SUMMARY REPORT

OF THE

MINES BRANCH

OF THE

DEPARTMENT OF MINES

FOR THE NINE MONTHS ENDING DECEMBER 31

1908

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EXCELLENT MAJESTY
1909

To His Excellency the Right Honourable Sir Albert Henry George, Earl Grey, Viscount Howick, Baron Grey of Howick, a Baronet, G.C.M.G., &c., &c., &c., Governor General of Canada.

MAY IT PLEASE YOUR EXCELLENCY:

The undersigned has the honour to lay before Your Excellency, in compliance with 6-7 Edward VII., Chapter 29, section 18, the Summary Report of the work done by the Mines Branch during the nine months ending December 31, 1908.

(Signed) W. TEMPLEMAN,

Minister of Mines.

Hon. WM. TEMPLEMAN,
Minister of Mines,
Ottawa.

SIR,—I have the honour to submit herewith, the Director's Summary Report of the work done by the Mines Branch during the nine months ending December 31, 1908.

I am, sir, your obedient servant,

(Signed) A. P. LOW,
Deputy Minister.

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SUMMARY REPORT

OF THE

MINES BRANCH OF THE DEPARTMENT OF MINES

FOR THE NINE MONTHS ENDING DECEMBER 31, 1908

A. P. Low, Esq., LL.D.,
Deputy Minister,
Department of Mines.

SIR,—I have the honour to submit, herewith, the Summary Report of the Mines Branch of the Department of Mines for the nine months ending December 31, 1908.

CHANGE FROM FISCAL TO CALENDAR YEAR.

My report for 1907-8, consisted of a statement of the general work of the Mines Branch for the fiscal year ending March 31, 1908; the main reason for the innovation being, the delay in getting all the facts relating to the assay office, Vancouver, B.C.; the business operations of which are necessarily regulated in accordance with the fiscal year. It has been deemed advisable, however, to issue all future reports at the end of the calendar year, so that the summary reports of both branches, viz., Mines Branch, and Geological Survey Branch, may be issued simultaneously, and under one cover as a combined report of the entire Department. This latter plan seems to me both logical and practical, and its adoption would doubtless evoke greater interest in the general work of the Department of Mines.

ORGANIZATION.

During the year the following appointments were made to the permanent staff of the Mines Branch:—

William W. Leach—Technical officer.
Benjamin F. Haanel—Technical officer.
Einar Lindeman—Technical officer.
Harold A. Leverin—Technical officer.
John McLeish—First-class clerk.
Miss Jessie Orme—Junior second-class clerk.
Miss Grace McGregor—Third-class clerk.

The work of editing, proof-reading, and publishing the increasing number of Mines Branch reports, etc., having, hitherto, been done by various members of the technical staff, a condition of things which was found to seriously interfere with regular field work in summer and the concentrated study of important technical subjects during the indoor months; it was decided to appoint a permanent editor. Mr. S. Groves commenced his duties as editor of the Mines Branch on March 23, 1908. Shortly after this date, however, the duties of the editor were enlarged. By Order in Council—May 14, 1908—Mr. Groves was appointed editor of the entire Department of Mines: his new duties being to edit all the publications of both the Mines Branch and the Geological Survey Branch. This establishment of a departmental editorial office, involving, as it did, considerable extra labour, necessitated additional help, hence on June 23, 1908—by Order in Council—Mr. J. J. Bell was appointed assistant editor.

MINING AND METALLURGICAL INDUSTRIES OF CANADA.

In 1907, the following special staