circuit will not exceed 25 volts. The positive pole of the dynamo must be connected to the trolley line, and whenever pipes or other underground metal work are found to be electrically positive to the rails or surrounding earth, they must be connected by conductors arranged so as to prevent a flow of current from the pipes into the ground."

The report recommends that the ordinance be amended to read as follows:

"Ground return wire and rail circuits must be of such current-carrying capacity and so arranged that the difference of potential between any two points on the return will not exceed the limit of 12 volts. The railway companies must so equip their return current systems with insulated pilot wire circuits and voltmeters that an indicating reading may be obtained at any time showing the difference of potential between the negative busbars in each station and the extreme limits of the return circuit in the corresponding feeding district.

"The railway companies must protect all metallic work from electrolysis by the proper installation of a system equal to or better than a pipe and cable sheath drainage system consisting of insulated copper wires, pipe straps, ammeters, etc., which limits the maximum amperes drained from this subsurface metallic work to 10 per cent. of the total output of the station."

To operate within the limits required by such an amended ordinance the railway companies would be compelled to make one or more of the following improvements:

(a) Reconstruct all defective track work and install additional return feeders.

(b) Install a negative booster system.

(c) Install a return-current drainage system.

(d) Reduce the size of the power plant and substation feeding districts.

(e) Insulate the railway return circuits.

The report states that the most practical and efficient method of reducing electrolytic damage would be the installation of a pipe-drainage system. It recommends that all track bonds should be repaired and maintained in an efficient condition.

CANADIAN RAILROAD EARNINGS.

Month.	Canadian Pacific Railway.			Grand Trunk Railway.			Canadian Northern Railway.		
	1910.	1911.	Increase.	1910.	1911.	ncrease.	1910.	1911.	Increase.
	$	$	$	$	$	$	$	$	$
January	6,007,000	5,650,000	357,000	3,152,992	3,381,239	228,247	792,200	822,600	30,400
February	5,813,000	6,180,000	367,000	2,965,709	3,103,166	137,437	698,900	803,100	114,200
March	7,667,000	8,648,000	981,000	3,793,257	3,909,773	116,516	934,100	1,270,600	336,500
April	7,200,000	8,458,000	1,258,000	3,567,367	3,747,251	179,884	1,153,100	1,345,400	192,300
May	8,215,000	9,111,000	896,000	3,731,820	3,942,055	210,235	1,224,900	1,445,600	220,700
June	8,404,000	9,040,000	636,000	3,965,062	4,437,438	472,376	1,228,600	1,465,300	236,700
July	8,660,000	9,291,000	631,000	3,179,946	4,237,383	1,057,437	1,225,100	1,475,950	250,850
August	8,926,000	10,073,000	1,147,000	3,885,049	4,502,674	617,625	1,093,000	1,420,650	327,650
September	9,115,000	9,834,000	719,000	4,107,963	4,409,559	301,596	1,279,900	1,576,400	296,500
October	10,150,000	11,113,000	963,000	4,200,039	4,468,768	268,729	1,627,800	2,028,900	401,100
November	9,249,000	10,399,000	1,150,000	3,845,640	4,101,244	255,604	1,565,400	2,001,500	436,100

LONDON TRAMWAY AND GENERATING STATION.

The London County Council was constituted under the Local Government Act of 1888, its administrative area being over 120 square miles, and including some of the most populous portions of the Empire.

Probably no single authority has ever before exercised so many diverse functions as the London County Council, for it enters into practically every social activity of the London citizen from the cradle to the grave, handling anything from transportation to hotels.

The committee responsible for the control of the London tramway system is the Highways Committee, and this portion of the council's activities are principally dealt with in this article.

What is known as the London County Council Tramways consists of what was formerly a number of independent tramway undertakings operating within the county of London, together with certain new lines subsequently built by the council. Each of these companies owned from four to fifty miles of line, but gradually the council has taken over by purchase all the tramway companies within its area. The first transfer took place in 1895 and the last in 1909.

At the end of March, 1910, the system extended over 135½ street miles, of which 115½ miles were electric lines. The remaining 20 miles were at that time still worked by horse traction, but the latter have now practically all been converted to electricity.

The following table indicates the progress which has been made with the work of electrification. In some years it will be observed that while the amount of electrified lines increased, the length of horse lines also increased. This is accounted for by the acquisition by the council of other tramway undertakings.

Street mileage at end of year.	Electric traction in operation. Street miles.	Horse traction incld. lines in process of reconstruction. Street miles.	Total. Street miles.
March 31, 1904.....	19¼	69⅜	88⅝
March 31, 1905.....	26⅝	68¾	95⅜
March 31, 1906.....	30⅜	73⅝	104
March 31, 1907.....	58⅞	57⅞	116¾
March 31, 1908.....	68⅝	51¾	120⅜
March 31, 1909.....	84⅜	54⅛	129½
March 31, 1910.....	115½	20	135½

The above figures are indicative of the victory won by electricity over every other form of power, during the last 20 years. That unhappy animal, the tramway horse, meandered on its way for some time after experiments in electric traction had proved the infinite superiority of electricity, but the horse trams with their innumerable stops, delays, and inconvenience, at last proved intolerable and once the first step in electric driving was taken the rest was easy. A few horse trams are still to be seen in some outlying districts, but for all practical purposes the route is complete. Even in those busy parts of the Metropolis, where tramways are not allowed, the service is very largely carried out by motor omnibuses.

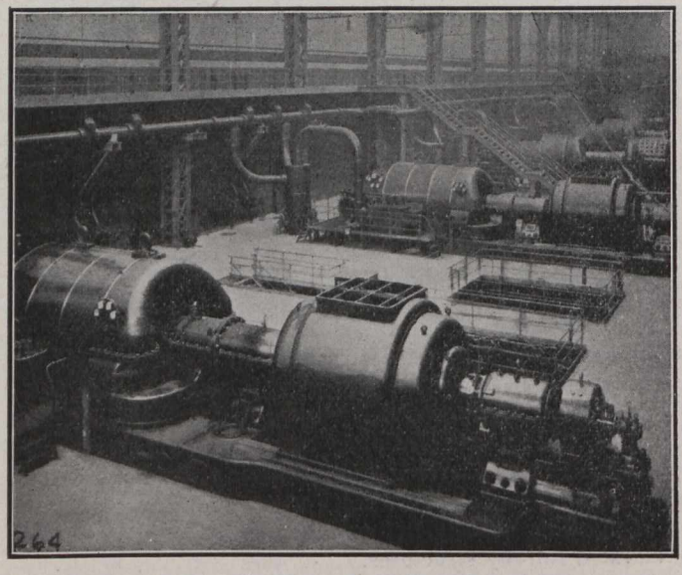
The total capital outlay of the London County Council Tramways amounted on the 31st March last to about $50,000,000. A report recently presented to the council, showing the results of the year's working during 1909-1910, gave the gross receipts of about $10,125,000 on the horse lines, viz., approximately $225,000, leaving a net surplus after payment on interest on capital outlay and for replacement of debt, of $960,000. The number of car miles run was 42,160,186, and the number of passengers carried 451,439,216.

The growth of traffic has arisen not merely from the increased mileage but also from the increase in the length of the routes electrified. Horse cars have only a small carrying capacity, and low-speed, and in London they are entirely at the mercy of the competition of motor omnibuses. Hence electrification in London has produced even more startling increases in the number of passengers than is the case in other towns.

Generating Station.—The electric generating station for the whole of London is situated at Greenwich, close to the River Thames. It was erected in two sections, and the site covers an area of approximately 3¾ acres.

The plant includes four vertical horizontal reciprocating engines coupled to three-phase alternators, of 3,000 kw. capacity each, four three-phase turbo alternators of 5,000 kw. capacity.

Two of the latter have only recently been installed. They were manufactured by the British Westinghouse Electric & Manufacturing Company, Limited, of Trafford Park, Manchester. An illustration of one of these sets appears below



5,000 kw. Turbo Alternator Sets Installed at Greenwich Power Station.

The two sets each comprise one 5,000 kw. 750 r.p.m. high pressure Westinghouse impulse type turbine coupled to one 5,000 kw. three-phase, 25-per., 6,600-volt, alternator, complete with Leblanc surface condensing plant and Leblanc auxiliaries.

The official tests of No. 7 turbine took place on the 8th, 11th and 13th January, 1911, after it had been eight months in regular service, with the results given below.

The guaranteed conditions were: Steam pressure, 180 lbs. per sq. in., with 120° F. superheat, vacuum 28½ inches (barometer 30 inches.)

No. 7 Set.

	25% Over-Load.	Full Load.	¾ Load.	½ Load.	¼ Load.
Test load in kws.....	6150	5165	3840	2572	1297
Guaranteed consumption..	——	14.5	14.75	16.0	19.5
Consumption obtained ..	14.74	14.30	14.60	15.67	19.31

This turbine has recently been opened for inspection after having been in operation for over 12 months, and it is found that the closest examination shows no trace whatever of erosion or corrosion, the blading being perfectly clean.

The normal plant capacity of the Greenwich generating station is 34,000 kw. The current is generated at a pressure of 6,600 volts, and is conveyed to various sub-stations over the tramway area.

The substations are provided with motor generators and rotary converters of a total capacity of 45,750 kw. transforming the current from alternating to direct at a pressure of from 550 to 600 volts.

The current is sent in the usual way from low tension switchboard through feeder cables which feed into the conductor rails in the conduit at half-mile intervals. On the over-head wire section the usual feeding arrangements for trolley wires are in use. The switches on the feeder panels in the sub-stations allow of the conductor bars in the conduit being changed so that either may be positive or negative, as required for the purpose of dealing with leakages to earth.

RAILROAD CONSTRUCTION THIS YEAR.

While about 2,000 miles of new railroad were built in Canada last year, the outlook for the present year is that as much if not more mileage will be added to the total. At the end of 1910, we had 24,730 miles. Last year the figures increased to approximately 26,500.

Sir Thomas Shaughnessy states that his road will probably build between 500 and 600 miles of new track this year and for an indefinite period. The main line from Medicine Hat westward for 534 miles is to be double tracked.

STEEL AS A TOWN BUILDER.
Canadian Northern Railway entering Stettler, Alberta, another link in Canada's transportation chain of 25,000 miles.

The contemplated construction on the Grand Trunk Pacific during 1912 is as follows:—

	Miles.
Main line	200
Brandon branches	16
Canora North	30
Regina boundary	155
Regina-Moose Jaw	45
Moose Jaw Northwest	50
Prince Albert	44
Battleford	48
Cut Knife	50
Biggar-Calgary	200
Alberta Coal	50
Mountain Park Coal	32
Melville to Watrous	75
Weyburn	60
Calgary to Coutts	50

The contract for five million dollars' worth of construction work in British Columbia for the Canadian Northern Railway was awarded to one firm who state that there is probably more railroad building going on in British Columbia than in any other part of the Dominion or the United States. They will begin active construction work on the new contract next spring. The plans call for 100 miles of road beginning about 50 miles above Kamloops, up north along the Thompson River Valley. When that is finished the Transcontinental chain of the Canadian Northern Railway will be practically completed.

Construction will commence on the Canadian Northern line from Toronto to Hamilton next spring.

The Canadian Pacific Railway is asking for parliamentary authority to construct new lines in Saskatchewan and Alberta. The Canadian Northern are seeking powers to build lines in the Peace River District, Alberta.

A large number of new railroad schemes are in the "charter" stage.

OUTLOOK IN ONTARIO MINING DEVELOPMENT.

By Thos. W. Gibson, Deputy Minister of Mines, Ontario.

During the past few years the advance in the mineral production of Ontario has been rapid, as the following figures show:—

Year.	Value of production.
1905	$17,854,296
1906	22,388,383
1907	25,019,373
1908	25,637,617
1909	32,981,375
1910	39,313,895

The statistician is rarely justified in venturing on the realm of prophecy, but the upward tendency of the curve described by the growth of mining in Ontario points strongly to still greater things in the future. It can hardly be doubted that the extension of prospecting into northern Ontario, now being rendered possible through railway construction, will bring to light new mineral fields probably as rich as any that have yet been found. The discovery of one such field leads almost as by a law of nature to the discovery of others. Silver Islet led to Rabbit Mountain and Beaver; Copper Cliff and Stobie to Creighton and Crean Hill and Garson; the Helen mine to the Josephine and Magpie; Sultana to Mikado; Cobalt to South Lorrain and Gowganda, and latest of all to Porcupine. Nor do the pre-Cambrian formations possess a monoply of mineral wealth; the Devonian and Silurian strata of southwestern Ontario have for years yielded goodly supplies of petroleum, natural gas, salt and gypsum. Petroleum may be declining in production, but that there are reservoirs, great or small, yet untouched, seems to be shown by the striking of oil in paying quantities a short time ago in Onondaga township, and the field for profitable production of natural gas appears to be steadily widening until it promises to cover a large part, if not the whole, of the northern and eastern shores of lake Erie. These stratified rocks have their counterparts on the slope leading down to James bay. Already gypsum in large deposits has been located there, and it would seem not unreasonable to entertain the hope that the future inhabitants of the clay belt north of the height of land may find it possible to light their homes with oil, cook their food with natural gas, and cure their pork with salt, all derived from the rocks underlying the farms from which they harvest their crops.

IRRIGATION BY PUMPING.*

By H. J. Kennedy.

In the development of an irrigated country, the lands first irrigated are naturally those which can be reached by gravity ditches; as these become settled and land values increase there comes a point where it pays to pump water on to lands lying too high to be reached by gravity flow. In irrigation by pumping, the efficiency of the use of water capacity takes on an added importance, for pumping is expensive, and the higher the irrigation duty obtained from a unit of water, the more land can be irrigated with a plant of given capacity and with a given power consumption.

As an instance of duty under a pumping system may be mentioned a certain large district in the interior of Washington, for which experts have concluded a rate of water pumped of 0.007 cu. ft. per second per acre, or 143 acres per second-foot, to be a reasonable amount. If 10 per cent. of this be lost by seepage and evaporation, the rate of application at the land becomes 0.0063 sec-ft. per acre, 4.5 acre-ins. per month, or 158.7 acres per sec-ft. But of course what is a fair allowance under some conditions of soil and drainage may be a great excess in others.

The next consideration when seeeking pumping economy is to reduce the unit cost of power as low as possible. This is attained by using apparatus of high efficiency, or by using cheap sources of power, or both. Falling water, in modern times as of old, furnishes a highly appreciated source of power. Quite a number of water power developments for irrigation pumping have been made or projected, both on large and small scales.

As examples of the large ones may be mentioned, in California the extensive system of the Mt. Whitney Power Company, comprising four power stations, on the Kaweah and Tule Rivers, which flow from the Sierras into the San Joaquin Valley, and a steam auxiliary generating plant; the total capacity of these plants is 8,850 kilowatts, which is conveyed by a network of transmission lines and utilized chiefly in pumping water by plants scattered throughout the valley, the area watered at present being about 18,000 acres.

In Idaho the power development at the diversion dam of the Minidoka project on the Snake River, the total capacity being divided into five generating units of 1,200 k.w. each, the irregular area under the pumping system being 49,900 acres.

In Washington a fraction of the 90,000 horse-power available on the great Columbia River at Priest Rapids has been developed by the Hanford Irrgation & Power Company, and utilized for pumping water from a different point on the same river to about 16,000 acres of land on the plateau above the river. This is an interesting example of private enterprise going into a region which was nothing but a vast treeless desert with a big river flowing through its midst and no population to speak of; putting the forces of nature to work and developing a new country out of the desert. It is still new and some particulars may well be included here.

The Hanford Power and Pumping Development.—The property has recently been taken over by the American Power & Light Company, but is still best known locally as the Hanford plant. The first generating unit was installed in 1909 and the second in 1910.

The Priest Rapids power station was designed for a present capacity of 2,600 horse-power, but provision was made for an ultimate development of 9,800 horse-power, with a minimum head of 18 ft. The maximum head reached, at high water, is 27 ft. The power house is of reinforced concrete, and has had installed in it two generating units, consisting of vertical-shaft turbines direct-connected to generators on the floor above. Each of the two shafts carries three turbine runners; the speed at 18 ft. head is 150 r.p.m. Each of the generators is a 900 k.w. three-phase, 60-cycle, 2,300-volt, revolving-field alternator. There is an exciter driven by a separate turbine, and another driven by an induction motor. The potential is stepped up by oil-filled, water-cooled transformers to 22,000 volts for the transmission line, which is 16.3 miles long, and which delivers the current to the pumping station at Coyote Rapids farther down the river.

The pumping station is of similar construction to the power station, and has room for four pumping units, two of which are at present installed. Like the generating units, these are vertical-shaft direct-connected, the induction motors being on the upper floor and the centrifugal pumps down below. Each motor is 450 horse-power, three-phase, 60-cycle, 2,200-volt, 175 r.p.m., the line potential being stepped down by transformers similar to those in the power station; half-voltage taps are provided for starting the motors.

Each pump is a single-stage, vertical-shaft, single-suction, enclosed-runner, centrifugal pump, designed for 62.5 sec-ft. capacity against a total head of 50 ft., with 30-in. suction connection and 30-in. discharge. The water from the two pumps enters a single delivery pipe of 66-ins. diameter, discharging into a cement-lined basin at the head of the main canal. The Allis-Chalmers Company, who built and installed the machinery and apparatus in these plants, guaranteed the pumps to have an efficiency of 65 per cent.

Utilization of the Power at Drops in Laterals.—The use of water-power for pumping is not, however, dependent upon the presence of big rivers and waterfalls where thousands of kilowatts run to waste. An extensive irrigation system may be run through a country in which the land is generally quite flat, but where, nevertheless, the topography is broken in some places; or it may be in a region abounding in steep places. In either case there will be points where the most direct location of canal or lateral will give a grade too steep for an earthen ditch, because of the erosion of the banks from the swiftly flowing water. This necessitates the use of drops. Sometimes a drop is in principle just like a timber or concrete dam; sometimes it is a conduit, open or closed, or merely a stream or waterfall down a rocky hillside; in any case there is a quantity of water falling a certain height in a reasonably short horizontal distance, constituting a water-power. With power going to waste in the system this way, and with areas of high land which could be irrigated by pumping, it is natural to study whether it will pay to make the necessary outlay and use the source to fill the need.

An example from actual practice will illustrate this kind of problem. Consider two drops in different laterals, situated a few miles apart; the former can be called A and the latter B. At drop A the water flows first through a wooden trough, then over the rocks where the surface soil has been eroded; total fall 75 ft. in a horizontal distance of 460 ft. At drop B there is four times as much water, but only about 21 ft. fall. Drop A is a natural one, drop B is entirely artificial, the deep excavation forming a channel which, for a long distance has no outlets and lies much below the level of the surrounding country. There are thousands of acres of dry land in the vicinity, higher than the main canal, having good volcanic ash soil, and needing only water to become valuable agricultural land. The main canal carries plenty of water. Now having power, water and dry land, what can best be done.

* Abstracted from an article in the "Purdue Engineering Review" for 1911.

We get up a preliminary design consisting of the following elements: A hydro-electric power plant at drop A; an electrical transmission line from there to drop B; hydraulic power development at power B; pumps at drop B driven by the transmitted electric power and by the hydraulic turbine. On the way over the transmission line is tapped to supply power to a pumping plant for an isolated high tract.

The electric power plant to be located at the foot of drop A would contain a turbine direct-connected to a three-phase alternating current generator. Concrete headworks at the top of the drop and a steel penstock would be provided to convey the water to the turbine. A by-pass must also be provided to supply lands below the drop in case the turbine is shut off.

The current can be transmitted this distance without step-up transformers, making the generator potential 2,300 volts. At drop B we can utilize the current in an induction motor at the line potential.

Starting with the horse-power available from the drops, and figuring the thing out step by step, allowing for the various hydraulic, mechanical and electrical losses, we come to the problem of determining the proper combination of height of lift and quantity of water pumped to make use of the power to the best advantage. There are in the problem several varying elements, as follows:

(a) Area of land between any selected contour line and the canal from which the water will be pumped.

(b) Quantity of water which can be pumped by the given horse-power to any selected height of lift.

(c) Number of acres which can be irrigated by the given horse-power at a given rate of duty, for any selected lift.

(d) Number of acres which can be irrigated by any selected quantity at the given duty.

The writer has applied with very satisfactory results a graphical method of solution previously used in this class of problem by Mr. E. A. Moritz, C.E. Figure 1 is a diagram for the simplest possible case, viz., a single lift and single district irrigated. Taking the total brake horse-power available at the site of the pumping station, and allowing a certain percentage for losses in pumps and delivery line, we get, say 156 net horse-power in water pumped, equal quantity pumped, in second-feet, multiplied by height of lift in feet and divided by 8.8 practically.

From a topographical map of the land above the canal, we obtain the areas between the various contour lines (which may be selected for discharge elevations) and the canal, by measurement with a planimeter, and plot them as a curve in which the abscissae represent acres and the ordinates represent height of lift, or difference of elevation between outlet contour and main canal, on line of proposed discharge pipe. In this case the slope of the land averaged up so nearly uniform that the portion of the curve plotted is shown as a straight line, marked A.

Curve B is also plotted with reference to lift on the vertical scale, but its abscissas represent the quantity of water which can be pumped at various lifts, as obtained from the foregoing equation. It is obvious that the curve will be an equilateral hyperbola.

A third curve, marked C, is plotted with reference to lifts; it is derived from B by multiplying the quantity pumped at any lift by the duty, or number of acres per second foot, in this case assumed at 143. It will, therefore, also be a hyperbola and will show acres of abscissas.

Finally, the different values of "water pumped," as shown on the horizontal scale, are multiplied by the constant duty (143), giving number of acres corresponding to each quantity pumped, at the given duty, and the resulting straight line D is drawn, acres being in this case read as ordinates, since the abscissas have already been used for quantity of water.

A and C intersect at a lift of 60.5 ft., and an acreage, read on the horizontal scale, of 3,250. The corresponding quantity pumped is found by running horizontally along the 60.5 ft. level to curve B, as indicated by the dotted line, which intersects B at value 22.8 cu. ft. per second. If now the dotted line be followed vertically downward to intersection with line D, we read on the vertical scale the acreage irrigable by this quantity, 3,250 acres, checking with the value read at the first intersection and demonstrating the accuracy of the work.

This diagram may become quite complicated if plans for using two or more lifts be considered, necessitating

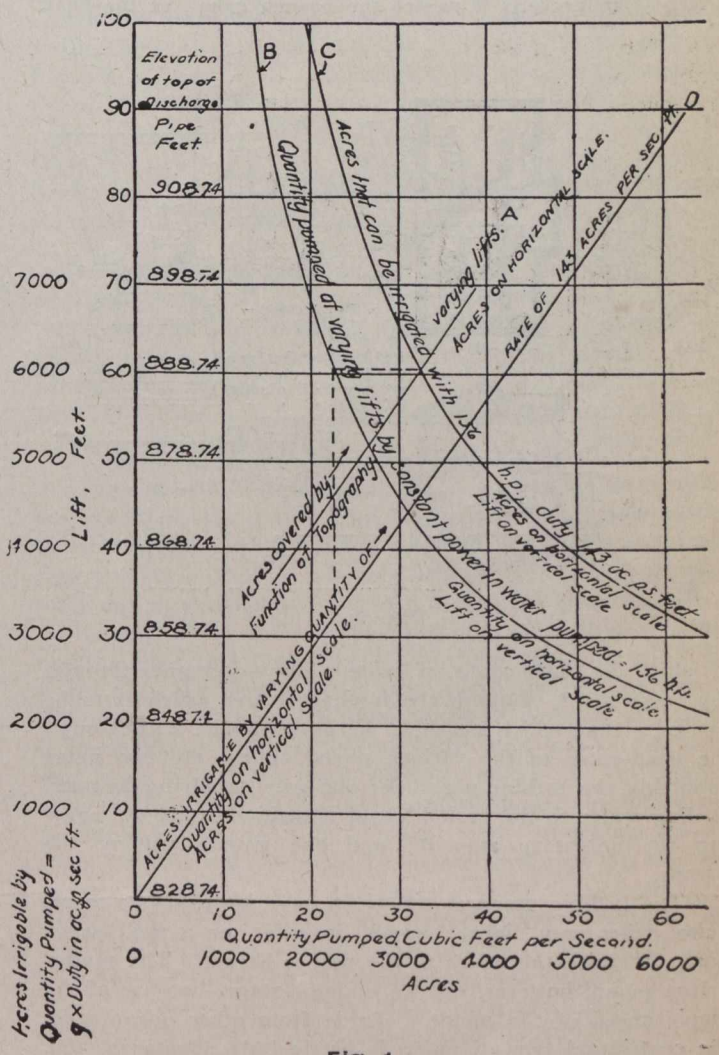


Fig. 1.

division of the horse-power into units and plotting separate curves B and C for each unit; and if different values of water duty be considered, the number of curves C and D plotted will be multiplied by the number of duty values considered. In such a case one would use a color scheme. The principle is sufficiently illustrated by the simple case chosen, without going into such complications, and it is evident that a great deal of figuring can be saved as compared with a cut-and-dry method of solution.

Having ascertained from the diagram the height of lift, computations can be made as to quantity pumped per unit, proper sizes of pipe, etc., and the selection of types, sizes and speeds of motors, pumps and turbines best adapted to the work and to each other is made. Making general plans for the setting and housing of the machinery, and an esti-

mate of construction cost of the different plants with their machinery, the transmission line, pipe lines and water distribution systems, and dividing by the number of irrigable acres, will give the charge per acre for first cost; the estimated cost of operation is divided in like manner. Statistics as to crop values and net profits per acre from similar lands already under cultivation in the neighborhood, will permit a comparison of the cost of the proposed improvement with the ability of farmers to stand the cost.

A preliminary design made by the writer for a pumping plant operated by hydraulic and electric power, is shown by Fig. 2. In this design the aim was substantital construction, with small maintenance cost, together with convenience and accessibility. It provides for concrete headworks and flash-board supports on the main canal, the cross-section of which is reduced as it passes the branch canal, at the head

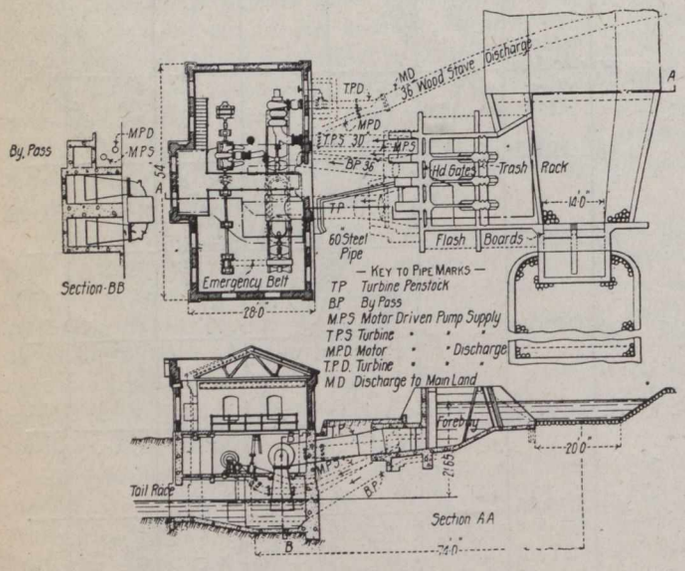


Fig. 2.

of which the plant could be located. The water goes through the trash racks, through the forebay (above which is to be carried a road which parallels the main canal), and through the head-gates to the various pipes. There are two gates supplying the turbine penstock; one gate supplying by-pass, feeding water to the branch canal if turbine is not discharging the necessary amount; and one gate supplying the pumps.

The turbine speed at the given head is so low as to require either very large pump impeller, or a multi-stage pump, to raise the water to the proper height. The motor-driven pump, however, can be a single-stage, because of the ample speed of the motor. Aside from other advantages, the centrifugal type of pump is particularly adapted to this service, because of the large amount of silt carried by the water in this canal.

In case of accident to the electric supply or apparatus, the turbine would be the sole motive power. The emergency belt connections shown makes it possible in such an event, to use either pump and shut off the other for repairs or other necessary attention. When not in use, the belt and shafting do not waste any power in friction as provisio is made for disconnecting them at the couplings.

As a considerable portion of the excavation at the site is already made, the excavation cost for this plant would not be as great as might appear from the drawing.

Greater compactness of the plant might be attained, at the sacrifice of certain features which it was desired to embody in this design. It should also be borne in mind that this does not represent a final, perfected design, but is merely a preliminary plan.

LABORATORY METHOD OF OBTAINING CORRECT PROPORTION OF PORTLAND CEMENT TO SAND OR STONE SCREENINGS FOR MORTAR.

That chemistry is a great help in matters pertaining to the manufacture of cement is a well-known fact, but that precise chemical methods may be used in concrete proportions is a fact not so generally known. The ideal or theoretically perfect concrete is that in which the best aggregates are scientifically proportioned and graded in size so as to reduce the percentage of voids to the minimum and give the greatest density. According to Mr. Albert Moyer, Asso. Am. Soc. C.E., who has spent considerable time in expedimental work along this line for the Vulcanite Portland Cement Company, Philadelphia, Pa., U.S.A., it is convenient to assume a weight of 94 pounds net (1 bag of Portland cement) to the cubic foot, and allow 2 42/64 oz. of cement to the 50 c.c.

The necessary equipment includes several graduated glass tubes of 200 or 250 cubic centimeters capacity and a balance that is sensitive to a sixty-fourth of an ounce (6 grains).

Weigh several samples of cement of 2 42/64 (50 c.c.) each. Measure several samples of sand from 87.5 to 150 c.c. each, so that proportions of cement to sand are secured thus, 1:1.75, 1:2, 1:2.25, 1:2.5, 1:2.75, 1:3.

The sand should be dried before measuring, which should be done accurately; pour the dry sand slowly into the measuring tube, jarring the same while pouring. Add the previously weighed cement sample to the sand, and then add sufficient water to make a mortar which, when tamped in the glass tube, will not cause any water to rise to the surface.

Place a little of this mortar at a time in the graduated glass tube (not over 4 c.c. at one time). Press the mortar down hard with a flat-end stick, leaving enough space for the expulsion of air between the walls of the tube and the stick. Pack the mortar as tightly as possible and note the space occupied by each sample. It will be found that the total volume of any one sample will exceed the space occupied by the sand alone.

The sample containing maximum density will be that which contains (in progression) the largest amount of sand but has not appreciably increased the volume of the mortar. As an example, supposing it to be found by this method that the sample containing proportions of 1:3 gave a volume of 110 c.c., 1:2.75 gave 110 c.c., 1:2.5 gave 110, and 1:2.25 gave 115 c.c. Then, the 1:2.5 is the sample which should theoretically give maximum density of the mortar. The 1:2.25 would be too rich, and the 1:3 too lean.

The cement having been weighed in each instance the unit of measurement for the cement being 94 lbs., 1 bag of cement assumed to be equivalent to 1 cu. ft., calculated on the actual volume of a barrel of cement as being 3.8 cu. ft. —the quantity of sand being measured and noted for each sample, you are thus in possession of the proportions required for a mortar for use in actual work. This refers entirely to concrete in which maximum density is required; such concrete will be almost impervious to water.

Having obtained the volume of mortar produced by each sample and the tensile strength of each sample, you can then determine as to whether a mortar of less density may with safety be used for work which does not require a water-tight concrete.

In the matter of screenings or quarry tailings for mortar, all of which will pass through a ¼-inch sieve and not containing over 10 per cent. of dust—that which would pass

through a 100 sieve—you may obtain the proportion of cement to screenings or quarry tailings which will produce maximum density, in the same manner, with the possible exception that a larger diameter graduated glass tube should be used on account of the shape of the particles of the quarry tailings.

By the method above described the relation of weight to volume is standard, these figures being based on 94 lbs. of cement as being equal to 1 cu. ft. Therefore, it makes no difference whatever if this be actual or not. Thus the variations in different brands of cement are automatically cared for, providing the same brand is used to determine the proportions for mortar as will be used in the actual work. These tests should be carried on with various sands, as there may be two or more sands obtainable in the same locality, one of which might require much less cement than the other and yet obtain maximum density in the mortar, effecting considerable economy on a large job.

THE ADHERENCE OF FLAT SURFACES.

A paper on the "Adherence of Flat Surfaces" was read before the Royal Society by Mr. H. M. Budgett, who remarked that in recent years it has been found possible to polish plane surfaces of hardened steel to a degree of accuracy which had previously been approached only in the finest optical work, and to produce steel blocks in the form of end gauges which can be made to adhere or "wring" together in combinations. These blocks will often cling together with such tenacity that a far greater force must be employed to separate them than would be required if the adhesion were solely due to atmospheric pressure, and the purpose of the paper was to examine the various causes which produce this adhesion.

The only previous experiments in this direction appeared, he said, to be those carried out with Whitworth surface plates by Professor Tyndall in 1875. By wringing together two of these plates and suspending them in a vacuum, he proved that the adherence between them was not caused solely by atmospheric pressure, as had been previously supposed. According to Goodeve, the conclusion at which Tyndall arrived was that the plates adhered by the molecular attraction of the bearing points brought into close contact by reason of the near approach to absolute truth of surface. Frequent references had been made to these experiments, and the conclusions of Tyndall appeared to have been generally accepted.

Liquid Films.—The author's curiosity was aroused by the fact that some steel gauges which he was constantly using in combinations did not always cling together with the same force. Frequently they refused to adhere to one another at all, whilst at other times considerable difficulty was experienced in getting them apart. On one occasion, when two blocks had been left wrung together for a long time, it was found necessary to hold one in a vice and hit the other sharply with a hammer in order to separate them. Subsequent examination showed that the faces had rusted together, which proved that some moisture must originally have been present between them. This led to the discovery that a minute film of condensed water vapor always formed upon the steel when the blocks were held with warm hands, and if care were taken to avoid this, and the faces were thoroughly cleaned with alcohol to remove grease, then all signs of adhesion vanished and the blocks would fall apart at once under their own weight. It soon became clear that the wringing effect was chiefly due to the presence of a liquid film between the blocks, and it was decided to make a series of experiments in order to examine the adhesive properties of various liquid films, the effects of atmospheric pressure, and the force of attraction between the molecules of steel in the two surfaces.

A number of hardened steel blocks were specially made in the form of cylinders 1 in. in diameter and ½ in. deep, having a central screwed hole 5/16 in. in diameter, the area of the faces being thus 0.7 sq. in. These were specially polished with great care so that their faces were true planes within one-millionth of an inch, the accuracy being optically tested by means of proof glasses. Many hundreds of readings were taken with dozen of pairs of blocks, and the average and maximum results were given in the following table:

Liquid.	Pull in lb. at separation.	
	Average.	Maximum.
Condensed water vapor	35	65
Turpentine	29	39
Paraffin	27	46
Oil of almonds	24	35
Lubricating oil (Price's)	22	30
Olive oil	20	33
Sperm oil	18	30
Rangoon oil (Price's)	17	28

Considerable variation in the readings was unavoidable, as it was impossible to gauge exactly the thickness and uniformity of the applied films, and there was an element of uncertainty in the action of sliding the blocks together. No adhesion could be obtained with volatile liquids such as alcohol, benzine, and petrol, and viscous liquids such as glycerine, treacle, and glucose produced very little effect.

Atmospheric Pressure.—In order to determine what were the effects of atmospheric pressure, arrangements were made by which, after being wrung together, the blocks could be separated in a vacuum. It was surprising to note that the force due to atmospheric pressure in no case exceeded 5 lb., as, the area of the faces being 0.7 sq. in., it might have been expected that this force would have approached 10.5 lb. It might naturally be supposed that such accurate surfaces, with a grease film between them, would be perfectly air-tight. It was evident, however, that air must have free access to a very large area of the faces, probably owing to the blocks being pulled apart or distorted slightly under the strain of the applied force, the film between them stretching before breakage occurred. It must be remembered that the volume required to fill the space between the faces was exceedingly minute, and since the pull was increased very gradually, a considerable time was allowed for the air to leak in or out. With thicker films the atmospheric pressure had a greater effect. Thus, with a fairly thick layer of Rangoon oil a difference of 6.5 lb. was noted between the force of separation in air and in vacuo, the force due to the air in this case being 9.3 lb. per sq. in. This might be due to the air being more impeded by the thick oil, or to the faces being less distorted, or separated, owing to a smaller force being required to cause breakage when a thick film was present. On the other hand, when the faces were perfectly clean and no film whatever was present, the adhesion almost vanished and the blocks would not support each other although their weight was only 1½ oz., showing that in this case the force due to atmospheric pressure was almost eliminated. For the same reason it was obvious that the force due to the attraction of the molecules of steel in the opposing faces was quite negligible in comparison with those under consideration.

The author concluded that at least 75 per cent. of the adhesion was caused by the presence of a liquid film between the faces in contact, and that not more than 25 per cent. was due to atmospheric pressure.

Metallurgical Comment

T. R. LOUDON, B.A.Sc.

Correspondence and Discussion Invited

PRODUCTION OF IRON AND STEEL IN CANADA.*

The iron and steel industry in Canada has had a fairly steady and continued development during the past few years. The serious depression under which this industry suffered in the United States in 1908 had comparatively little effect in Canada although there was a general falling off in output during the year. The production of 1909, however, greatly exceeded that of 1907, while the year 1910 again shows a very substantial increase in the production of pig iron and steel over the year 1909. The actual shipments of iron ore, however, from Canadian mines in 1910, were less than in 1909, although greater than the 1908 shipments.

The total shipments of iron ore from mines in Canada in 1910 were 259,418 short tons; there were used in blast furnaces 1,548,226 tons of iron ore, and in steel furnaces 39,332 tons; 800,797 tons pig iron were made, a large part of which was used directly in the manufacture of steel, and a total of 822,284 tons steel ingots and castings were made.

The development of iron ore mining in Canada has not kept pace with the growth of the metallurgical industry in iron and steel. The rate of production of iron ore has shown practically no increase during the past ten years, while the production of pig iron during the same period has increased nearly eight fold.

About 11 per cent., only, of the iron ore used in Canadian blast furnaces during 1910, was of domestic origin; of the coke used 49 per cent. was either imported or made from imported coal, and 18 per cent. of the limestone flux used was from sources outside of Canada. It is evident that this industry is now to a very large extent dependent upon imported raw materials.

The assistance granted by the Federal Government to the iron and steel industries in the form of bounties, ceased on December 31, 1910, with the exception of the bounty on steel rods, which was continued to June 30, 1911.

The accompanying table gives a summary of the chief statistics of production of iron ore, pig iron, and steel, while more detailed records will be found in subsequent pages:

Summary of Iron and Steel Statistics 1908, 1909, and 1910.

		1908.	1909.	1910.
		Tons.	Tons.	Tons.
Iron ore shipped		238,082	268,043	259,418
Canadian iron ore charged to blast furnaces		209,266	257,502	171,191
Imported iron ore charged to blast furnaces		1,051,445	1,235,000	1,377,035
Iron ore charged to steel furnaces		(a)	(a)	39,332
Pig iron made		630,835	757,162	800,797
Pig iron imported		58,365	148,338	243,859
Pig iron exported		290	5,063	9,763
Pig iron consumption (calculated)		688,910	900,437	1,034,893
Pig iron used in steel furnaces		(a)	(a)	690,913
Steel ingots and castings made		588,763	754,719	822,284
Steel rails made		267,192	377,642	399,762
Canadian coke used in iron blast furnaces		492,076	412,016	491,281
Imported coke used in iron blast furnaces		325,670	507,255	476,838
Iron and steel imported	(b)	1,079,000	565,740	979,939
Number of completed blast furnaces	No.	16	16	17
Number of men employed in blast furnaces	No.	1,380	1,486	1,403
Wages p'd in blast furnaces	$	750,224	879,429	1,006,727
Value of pig iron produced	$	8,111,194	9,581,864	11,245,622
Value of iron and steel goods exported	(c) $	5,907,792	7,172,413	7,895,489
Value of iron and steel goods imported	(d)	$61,819,698	40,393,431	59,952,197

(a) Not collected.

(b) Figures cover the fiscal year ending March 31 and include all iron and steel goods for which weights are given.

(c) Figures cover the calendar year.

(d) Figures cover the fiscal year ending March 31.

IRON ORE.

The total shipments of iron ore from mines in Canada in 1910 were 259,418 tons valued at $574,362 at the shipment point, as compared with 268,043 tons valued at $659,316 in 1909, and 238,082 tons valued at $568,189 in 1908. Of the 1910 production 130,380 tons are classed as hematite, 127,768 as magnetite, and 1,270 tons as bog ore. Ontario is the largest producer, having shipped 231,445 tons or nearly 90 per cent. of the total production. New Brunswick enters the list of producers with shipments of 5,336 tons from the mines near Bathurst. In Nova Scotia 18,134 tons were shipped from the Torbrook mines and in Quebec province, in addition to the bog ores, a small tonnage (3,233 tons) of titaniferous iron sands was shipped from the north shore of the St. Lawrence. Although no production of iron ore is credited to British Columbia, a shipment of a small barge load of copper was made from the Raven mine, Texada island, to Seattle, Wash.

The production by provinces during the past three years was as follows:—

Production of Iron Ore by Provinces, 1908-9-10.

Provinces.	1908. Tons.	1908. Value. $	1909. Tons.	1909. Value. $	1910. Tons.	1910. Value. $
New Bruns'k	.....	.....	.....	.....	5,336	11,910
Nova Scot'a.	11,802	17,620	.....	.....	18,134	40,478
Quebec	10,103	22,094	4,150	5,508	4,503	8,252
Ontario	216,177	528,475	263,893	653,808	231,445	513,722
British Colm.	.....	.....	.....	.....	.....	.....
	238,082	568,189	268,043	659,316	259,418	574,362

The production during 1909 and 1910 classed as magnetites (including titaniferous iron sands and some ores with an admixture of hematite), hematites (including brown ores), and bog ores, was as follows:—

Classified Production of Iron Ore, 1909-10.

Character of ore.	1909. Short Tons.	1909. Value. $	1909. Per Ton. $ c.	1910. Short Tons.	1910. Value. $	1910. Per Ton. $ c.
Magnetite	74,240	162,280	2 19	127,768	289,876	2 27
Hematite	190,473	492,348	2 58	130,380	281,090	2 16
Bog	3,330	4,688	1 41	1,270	3,402	2 68
	268,043	659,316	2 46	259,418	574,362	2 21

* Abstracted from Govt. Report.

Nova Scotia.—The Torbrook mines were the only shippers during 1910, the quantity shipped being 18,134 tons in three cargoes to Philadelphia, Pa., Glasgow, Scotland, and Middlesborough, England, respectively. The ore is a hematite and the shipments averaged about 48 per cent. metallic iron. The total quantity of ore mined during the year was 53,054 tons, a large part of which was in the stock piles at the mines at the close of the year.

Some development work was done at Arisaig, Antigonish county, by the Arisaig Iron Company, but no ore was shipped.

The blast furnaces at Sydney and North Sydney receive their ore supplies from Newfoundland chiefly. The two Canadian companies operating at Wabana, shipped during the year 1,259,626 short tons of hematite ore averaging fro n 50 to 52 per cent. iron; of which 808,762 tons were shipped to Sydney and 450,864 tons to the United States and Europe.

New Brunswick.—Shipments were made from the mines at Austin Brook, near Bathurst, to the extent of 5,336 tons, the ore being sent to Philadelphia. The ore is a magnetite with an intermixture of hematite, and the properties are being developed by the Canada Iron Corporation. About 25,515 tons of ore were mined during the year. Shipments are made from the company's docks at Newcastle, at which there was a considerable tonnage in stock at the close of the year.

Quebec.—The iron ore production in Quebec in 1910 included 1,270 tons of bog ore shipped to Drummondville, and 3,233 tons of titaniferous magnetic sands shipped from St. Urbain, Champlain county, to the United States. In 1909 the shipments were 3,330 tons of bog ores and about 820 tons of titaniferous iron sands.

These titaniferous sands have been shipped largely for experimental purposes and a nominal value of $1.50 per ton has been placed upon the production, although the actual cost of placing the ore on board vessels was possibly several times this amount.

Ontario.—Shipments were made by four mines in this province during the year, viz.: the Mayo, at Bessemer, Hastings county; the Moose Mountain, at Sellwood, 30 miles north of Sudbury; the Helen, north of Michipicoten, and the Atikokan, 130 miles northwest of Port Arthur, on the Canadian Northern Railway. In addition to these a considerable tonnage of ore was reported as having been raised at the Wilbur mine in Lanark county, but no shipments were made.

The total shipments of ore during the year were 231,445 tons, valued at $513,722; as compared with shipments of 263,893 tons, valued at $653,808, in 1909.

British Columbia.—No regular shipments of iron ore were reported from the province. Some prospecting work was done on the Raven mine on Texada island, and a small scow load of cupiferous iron ore shipped to Seattle, Wash., for experimental purposes.

Following is a list of the principal producers of iron ore in Canada:—

Canada Iron Corporation, Limited, Mark Fisher Bldg., Montreal.

E. H. Duval, Levis, Que. (Guay P. O.).

H. C. Bosse, 92 St. Peter St., Quebec, Que.

Joseph Bouchard, Baie St. Paul, Que.

The Canadian Iron Ore Co., 1231 St. Valier St., Quebec, Que.

Exploration Syndicate of Ontario, Limited, Wilbur, Ont.

The Lake Superior Power Company, Sault Ste. Marie, Ont.

Atikokan Iron Company, Port Arthur, Ont.

Moose Mountain, Limited, Sellwood, Ont.

Dominion Bessemer Ore Company, Limited, 472 Bullitt Bldg., Philadelphia, Pa.

Pig Iron and Steel.—An increase of 5.58 per cent. is shown in the production of pig iron in Canada in 1910 over the production of 1909, as compared with an increase of 20 per cent. in 1909 over that of 1908.

At the close of the year Canada had seventeen completed furnaces and two under construction, grouped in ten separate plants and operated by eight separate companies or corporations.

The Londonderry furnace was not in operation during either of the past two years. These figures do not include the output from electric furnaces making ferro-products which are situated at Welland and Sault Ste. Marie, Ont., and Buckingham, Que. Ferro-silicon was made at Welland during 1910, but the Sault Ste. Marie and Buckingham plants were not in operation during the year.

Of the total output of pig iron in 1910, 17,164 tons, valued at $333,956 or $19.78 per short ton, were made with charcoal as fuel, and 783,633 tons, valued at $10,911,674 or $13.92 per ton, with coke.

The classification of the production in 1910 according to the purpose for which it was intended was as follows:—

Bessemer 219,492 tons, basic 425,400 tons, foundry (including miscellaneous) 138,741 tons.

The total production of pig iron in 1910 and 1909 is shown by provinces in the following table, the average value per ton being also indicated. In the case of Nova Scotia a large proportion of the pig iron is directly converted to steel, and as a very small portion of the metal is sold as pig iron it is somewhat difficult to place a satisfactory valuation upon the output. For statistical purposes a value of $12 per short ton has been placed upon this production in 1910. The Quebec production is entirely charcoal iron, which has for many years commanded a high price.

Production of Pig Iron by Provinces, 1909-10.

Provinces.	1909. Tons.	1909. Value.	1909. Value per ton.	1910. Tons.	1910. Value.	1910. Value per ton.	Percentage increase or decrease in quantity.
		$	$		$	$	%
Nova Scotia	345,380	3,453,800	10.00	350,287	4,203,444	12.00	+ 1.4
Quebec	4,770	125,623	26.34	3,237	85,255	26.34	—32.1
Ontario	407,012	6,002,441	14.75	447,273	6,956,923	15.55	+ 9.9
Total	757,162	9,581,864	12.65	800,797	11,245,622	14.04	+ 5.8

Of seventeen completed furnaces, six were in blast in 1910, for varying periods of time. The operating companies, with numbers and capacities of furnaces, were as follows:—

Dominion Iron & Steel Company, Sydney, C.B., one of the constituent companies of the Dominion Steel Corporation, Ltd.: four completed furnaces of 280 tons capacity each per day, operated throughout 1910, two for 365, one for 112 days, and the fourth for 255 days. A fifth furnace has been completed and will go into blast early in 1911, while the erection of a sixth furnace has been arranged for, the completion of which will give this company a capacity of over 400,000 tons per annum.

Nova Scotia Steel and Coal Company, Limited, New Glasgow, N.S.: one furnace at Sydney Mines, C.B., of 200 tons capacity, operated 311 days. Furnace was blown out on May 1, when, according to the report of the general manager, a new crucible jacket of 2½-inch plate, steel reinforced with cast-iron, water-cooled slabs 4½ inches thick, dovetailed into each other, new bosh jacket and mantel were installed; the furnace lined throughout, hot blast stoves, downcomers, gas-mains, boilers, blowing engines, and pumps were all overhauled and renewed where necessary. The furnace again went into blast June 24, and from this date to December 31, made an average daily output of 243 tons. For the same

period, previous to relining, the average daily output was 160 tons.

Londonderry Iron & Mining Company, Limited, Londonderry, N.S.: one furnace of 100 tons capacity; idle throughout the year.

Canada Iron Corporation, Limited, Montreal, Que.: two small furnaces of seven and eight tons capacity, at Drummondville, Que., operated 272 days; one furnace of 25 tons daily capacity, at Radnor Forges, Que., operated 41 days during 1910; two furnaces of 125 tons and 250 tons at Midland, Ont., operated for 7 months and 4 months respectively.

Standard Chemical Company of Toronto, Deseronto, Ont.: one furnace with a daily capacity of 50 tons, operated for 253 days, during 1910.

Hamilton Steel & Iron Company (now the Steel Company of Canada, Ltd.), Hamilton, Ont.: two furnaces, one of 200 tons capacity, operated throughout 1910, a second furnace of 300 tons capacity, operated 329 days in 1910.

Algoma Steel Company, Limited, Sault Ste. Marie, Ont., a constituent Company of the Lake Superior Corporation: two furnaces at Steelton, near Sault Ste. Marie, of 250 tons capacity each, operated throughout the year. This company also has under construction a 400-ton furnace, a 12-inch and 18-inch merchant mill, and a complete installation of by-product coking ovens (110 ovens, Koppers type, with capacity of 1,100 tons of coke per day).

The Atikokan Iron Company, Limited, Port Arthur, Ont.: one furnace of 100 tons capacity, operated for 8 months during 1910.

Ferro-silicon, ferro-chrome, ferro-phosphorus, etc., have been made in electric furnaces at Buckingham, Que., by the Electric Reduction Company, Limited; the furnaces, however, were not in operation during 1910. Ferro-silicon has also been made in electric furnaces at Saulte Ste. Marie, and at Welland, Ont. The electric furnaces operated by the Electric Metals Company were in operation during 1910. These furnaces, constructed some three years ago, consist of four furnaces of from 1,000 to 1,500 horse-power each, the daily production being from 5 to 8 tons.

The imports of ferro-silicon, manganese, etc., during the calendar year 1910, were 18,900 tons values at $464,741, or an average of $24.59 per ton. The imports during the calendar year 1910 were 17,699 tons valued at $411,536, an average of $23.25 per ton.

Returns of steel production received direct from the producers showed a total production of ingots and castings for 1910 of 822,284 tons, as compared with 754,719 tons in 1909, and 588,763 tons in 1908. In 1910 the production of open-hearth ingots was reported as 580,932 tons, Bessemer ingots 222,668 tons, direct open-hearth castings 18,085 tons, and other steels 599 tons; compared with 1909 there was an increase in total production of 67,565 tons, or nearly 9 per cent.

Following is a list of firms making steel in Canada:—

Dominion Iron and Steel Company, Sydney, N.S.
Nova Scotia Steel and Coal Company, New Glasgow, N.S.
Montreal Steel Works, Limited, Montreal, Que.
The Algoma Steel Company, Sault Ste. Marie, Ont.
The Hamilton Steel and Iron Company, Hamilton, Ont.
The Wm. Kennedy Sons, Limited, Owen Sound, Ont.
The Ottawa Steel Castings Company, Limited, Ottawa, Ont.
The Ontario Iron and Steel Company, Limited, Welland, Ont.

The production of finished rolled iron and steel in Canada from 1906 to 1910, as ascertained and published by the American Iron and Steel Association, was as follows, in long tons:—

Annual Production of Rolled Iron and Steel, 1906-10.

Products—Gross tons.	1906.	1907.	1908.	1909.	1910.
Rails	312,877	311,461	268,692	344,830	366,465
Structural shapes and wire rods	48,351	65,541	41,520	74,136	80,993
Plates and sheets	15,202	18,493	11,656	36,241	26,642
Nail plate, merchant bars and all other finished rolled forms	195,312	204,684	174,649	207,534	265,711
Total	571,742	600,179	496,517	622,741	739,811

ELECTRIC STEEL EXPERIMENTS.

A German steel company carried out a few experiments on a 3-ton Girod furnace preparatory to equipping their plant with electric furnaces. That connections to such a furnace can play such an important part in the life of the lining and the power consumption of it is well emphasized in the changes made by the author in question on his furnace. Where one connection was made to the top electrode and another to the bottom electrode it was found that the arc was thrown strongly against the opposite side of the furnace to the conductors. The top conductor was then split into two and led to the electrode on opposite sides, a single conductor being used on the bottom electrode. With this system the arc was blown toward the line. The final solution of the problem was to split both the conductors, bring them up to the furnace many feet underneath and then rise vertically, a pair on each side of the furnace, carrying the conductors leading to the top and bottom electrodes just as far as possible side by side. To increase this length the bottom electrodes were in electrical connection with the shell of the furnace so that connection with them could be made high up on the side of the furnace. The splitting of the conductors keeps the arc central and saves half the lining and all trouble with blowing out of the arc. Even the shell of the furnace was finally made of steel of low permeability. The energy saving in the conductor system and shell as revised amounted to 10 per cent. over the first installation. The flat circular arc now carried on the furnace means an even greater saving of electrode, as previously when it was thrown off to one side it caused very uneven consumption and consequent waste of electrode.

The present system of working is to charge the furnace with about three tons of open-hearth metal and put on a current of 4,000 to 6,000 amperes. A highly oxidizing slag is formed, and all the phosphorus and some of the sulphur is removed during this oxidizing period. The bath is then deoxidized under a new slag formed of lime, sand, ferro-silicon and petroleum coke or scrap electrode ends. This removes sulphur down to 0.01 per cent. On an average five charges are worked in 12 hours, though this is dependent on the amount of impurities to be removed.

With the original form of two conductor connections where the arc was thrown to one side, the silica roof over that side even with air cooling, lasted only 20 heats. With the four-conductor system the roof now lasts 60 to 70 charges. Experiments are not yet completed as to the economy of using other materials in place of silica for the roof.

The side walls were first formed by ramming a mixture of magnesia and tar around a core shaped like the inverted frustrum of a pyramid. Such a lining cost £36. It was later determined that dolomite would most economically replace the magnesia, so all linings are now made of this material. They last 120 charges and cost £17. The total cost of lining, including repairs to slag line between heats, amounts to 15.

3d. per ton of steel. The area of the ends of steel electrodes in the bottom bears the ratio of 0.05 to 80 to that of the whole bottom.

The bottom electrodes are water-cooled in the ends projecting outside of the furnace. The dolomite bottom is rammed in between them with an air tamper, such a bottom lasting 1,000 heats in a furnace run very intermittently. A calorimetric determination of the heat carried out in the cooling water of these bottom electrodes gave 10.1-kw.-hours for the 130-minute run, or about 1.01 per cent. of the total electrical energy supplied, or 2.9-kw.-hours per ton of steel produced. The cooling water used in the top electrode carried out 36.7-kw.-hours, 3.65 per cent. of total energy supplied, or 10.5-kw.-hours per ton of steel.

The running of this small experimental furnace has thrown much light on the nature of many reactions in the refining of the steel. In the oxidation period carbon is but slowly removed, manganese more rapidly, phosphorus very rapidly, and about 20 to 35 per cent. of the sulphur. The sulphur appears to be removed in three ways: In the oxidation period by the action of the iron oxide in the slags; in the deoxidation period by solution in the high lime slags; and volatized as silicon sulphide. It has also been noted that oxides, slag emulsions, and gases have a much more important bearing on the physical properties of the finished metal than the sulphur and phosphorus present.

NEW YEAR'S HONORS FOR CANADIANS.

The following Canadians were honored by King George on New Year's Day:—

Premier R. L. Borden—Privy Councillor.

Lieutenant-Governor J. M. Gibson—K.C.M.G.

Joseph Pope, undersecretary for external affairs—K.C.M.G.

Thomas Cooper Boville, deputy-minister of finance—C.M.G.

Rudolphe Forget—K.B.

E. B. Osler—K.B.

Charles Slemin, Brantford's chief of police—King's medal.

THE ELECTRICAL DEPARTMENT OF LONDON, ONT.

The financial statement of the electrical department of London, Ont., shows that buildings and land cost $21,000; plant equipment, $44,000; distribution system and municipal street lighting, $193,000, which, with other expenditures on capital account amounted to $350,000. The statement of revenue and expense is the most interesting, as there had been some doubt as to whether there might not be a deficit the first year. The total receipts were $78,892.16, including street lighting and other municipal business. The expense for power and operation was $55,692.07, leaving a gross revenue of $23,200.09. Out of this the sum of $16,807.93 has to be taken, this being the amount estimated by the City Council as necessary to cover interest and sinking fund charges on debentures for distribution system, leaving a net surplus of $6,392.16. Included in the expense account is an item of $7,477.98 for the promotion of business. While some municipalities are allowing five years to pay this, London decided upon four and $6,000 was to have been carried forward to be written off in the future, but on account of the excellent showing made already it was decided to write off the full amount this year. Had this $6,000 been added to the assets, the total surplus would have been $12,392.16.

PERSONALS.

Mr. Thomas Graham, of Nanaimo, B.C., has been appointed to the position of chief inspector of metalliferous ores and coal mines.

Mr. C. B. Smith, of the firm of Smith, Kerry and Chace, is back in Toronto again, after a prolonged absence in the West.

Hon. William Harty, president of the Kingston Locomotive Company, has resigned his position. Mr. Æmilius Jarvis, of Toronto, will succeed him.

Mr. R. H. Murray, who has been with Mr. T. Aird Murray, consulting engineer, of Toronto, is leaving on a two months' trip to Scotland and England.

Mr. Hugh Jackson, treasurer of the Positive Clutch & Pulley Co., has resigned his position ao accept the cashiership of The Canadian Fairbanks-Morse Co., Limited, at Calgary, Alta.

Mr. J. P. Hynes, of Toronto, is named as the successor of Senator Frost to the position vacated on ahe Ottawa Improvement Commission. Mr. Hynes is greatly favored by Ottawa architects and other technical gentlemen, while in Toronto a strong effort is being made to secure his appointment.

Mr. Noble, who was employed by The Canadian Fairbanks-Morse Co., Limited, previous to his entering the organization of the Positive Clutch & Pulley Co., Toronto, last June has accepted a position under Mr. Patton, and now has charge of the transmission department of The Canadian Fairbanks-Morse Co., Limited, at Toronto.

Mr. Adolph Butze and Mr. J. R. Nutter have resigned their positions on the staff of the Grand Trunk Railway. Mr. Butze had an eventful career before joining the Grand Trunk. He served with Sherman through the Civil War. Later he was with the Wabash, Missouri Pacific, and Monon Route roads. He is succeeded by Mr. J. H. Guess, who joined the Grand Trunk last February as assistant to Mr. Butze. Mr. J. R. Nutter, who retires from the position of chief clerk to superintendent of eastern division, entered the G.T.R. service November 1st, 1883, as a porter, and subsequently served as clerk in assistant superintendent's office at Richmond, Que., and timekeeper at Montreal, received the appointment he retires from, October, 1897.

OBITUARY.

The death is reported of Prof. Leigh R. Gregor, who, for almost twenty years, has been connected with the McGill University as professor of languages, on January 1st, 1912.

Prof. Gregor was born in Charlottetown, P.E.I., fifty-two years ago, and was educated in the Prince of Wales' College, Charlottetown. He came to McGill in 1878 and entered the Arts course, graduating as B.A., in 1882. Having made a specialty of languages during his studies, he was appointed instructor of modern languages at the McGill High School shortly after he had graduated. In 1892 he was appointed lecturer in German at McGill, and in 1906 was promoted to the rank of associate professor of Modern Languages. He also had the degree of Ph.D. of Heidelberg conferred upon him.

CANADIAN NATIONAL ASSOCIATION OF BUILDERS' EXCHANGE.

City.	Secretary and Address.
Montreal—	J. H. Lauer, Sec., 263 St, James Street.
Toronto—	P. L. Fraser, Sec., 2 Berti Street.
Quebec—	A. Cote, Sec., 23 Rue St. Jean.

Ottawa—W. Hastings, Sec., 22 Metcalf Street.
London—Geo. S. Gould, Sec., Bank of Nova Scotia, Building.
St. Thomas—E. O. Penwarden, Sec., Dowler Block.
Kingston—E. R. Beckwith, C.E., 292 Earl Street.
Guelph—Mahoney Brothers.
Sault Ste. Marie—MacPhail & Wright Cons. Co., Ltd., P.O. Box 835.
Brantford—A. J. Cromar, Sec., 103½ Dalhousie St., P.O. Box 212.
Windsor—J. L. Young, Sec., 44 Campbell Avenue.
Hamilton—B. F. Richardson, Sec., The Building & Contracting Assoc., 60 Market Street.
St. John, N.B.—H. L. McGowan, 137 Princess Street.
Halifax, N.S.—H. Roper, care S. M. Brookfield, Ltd., 58 Grandille Street.
Winnipeg, Man.—J. H. Buxton, Jr., Sec., Portage Avenue and Hargrave Street.
Regina, Sask.—H. R. Abbott, Sec., Builders' Exchange.
Calgary, Alta.—A. Chamberlain, Sec., Board of Trade Bldg.
Edmonton, Alta.—A. O. Wetmore, Sec., McDougall Court.
Medicine Hat, Alta.—J. D. Everard Sec., Builders' Exchange.
Lethbridge, Alta.—E. Power, Sec., Acadia Block.
Vancouver, B.C.—Builders' Exchange, 342 Pender Street.
Victoria, B.C.—Chancery Chambers.

COMING MEETINGS.

THE AMERICAN INSTITUTE OF CONSULTING ENGINEERS.—January 16th, 1912, Annual Meeting, Aldine Club, Fifth Avenue and 23rd Street, New York City, at 8 p.m. Secretary, Eugene W. Stern, 103 Park Ave., New York.

THE CLEVELAND ENGINEERING SOCIETY.—January 23, 1912. Special Meeting, Chamber of Commerce Bldg., Cleveland, O. R. C. Beardsley, Hydraulic Engineer, will present an illustrated paper on "The Design and Construction of Dams," with special reference to recent failures. Secretary, F. W. Ballard.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Jan. 24. 25, 26, 1912, General meeting, 413 Dorchester St. West, Montreal. Prof. C. H. McLeod, Secretary.

CANADIAN FORESTRY ASSOCIATION.—February 7th and 8th, 1912. Forestry Convention Meetings held in the Railway Committee Room, Parliament Buildings, Ottawa. Secretary, Mr. James Lawler, Canadian Bldg., Ottawa.

CANADIAN LUMBERMEN'S ASSOCIATION.—February 6, 7 and 8, 1912. Annual Meeting to be held at the same time and place as the Canadian Forestry Association.

CANADIAN NATIONAL ASSOCIATION OF BUILDERS. — The Sixth Annual Convention will be held in Toronto, February 20, 1912.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, C. H. Rust; Secretary, Professor C. H. McLeod.

QUEBEC BRANCH—
Chairman, P. E. Parent; Secretary, S. S. Oliver. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, H. E. T. Haultain, Acting Secretary; E. A. James, 57 Adelaide Street East, Toronto. Meets last Thursday of the month at Engineers' Club.

MANITOBA BRANCH—
Secretary E. Brydone Jack. Meets every first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 319 Pender Street West, Vancouver. Meets in Engineering Department, University.

OTTAWA BRANCH—
Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N. T. Ry., Cory Bldg.

MUNICIPAL ASSOCIATIONS.

ONTARIO MUNICIPAL ASSOCIATION.—President, Chas. Hopewell, Mayor, Ottawa; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF ALBERTA MUNICIPALITIES.—President, H. H. Gaetz, Red Deer, Alta.; Secretary-Treasurer, John T. Hall, Medicine Hat, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer, J. W. McCready City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secretary, Mr. Heal, Moose Jaw

CANADIAN TECHNICAL SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang; Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS, CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Charles Kelly, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President. Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. Frank D. Adams, McGill University, Montreal; Secretary. H. Mortimer-Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, T. A. Starkey, M.B., D.P.H., Montreal. Secretary, F. C. Douglas, M.D., D.P.H., 51 Park Avenue, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—President, Thos. Fawcett, Niagara Falls; Secretary-Treasurer, A. W. Ashton, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, W. B. McPherson; Corresponding Secretary, A. McQueen.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, Killaly Gamble; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary, R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C.B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; Secretary, J. E. Farewell, Whitby.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, J. Whitson; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5 Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Alfred T. de Lury, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Dr. A. McGill, Ottawa, President; Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Wm. Pierce, Calgary; Secretary-Treasurer, John T. Hall, Brandon, Man.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, 115 Phœnix Block, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Medicine Hat, Alta., church	Jan. 20.	Dec. 28.	59
Ottawa, Ont., iron posts	Jan. 31.	Dec. 21.	68
Ottawa, Ont., supplying timber	Jan. 15.	Jan. 4.	59
Ottawa, Ont., Indian supplies	Jan. 15.	Jan. 4.	59
Ottawa, Ont., rails and rail fastenings	Jan. 10.	Dec. 28.	68
Ottawa, Ont., breakwater, Devil's Island, N.S.	Jan. 11.	Dec. 28.	59
Ottawa, Ont., wharf, Anse Aux Canards, Que.	Jan. 15.	Jan. 4.	59
Ottawa, Ont., wharf, New Liskeard, Ont.	Jan. 10.	Jan. 4.	59
Toronto, Ont., sewers	Jan. 16.	Dec. 28.	70
Toronto, Ont., main drainage works	Jan. 16.	Jan. 4.	70
Walkerton, Ont., bridge, Saugeen River	Jan. 23.	Jan. 4.	59
Woodstock, Ont., church	Jan. 15.	Dec. 21.	59
Winnipeg, Man., drawings for government buildings		Dec. 21.	68
Winnipeg, Man., motor generator set	Jan. 22.	Dec. 21.	59

TENDERS.

Arcola, Sask.—Tenders will be received until January 15th, 1912, for the erection of an addition to school building at Arcola, Sask. Plans and specifications may be seen at the office of Storey and Van Egmond, Architects, Regina, Sask., or from Jas. R. Donaldson, Sec.-Treas. Arcola S.D. 37, Arcola.

Dauphin, Man.—Tenders addresed to the town clerk, Canora, Sask., will be received until January 17th, 1912, for the erection and completion of a solid brick town hall building for the town of Canora, Sask. Plans, etc., may be seen at the office of the town clerk, Canora, or at the office of J. H. Bossons, architect, Dauphin, Man.

Ottawa, Ont.—Tenders will be received until January 16th, 1912, for the construction of a breakwater at Rimouski, Que. Plans, etc., may be seen at the offices of the District Engineers at Quebec, Montreal, and on application to the postmaster at Rimouski, Que. R. C. Desrochers, Secretary Dept. of Public Works, Ottawa.

Ottawa, Ont.—Separate tenders addressed to the Minister of Marine and Fisheries, will be received until noon of February 26th, 1912, for the following:—1. The construction of one or two steel single screw bucket dredges, to be delivered at Sorel. 2. The construction of a steel single screw hopper barge, to be delivered at Sorel. 3. The construction of one set of compound steam engines to develop 450 indicated horsepower for dredge No. 37, to be delivered at Sorel. 4. The furnishing of fifty steel rock digging buckets, cast steel links and manganese bucket pins, to be delivered at Sorel. Full information and specifications can be obtained on application to the Purchasing and Contracting Agent, Department of Marine and Fisheries, Ottawa. Alexander Johnston, Deputy Minister of Marine and Fisheries, Ottawa.

Ottawa, Ont.—The time for receiving tenders for the construction of a jetty at the mouth of the Fraser River at Steveston, B.C., has been extended to Friday, January 19, 1912. R. C. Desrochers, Secretary Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received until January 24th, 1912, for an Armory at Fernie, B.C. Plans, specifications, and form of contract can be seen and forms of tender obtained on application to the Caretaker of Dominion Public Buildings, Fernie, B.C.; at the office of Mr. Wm. Henderson, resident architect, Victoria, B.C., and at the office of R. C. Desrochers, Secretary Department of Public Works, Ottawa.

Toronto, Ont.—Tenders will be received until January 16th, 1912, by the Board of Control, for the construction of sewers on Hocken Avenue and Ellsworth Avenue, from Vaughan Road to Bracondale Avenue. G. R. Geary, Mayor, Chairman Board of Control, City Hall, Toronto.

Toronto, Ont.—Tenders will be received by the Board of Control until January 16th, 1912, for the supply of lead for 1912. Specifications at the office of the City Engineer. G. R. Geary, Chairman Board of Control, City Hall, Toronto.

Victoria, B.C.—Tenders for the erection of a six-story reinforced concrete building, for Messrs. C. Hayward and F. Barnard, will be received until January 15th, 1912. Bresemann & Durfee, Architects, Sayward Bldg., Victoria.

CONTRACTS AWARDED.

Fort William, Ont.—Tenders for the structural steel work for the four main buildings of the contemplated tube mills have been called for, and will be opened January 15th. All the other work in connection with the structures will be let to local contractors.

Lethbridge, Alta.—The bids for the sewage disposal works are given as follows:—

Tender No.	Firm	Price
2.	J. A. Broley, Fernie, B.C.	$65,439.78
" 3.	Smith Bros. & Wilson, city	63,720.00
" 4.	Hotson, Leader & Goode, Lethbridge, Alta.	63,522.24
" 5.	W. Manders, Edmonton, Alta.	79,527.29
" 7.	Allison & Co., Toronto	65,987.48

The successful tender for the sewage disposal plant was that of Messrs. Hotson, Leader & Goode, of Lethbridge, at a price of $63,522.24. The consulting engineer for this work is Mr. T. Aird Murray, of Toronto. City engineer, Mr. A. C. D. Blanchard.

Lethbridge, Alta.—Following is the analysis of bids for street paving:—

Tender No.	Prices $	$	$	Remarks
1. Dom. Pavers, Ltd.	3.97	3.99	3.94	4-in. wood block
Dom. Pavers, Ltd.	3.74	3.76	3.71	3½-in. wood block
Dom. Pavers, Ltd.	3.49	3.51	3.46	3-in. wood block
2. "National"	3.20	3.26	3.25	sheet asphalt
3. "Crown"	2.69	....	....	sheet asphalt
4. "Eloso"	2.65	2.69	2.59	sheet asphalt
"Eloso"	2.50	2.54	2.43	asphaltic concrete
5. "Kettle River"	4.45	4.47	4.43	3½-in. wood block
6. "Warner Quinlan"	3.05	....	....	sheet asphalt
7. "Bitulithic"	2.90	2.93	2.97	bitulithic
8. Gorman, Clancy & Grindley	....	....	2.40	Dolarway

The street paving is divided into two contracts, 17,000 square yards going to the "Bitulithic & Contracting Company," Winnipeg, at $2.93 per square yard; and 11,000 sq. yds. going to the "Eloso Company," Vancouver, at $2.43 per sq. yd. City engineer, Mr. A. C. D. Blanchard.

London, Ont.—Hon. F. D. Monk, Minister of Public Works for Canada, has awarded the contract for the new breakwater at Port Stanley to Mr. M. J. Hogan, of Port Colborne. The cost is estimated at about $275,000.

Ottawa, Ont.—The contract for the construction of the smallpox hospital on Porter's Island, has been awarded to Mr. George A. Crain.

Ottawa, Ont.—Messrs. Jones & Girourard are the successful tenderers for a bridge for the city of Ottawa, their price being $99,500.

Ottawa, Ont.—The Norton-Griffiths Company have received the contract for the work of the St. John Harbor Improvements, Courtenay Bay, this company having contracted to do the work for $7,700,000.

St. John, N.B.—Messrs. M. Connolly & E. P. Charleson have the contract for the construction of wharves at Sand Point, West St. John, at a cost of $800,000.

Sydney, N.S.—The Saunderson Manufacuring Company have secured the contract for the supplying of the necessary roofing velvet for the Dominion Iron & Steel Company's new nail mill, which is now being constructed.

Victoria, B.C.—The tender of Mr. Thomas Stedham for the erection of a reinforced concrete lighthouse, forty feet in height, together with dwelling, boathouse and oil-shed at Sherringham Point, near Sooke, has been accepted by the Marine and Fisheries Department.

Vancouver, B.C.—In connection with the Seymour Creek Extensions the following contracts have been awarded: Steel pipe, Messrs. Balfour, Guthrie & Co., for $75,900. valves, Messrs. A. J. Forsyth & Co., for $8,687; both are Vancouver firms. The contract for trenching has not yet been awarded.

Vancouver, B.C.—The Union Steamship Company have closed the contract for the extension to its dock, the successful tenderers being Messrs. O'Brien, McCaughey & Lamcke. The contract for the shore end of the improvements has been let to Messrs, Ironsides, Rannie & Campbell, and the contract for the new office building which will be erected there has been awarded to Mr. J. McNee.

RAILWAYS—STEAM AND ELECTRIC.

Eastern Canada.—A movement is under way to have the Dominion Government place the York and Carleton Railway under the management of the I.C.R.

Montreal.—A batch of charter amendments were put through the city council recently. They will form part of the Montreal bill to be submitted to the legislature at the present session. Among the powers the city is asking is the right to establish and operate or lease one or more underground tramway lines, to be operated by electricity or other motive power, and the right to regulate the operation of auto-bus lines.

Montreal, P.Q.—The Montreal & Northern Colonization Railway Company has applied to the Legislature for power to tunnel Mount Royal. The company is also seeking extension of the time limit for buliding its line from Montreal to the National Transcontinental.

Montreal, P.Q.—The municipal council are preparing a bill to be submitted to the legislature at the present session, asking the right to establish and operate or lease one or more underground tramway lines, to be operated by electricity or other motive power, and the right to regulate the operation of auto bus lines.

Montreal, P.Q.—The plans of the Canadian Northern Railway for improved passenger and freight facilities on the island of Montreal, were officially laid before the Board of Control on January 9th. These plans provide for a tunnel through Mount Royal, an elevated railway and a freight line.

Northern Ontario.—It is reported that further exploration of the James Bay slope of Ontario, as well as the Moose River estaury and the James Bay shore, will be undertaken next spring under the direction of the Temiskaming & Northern Ontario Commission.

Port Arthur, Ont.—The Canadian Northern Railway propose erecting a new steel dock. This dock will be about 800 feet long, and will be arranged so that several boats can unload at the same ime.

Ottawa, Ont.—A law suit involving rather a unique technicality is being heard in the courts. The Peerless Brick Company and the Canadian Northern Railway are the principals. The Canadian Northern Railway desire to expropriate the pits of the brick company, basing their compensation on the point that the property is mud. The brick company contends that the area is a "mine" of clay. It quotes the Railway Act, which states that a railway has not the power to expropriate lands which might obstruct the workings of a mine. The compensation asked for is $40,000, which the railway considers too large. The action has been adjourned until April 10, 1912.

Ottawa, Ont.—The management of the Ottawa, Montreal and Eastern Railway Company will apply at this session of parliament for extension of time to complete the work now under construction.

Toronto, Ont.—An application will be made by the Toronto Suburban Railway Company to the Legislature of the Province of Ontario at its next session for an Act authorizing the company: To extend its line from some point at or near Guelph, in the County of Wellington, to some point at or near Berlin, Preston, Hespeler, and Galt, in the County of Waterloo, and thence to a point at or near Hamilton, in the County of Wentworth, passing through or near the Townships of Guelph, Waterloo, Dumfries, Puslinch, Beverley, Flamboro West and Ancaster.

Toronto, Ont.—The civic percentage of the Toronto Railway Company's earnings for 1911 amounted to $687,650.44. In addition there was also $83,000 in mileage rates, and taxes of $50,000, or a total of over $820,000. The percentages show an increase of $91,353.09.

Toronto, Ont.—A proposal is under way for the construction of a railway to serve a portion of the fast growing suburban district around Toronto. The purpose of the three-mile railway, which will have Lambton and Sunnyside as its terminals, is to provide an efficient service for the property owned by the Toronto Land Corporation, the concern backed largely by English capital, which has promoted the Humber boulevard scheme. The route at present is purely tentative. As planned it runs down the west bank of the Humber from Lambton to Bloor Street, where it crosses and follows Jane Street to the Lake Shore Road. It might follow the Lake Shore Road, or might cut across the old Belt Line Railway about the brickyards, and cut Windermere Avenue and Ellis Avenue, crossing the Grenadier Pond on piles.

Toronto, Ont.—The plans of the new Union Station will be up for discussion and examination when the Dominion Railway Board sits in Toronto on February 8th. These plans will be completed and filed with the City Solicitor by February 1st, the idea being that a week at least should intervene to allow examination of them before the board's meeting. In this connection it will probably be necessary to bring up the whole question of the viaduct and the York Street bridge once more. The whole general question of the entrance of the Canadian Northern Ontario Railway to Toronto at the north end of the city, will also be up for discussion.

Western Canada.—A number of towns and cities in Western Canada are preparing to petition the government in an endeavor to secure the terminus of the Hudson Bay Railway.

Winnipeg, Man.—The appropriations which are now being prepared in Winnipeg for the work of the Canadian Pacific for 1912, will contain an item for the installation of over 1,000 miles of telephone circuits. It will not be long till the telephone system will be used throughout the main line and all branches as well for train despatching.

The authorized mileage of the Grand Trunk Pacific main line and branches is 11,500 miles, of which 1,745 miles are between Winnipeg and Prince Rupert. 1,800 miles are under contract by Transcontintnetal Railway Commission between Winnipeg and Moncton. The company claim that at the completion of railway the trip around the world will be shortened by about a week.

LIGHT, HEAT AND POWER.

Brantford, Ont.—Engineer Sothman, of the Hydro-Electric Commission, addressed the Brantford council, pointing out that Blue Lake and St. George, just west of Brantford, were desiring hydro-electric power, and if Brantford came in matters would be greatly facilitated. If not, these places would have to be supplied either from Dundas or Galt. It is considered likely that the by-law will be submitted to Brantford ratepayers at an early date.

Calgary, Alta.—An estimated total of $200,000 for electric light extensions for 1912 and $168,000 for extensions to the city power plant during the coming year have been ap-

proved by the council. The particulars of the estimates in each case are as follows:—

400 additional street lamps, wire and labor	$40,000
Transformers for light and power	20,000
Meters	18,000
Cross arms	2,000
Poles	10,000
Hardware	5,000
Labor on overhead construction	40,000
New sub-station on Ninth Ave. West, and equipment	20,000
Underground lead covered cable (feeders) and labor	30,000
Sundry accounts	15,000
Total	$200,000

1 Exciter for 1,000 K.W. ry. motor generator	$ 1,000
4 Water tube boilers 350 H.P. each	32,000
Bricking in boilers	2,000
4 Mechanical chain grate stokers	8,000
1 2,500 K.W. steam turbo generator, complete	65,000
1 1,000 K.W. ry. motor generator, complete	25,000
1 Exciter set for 300 K.W. motor generator	800
1 Feed water heater, closed type	2,000
2 Feed pumps	4,000
Boiler and feed piping	2,500
Auxiliary piping	2,000
Foundations for turbine motor generator, feed pumps, feed water heater, etc.	2,500
1 5,000,000 gallon motor-driven pump	5,000
Extension to power house sewer	2,000
Sundry extensions	15,000
Total	$168,000

Montreal, P.Q.—Owing to the severe cold weather, considerable trouble was experienced by the Montreal Light, Heat & Power Company in their gas mains. The trouble existed in all parts of the city at once. The absence of the usual snow blanket gave the sudden severe frost easy access to the ground, and it penetrated to the level of the gas mains.

Ottawa, Ont.—One of the first measures to be brought before the new city council will be a resolution urging the Hydro-Electric Commission to expropriate for the City of Ottawa the water power on the Ontario side of the Chats Falls, owned by Hon. William Harty, of Kingston. The engineers sent down by the Hydro-Electric to investigate the Ottawa power situation have reported that the Chats Falls is by all odds the one best suited for the City of Ottawa.

Quebec, P.Q.—The contract by which the Dorchester Electric Company agrees to proivde the city's lighting for ten years is based on rate of seven cents per kilowatt hour, as against the present rate of 12 cents (or 15 cents if not paid within a certain time) charged by the Q.R.L and P. Company.

Regina, Sask.—The long delayed generator has at last been shipped by the constructors in England. It will likely be at least another month before the generator is installed by the local power house officials, and in the meantime the units at present doing service will have to continue carrying an overload. The generator was to have arrived in the city some months ago, but shipment was delayed. A shipment was made during November, and the power house officials were assured at that time that everything would be on hand during December. The shipment arrived, but consisted of the turbine only, the electrical equipment having been left out. The electrical equipment was shipped from Liverpool on December 22, according to communication. It is not expected that the shipment will reach Regina for several weeks, and another week willl likely be occupied in setting up the unit.

Saskatoon, Sask.—Some difficulty is being experienced in placing the machinery in the new power house as a result of defects of the travelling crane, and an employee of the manufacturers is investigating. It appears that the track on which the crane travels is all right, and the traveller itself could not be better, but the lifting power of the blocks is said to be less than the guarantee. The warranty from the manufacturer was to the effect that the crane would lift and carry a weight of fifteen or sixteen tons, but the crane has failed on lifting a weight to the extent of only six tons. It is thought that the blocks are not of the correct capacity, and, in view of this, an imperative wire was dispatched to the firm to send an expert forthwith to adjust it. This was necessary, as some of the parts of units to be installed weigh nearer twenty tons than sixteen, and the assistance of the crane is badly needed, its defection being severely felt in hampering the installation of machinery. Under the circumstances, it is doubtful if any accurate prediction can be made as to when the new plant will start in full operation, and in the meantime the overloaded old plant is being worked to its utmost capactiy. Preparations are being made for converting this plant into a pumping station directly the new system of power production is supplying the electrical energy which the city so badly requires.

Saskatoon, Sask.—The same generator which caused so much trouble at the city power plant a few weeks ago was again the cause of considerable inconveninece to the city. The trouble was due to the heavy load burning out three or four coils and these had to be replaced before the generator could be put in commission again. The burning out of the coils did not put the entire plant out of commission. One generator was still in working order aud thus sufficed to supply a feeble current to the city.

Toronto, Ont.—The Ontario and Minnesota Power Company, of Vernon, has applied for an injunction against the Rat Portage, the Rainy River and the Shevlin-Clarke Lumber Companies, the Northern Construction Company, and Lockhart & Company, to restrain the defendants from damming up the waters at the head of Rainy River. The power company has a large plant at Fort Frances. It claims that the defendants dams are constructed all the way up the river, some being 200 miles away, and that the flow of water is seriously weakened.

Among the questions taken up before the International Deep Waterways Commission which met in Washington, January 10th, was the proposition to render deep water navigation possible from the mouth of the Richelieu River at Sorel, up that river, through Lake Champlain and Lake George to Albany and thence to New York, and the Long Sault dam project.

SEWAGE AND WATER.

Berlin, Ont.—H. J. Bowman, of Berlin, has been engaged to prepare plans and specifications for the proposed extension to the waterworks.

Montreal, P.Q.—The Aldermanic caucus have decided to approve in council the recommendation of the Board of Control that the tax for water used for baths in dwelling houses should be abolished.

Port Arthur, Ont.—The city engineer has recently reported to the council upon a new and extensive water supply project for the city. The proposal includes the provision of new duplicate intake pipes at a location about two miles east of the present intake pipe, which was recently badly damaged by alleged dredging operations. Also the extension of a considerable length of force main and new pump station. The estimated cost is about $200,000. We understand that the whole project has been submitted to Mr. T. Aird Murray, of Toronto, as consulting engineer, and that that the new city council will do nothing in the matter until the report is received.

Toronto, Ont.—Mr. Isham Randolph, of Chicago, one of the members of the Board of Water Experts, sent to the Board of Control his account for services and expenses from March 20th to December 29th. The amount is $4,678, and includes railway and hotel expenses and his fee of $100 per day. He had been paid $1,500 on account, leaving a balance due of $3,178. The Mayor said the experts now only had to report on the cost of the larger scheme for a new intake and reservoir at Scarboro. Controller Hocken agreed with the Mayor that the sewage effluent would have to be chlorinated. Then, he thought, it would be safe to have another intake at Scarboro Heights, and he favored that plan. Ultimately there should be a third intake in the west. Three smaller units would be better than concentrating on one.

Vancouver, B.C.—The $100,000 Little Mountain Reservoir in South Vancouver, which was built under the direction of Consulting Engineer Burwell for the City of Vancouver, has been completed, and now contains several feet of water. The following are the dimensions of the reservoir and its capacity: Top length of reservoir, 612 feet; bottom length of reservoir, 514 feet; top width of reservoir, 377 feet; bottom width of reservoir, 280 feet; depth from top to bottom, 25 feet; slopes of inside, two horizontal to one vertical; top width of bank, 45 feet; width of base of bank, 145 feet;

total excavation, 80,000 cubic yards; rock excavation, 18,000 cubic yards; plain concrete lining, 15,030 square yards; reinforced concrete lining, 9,835 cubic yards; cost of excavation, $52,000; cost of concrete lining, $43,000; capacity when filled to the top, 29,000,000 imperial gallons; with a depth of 22 feet; 25,000,000 imperial gallons; elevation of top above sea level, 400 feet; total cost, $95,000, being $3.80 per 1,000 imperial gallons. The one 24-inch pipe into the reservoir acts both as inlet and outlet and is provided with a balanced valve inside of the reservoir, consisting of a vertical 24-inch pipe suspended within a steel tower, by which arrangement the outflow from the reservoir can be shut off when desired, and any additional connections or repairs made to the supply pipe without emptying the reservoir.

BUILDING.

Brandon, Man.—A new factory is to be erected by the Brandon Construction Company at the corner of Princess and 16th Street. The new factory is for manufacturing sash, doors, and other fittings for construction.

Montreal, P.Q.—Preparations for building a large concrete factory in the Park Avenue extension section are under way. It is understood that the factory will employ 400 persons. The property is situated on Beaumont Street, at the foot of King Edward Boulevard, and comprises an area of about 200,000 square feet.

Port Colborne, Ont.—About $50,000 was spent in Port Colborne during the year 1911 on building operations outside of the new Maple Leaf Mill. The buildings include a new bank building of terra cotta brick and a new theatre. The prospects for 1912 are the best in the town's history. The cement company is spending about half a million dollars, doubling its capacity. The cork works expects to double its capacity. The Union Smelting Works of Buffalo will erect a $200,000 plant, and it is expected the C.P.R. will run a branch line into the town.

CURRENT NEWS.

Carleton Place, Ont.—The by-law to borrow $150,000 to install a system of waterworks and sewerage in Carleton Place was carried by a majority of 216.

Castor, Alta.—A water tank near this point collapsed and crushed out the life of one young man.

Desbarats, Ont.—Owing to lack of a bridge, communication has been cut off between St. Joseph Island and the mainland. A large number of people are at Desbarats awaiting to get across, while many on the island from Sault Ste. Marie and other points are unable to return. Applications have already been made to both the Provincial and Dominion Governments for relief, by having the proposed bridge built.

Esquimalt, B.C.—According to a report of the American Consul at Victoria, B.C., the British Columbian Marine Railway have completed financial arrangements for the construction of a large graving dock at Esquimalt, which is to be 1,000 ft. long and will be constructed on similar lines to the one at Southampton. It is proposed to build the dock of reinforced concrete with granite facings and to employ electric plant for pumping purposes, etc. Work is to be started at once in order that the dock may be completed before 1915, or in time for the opening of the Panama Canal.

Fort William, Ont.—It is reported that the Good Roads by-law carried in all the townships in this vicinity except Oliver, and it is expected that the by-law will be legalized there.

Hamilton, Ont.—The Hamilton Bridge Works Company has been granted a building permit for the erection of five concrete, steel and corrugated iron buildings in East Hamilton for the Steel Company of Canada. The cost is given as $100,000, and the different buildings are: Rod mill, 83 by 550; bloom and billet mill, 65 by 400; open crane runway building, 50 by 400; boiler house and gas producing building.

Hamilton, Ont.—It is stated that $2,500,000 is the amount involved in the deal by which a large American gas and coke concern will shortly take over the Hamilton Gas, Light Company, and the Ontario Pipe Line Company, giving it control of the natural and artificial gas situation here. The Manufacturers' Gas Company will likely be taken in later, too. The new company will erect a mammoth new plant here and carry on an immense coke business.

London, Ont.—The comparative building statistics for 1910 and 1911 for London, Ont., are as follows:—

	No.	Value
1911 December	38	$ 187,553
1910 "	17	03,085
1911	1039	1,036,880
1910	882	805,074

Montreal, P.Q.—Estimates prepared from authentic information on building figures for 1911 show a total of $25,820,144 for Greater Montreal. While these figures are nearly two million dollars lower than those for last year, they are regarded as extremely satisfactory, since last year's figures were swollen by the taking out of permits by the C.P.R. for work amounting to several millions of dollars, while the present year has not been marked by any such immense expenditure.

Ottawa, Ont.—It was announced on January 9th that the good roads programme which the Federal Government proposes to inaugurate, will be attended to by Hon. Frank Cochrane, Minister of Railways. Mr. F. W. Campbell, the present Deputy Minister, will probably be the head of the new department.

Ottawa, Ont.—The main estimates of the Federal Government will contain an appropriation of approximately one million dollars for the further improvement of the St. Lawrence route. Much additional dredging will be done, particularly in the vicinity of Cap a la Roche.

Owen Sound, Ont.—The municipality are considering an offer recently made by the Standard Chemical, Iron and Lumber Company, regarding the installation of a blast furnace. The president, Major Peuchen, in an address to the ratepayers remarked that the company had decided to establish a smelter on the Georgian Bay, and they had almost closed the deal with Midland, which had offered a dock, a site, loan and bonus. If the ratepayers should decide to carry the project, the terms laid down by the company are: The town to furnish a dock to cost at least $30,000, and the speaker stated that if it cost over $35,000 the company would pay the extra cost. A bonus of $25,000 and a loan of $25,000 is also to be given the company, but the bonus is not to be handed over until the plant is erected and running. On the $25,000 loan the company will pay back $1,250 per year, and they will lease the dock at $100 per year. The dock will be 600 feet long. The town is also to furnish the company with a free site. The town council at an early meeting will take up the by-law for the raising of the necessary money, and if it receives its first and second readings, it will be submitted to the ratepayers to be voted on.

Province of New Brunswick.—The year 1911 in this eastern province was the dryest in seventeen years. The total precipitation of rain and melted snow was 26.25 inches, while the average for the past seventeen years was 34.68 inches.

Quebec, P.Q.—The municipal council is in receipt of a cheque for $300,000. This amount is a refund of a subscription raised to assist in the construction of the ill-fated Quebec Bridge. This refund was provided for in the Act of Parliament, passed at the instance of the Laurier Government, providing for the dissolution of the old Quebec Bridge Company and the assumption of its obligations by the Government of Canada, after the collapse of the first bridge.

Regina, Sask.—Provision has been made in the civic estimates of expenditures for the installation of a gas plant during the year, at a cost of $200,000. At the time the Street Railway service was inaugurated it was announced that the next civic undertaking would be a municipal gas plant, and provision is made for a start on the work during the early part of 1912. Although the plant is to cost $200,000, only $20,000 is provided for the start on construction, investigations as to the best plant, probable revenue, advisability and necessity for plant.

Toronto, Ont.—In the past five years the total increase of assessable property in this city amounts to $159,571,000, and at the present time the total taxable amount of assessable property is $806,751,673. These figures show an increase of $32,239,000 over last year.

Vancouver, B.C.—Mr. A. D. Swan, who has been employed by the Dominion Government to plan Greater Vancouver's harbor improvements, and Mr. R. S. Lea, who is laying out a scheme of sewerage for Greater Vancouver, arrived from Eastern Canada, and at once began the prelimin-

ary work of getting in touch with local conditions. It is understood that Mr. Lea is now prepared to place the whole sewerage scheme before the joint committee, defining the position of the mains that will have to be constructed at once and also outlining the work necessary during the next ten or fifteen years.

Welland, Ont.—The building figures for Welland, Ont., for 1911 is as follows: Public and business, $213,878; residences, $128,930. If the factories and residences erected in the suburb (Welland South) were added, the total would exceed $1,000,000. During last year an unsuccessful effort was made to extend Welland boundary to take in Welland South.

York County, Ont.—Mr. E. A. James, engineer for the York County good roads, has located an important stone showing about twenty miles from Toronto. This rock can be placed f.o.b. any siding in York county at less than $1.90 a ton, and since this is an exceedingly hard and tough rock and can be delivered at a price almost equal to that of granite, the engineer predicts that it will be the rock largely used in macadam highway construction in this section of Ontario from this time forward.

The Asphalt & Supply Co., Ltd., 213 St. Nicholas Bldg., Montreal, Que., would like to get in touch with some of the larger construction companies on the Pacific coast and middle west, who make a specialty of street and sidewalk paving work. Any firms who are interested are invited to correspond with the company at the above address.

LIST OF PRIVATE BILLS OF ONTARIO LEGISLATURE.

An application has just been received from the Kawartha Transportation Co., who want to build an electric car line in Peterboro, and from there to several of the summer resorts on the Kawartha Lakes.

The Bruce Mines and Algoma Railway Co. want to extend their line from Rydall Bank Station to Algoma, north and east to Hanna and other points on James Bay. The railway company also wants to increase its bonding power to $30,000 a mile.

The town of Brampton wants to introduce a by-law to permit the issuing of bonds amounting to $23,000, to assist the Peace Foundry Co. in obtaining a site for a new plant there.

The town of Haileybury wants power to issue $26,000 worth of debentures for various municipal improvements, including a firehall, municipal building and waterworks extensions.

The town of Milton wants an agreement to guarantee the issuing of bonds to the Williams Shoe Co., who are planning to locate a shoe factory in that town.

The town of Renfrew is making application to validate two by-laws, one for $60,000 for an electric power plant and steam auxiliary. The municipality also wants to install its own lighting plant.

The Dunnville, Wellandport and Beamsville Electric Railway have made application to have a four years' extension made to the time in which the railway is to be completed.

NOVA SCOTIA MINERALS.

The mineral production of Nova Scotia for the year 1911 shows a large increase over the production of the year 1910, and is the largest in the history of the mining industry of the province. The different branches of the industry, with but three exceptions, show large increased outputs, whereas the decreases shown are very small. With the exception of iron ore, pig iron, steel, prices have been the same as during the preceding year.

A total of 6,400,000 tons of coal were mined, this being an increase of 700,000 tons over the production of 1910. The Dominion Coal Company took over and reopened the mines of the Cumberland Railway and Coal Company at Springhill, and have during the year opened three new mines in Cape Breton County. This company have at the close of the year fifteen producing mines and five mines in stage of development on the Island of Cape Breton. At Stellarton the Acadia Coal Company have been engaged in extensive alterations and additions to their equipment, electrifying their plant. At North Sydney the MacKay Mining Company have completed and are now operating a Coal Briquette Plant.

The production of coke for the year was 500,000 tons, an increase of 55,000 tons over the 1910 production. The prinicpal producers and users of coke in the province are the Dominion Iron and Steel Company, and the Nova Scotia Steel and Coal Company.

A total of 840,000 tons of iron ore were imported into the province: 140,000 tons more than the amount imported during 1910, and 40,000 tons of ore were mined in the province, this being 10,000 tons less than the amount mined during 1910.

400,000 tons of pig-iron and 445,000 tons of steel ingots were made, being increases of 50,000 tons and 33,000 tons respectively. The iron-ore, pig-iron and steel markets throughout the world have been dull, and prices consequently low.

At Torbrook the Canada Iron Corporation have completed an ore concentrating plant. This company, in August, on account of the unsatisfactory condition of the iron market ceased to operate their mines. Operations are to be resumed just so soon as the market conditions improve.

At Scheelite, Moose River, the Scheelite Mines, Ltd., continued the development commenced last year in connection with their Tungsten areas. Additional shafts have been put down and long levels driven, good ore has been encountered, a modern concentrating mill and power house have been constructed, the equipments placed and the plant is now in operation. Ore shipments will be made early in the New Year.

At New Ross, the Nova Scotia Manganese Company have lately completed a concentrating mill and power house, and have part of their machinery in place; recent development work at their mine has opened up large bodies of high grade pyrolusite. This company is now prepared to make shipments of ore.

At Lake Ainslie, Cape Breton, the Byrites, Limited, have recently completed a modern mill, and expect to commence shipment of their products early in 1912. The milling of byrites at the mine is a new departure for the province; in the past all ore being shipped from the mines in a crude state.

The following table shows the approximate values of the mineral production of the province for the year:—

Value of Nova Scotia Mineral Products—Year 1911.	
Coal	$19,200,000
Steel	8,900,000
Pig Iron	4,800,000
*Iron Ore	2,475,000
Coke	2,200,000
Quarry products	880,000
Gold	142,000
Clays	190,000
Miss. Scheelite, Manganese, etc.	100,000
Total	$38,887,500

* 120,000 Nova Scotia ore balance imported.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners. to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

15639—December 19—Relieving C.N.R. from further protection at crossing east of switch at Dauphin, Manitoba.

15640-51—December 20—Authorizing C.N.R. to construct across public road on its Maryfield Extension, Saskatchewan, and two highways on same extension in Saskatchewan.

15642—December 20—Authorizing C.N.R. to cross with its Rossburn Line highway and to divert same in Saskatchewan.

15643-44-45—December 20—Approving revised location of C.N.O. Ry. (Montreal-Port Arthur Line), through Twp. of Ross, Ontario, (Renfrew County); and through unsurveyed territory in Dist. of Algoma, mileage 148 to 166 from Sudbury Junction; and revised location through Township of Loughborough, Ct. Frontenac, Ont.

15646-47-48-49—December 20—Authorizing C.P.R. to construct spur for Carbon Oil Company, Ltd., in municipality of Rosser, Manitoba; for city of Moose Jaw, Sask.; for Continental Oil Co., Ltd., Lethbridge, Alberta; for Eley Bros., near Woods, Manitoba.

15650—December 21—Amending Order 15594, of December 12th, 1911, by striking out words "Canadian Pacific Railway Company."

15651-52—December 20—Authorizing T.H. & B. Rv. to operate two spurs in city of Hamilton, into land of Laidlaw Bale Tie Co., Ltd., and also spur into lands of Canadian Drawn Steel Company, Ltd., Hamilton, Ontario.

15653—December 20—Approving plans of G.T.R. for new station at Exeter, Ontario.

15654—December 16—Directing that upon conveyance by the Petrolea Waggon Co., Ltd., of land necessary for interchange track to be constructed by G.T.R. or M.C.R. Cost of work to be divided equally between companies. Application, town of Petrolea, Ont., and manufacturing interests.

15655—December 20—Authorizing city of Fort William to open up Victoria Avenue across C.N.R. at Vickers Street, an additidonal width of 14 feet.

15656—December 20—Directing C.P.R. on or before April, 1912, to submit plans for station at Dysart, Saskatchewan.

15657—December 13—Authorizing B. C. Electric Railway to cross C.P.R. at foot of Twelfth Street, city of New Westminster, B.C.

15658—December 21—Approving location of C.N.R. station to be erected at Veregin, Saskatchewan.

15659—December 19—Directing that effective dates of new freight tariffs required to be filed under Order 12520 of December 10th, 1910, be changed to April 1st, 1912. Tariffs to be filed by C.P.R. and C.N.R. Regina Rates Case.

15660—December 20—Authorizing C.P.R. to construct a spur for T. Kinnear & Co., in city of Peterborough, Ontario.

15661—December 22—Directing that T.H. & B. Ry. maintain light on electric bell at Mohawk Road crossing, mileage 62, from Welland, in city of Brantford, and as soon as same is installed railway company be released from speed limitation at said crossing.

15662—December 21—Relieving C.P.R. from further protection at crossing between Makarooff & Togo, between mile posts 253 and 254, from Winnipeg, Kamsack S.D., 3rd District.

15663-64—December 21—15665—December 22—15666—December 21—Approving location of C.N.O. Ry. station grounds at Lombardy, in Twp, of South Elmsley, at Perth Road, in Township of Loughborough, at Elgin, in Township of South Crosby, at Bedford, in Township of Bedford, Ont.

15667—December—Authorizing G.T.R. to construct spur to premises of St. Mary's Portland Cement Co., Ltd., and Horse Shoe Quarry, in Township of Blanchard, Oxford County, Ontario.

15668—December 21—Extending until January 31, 1912, time for completion of work to be done under Order 14164, dated June 24th, 1911.

15669—December 16—Authorizing G.T.R. to construct bridges at Mill, Peter, Barrett, and Ontario Sts., Port Hope, Ont.

15670—December 16—Re G.T.R. taking lands in Twp. of Etobicoke, Ont., of W. H. Miles, referring taxation of costs under sub-clause (e) of Clause 1 of Order 13418, to J. H. Thom, Taxing Officer of Supreme Court of Judicature for Ontario. Amount taxed and allowed by him to be paid by G.T.R. to applicant.

15671—December 22—Authorizing G.T.R. to construct track on east side of Metcalf St., town of Simcoe, Ontario.

15672—December 22—Amending Order 14606 of August 21st, 1911, paragraph 4, re interswitching at Brandon, Man., $2.00 per car to be revenue of Brandon, Sask. & H.B. Ry. on empties transferred between C.P.R. and C.N.R. at Brandon.

15673—December 22—Approving location of C.N.O. Ry. at Cushing, Que.

15674—December 23—Approving location of South Ontario Pacific Ry. (C.P.R.), proposed station at Waterdown, Ontario.

15675—December 23—Relieving G.T.R. from further protection of 1st crossing west of Port Robinson, Ont.

15676—December 22—Authorizing C.N.O. Ry. to cross and divert public road between Cons. 1 and 2, Twp. of South Elmsley, Ct. Leeds, Ont.

15677—December 23—Approving location of C.N.O. Ry. through Twps. of Chisholm and Ferris, Dist. of Nipissing, Ont., mileage 325.23 to 343.55 from Montreal.

15678—December 16—Varying Order No. 15151, of October 12th, 1911, that gates be put outside of tracks of C.P.R., and new plan to be filed for approval, Royce Ave. Gates, Toronto, Ont.

15679—December 23—Authorizing C.P.R. to cross with its Moose Jaw Northwesterly Branch across highway at mileage 202.77.

15680—December 26—Authorizing C.P.R. to open for carriage of traffic (freight) its railway from Coldwater, mileage 12.2, to Bethany, mileage 88.2.

15681—December 26—Authorizing C.P.R. to reconstruct bridge No. 127.2 on Mountain Subdivision.

15682—December 26—Authorizing C.P.R. to open for carriage of traffic its second track, Moose Jaw S.D., mileage 127.68 to 134.43 from Moose Jaw to Pasqua.

15683—December 23—Recommending to the Governor-in-Council for approval, Rules of G.T.R. Transportation Department.

15684—December 26—Extending until June 30th, 1912, time for completion of spurs into premises of Durham Rubber Co., Bowmanville, Ont., by Toronto Eastern Railway (C.P.R.).

15685—December 23—Directing Central Vermont Railway to ballast its entire line between St. Lambert & Waterloo, Marieville & St. Cesaire, Farnham and Frielsburg and Iberville and Farnham, and repair all bridges, farm crossings, highway crossings ,and fencings, ballast to be 6-inch lift. Work to be completed by October 1st, 1912 and that within 30 days from date of this Order, frogs and guard rails be filled, under penalty of $25 a day.

15686-87—December 27—Authorizing C.P.R. to reconstruct bridge No. 127.2 on Mountain S.D., B.C. Division, and bridge 94.8 on Moose Jaw S.D., over Wascana Creek.

15688—December 27—Authroizing C.P.R. to construct spur for Park Fuel and Lumber Co., at Calgary, Alberta.

15689-90—December 27—15691—December 23—Approving location of C.N.O. Ry. through unsurveyed territory in Dist. of Algoam, mileage 287 to 307, from Sudbury Junction, and from mileage 307 to 327, from Sudbury Junction, and approving revised location through Twps. of Alice, Fraser, and Richards, in County of Renfrew, Ont., mile 209 to 225.42 from Montreal.

15692—December 27—Directing that C.P.R. install improved type of electric bell at crossing of County Road, 1¼ miles east of Ivanhoe Station, Ontario; 20 per cent. from Railway Grade Crossing Fund.

15693—December 27—Authorizing C.N.R. to construct a spur line to Ritchie Coal Co.'s yards at Edmonton, Alta.

15694—December 27—Authorizing C.P.R. and G.T.P. B.L. Co., to operate their trains over crossing pending installation of interlocker required to be constructed by Order 13663, of May 16, 1911, Melville-Regina Branch, G.T.P. and C.P.R Bulyea Branch.

15695—December 28—Recommending to the Governor-in-Council lease for sanction between C.P.R. and Dominion Atlantic Ry.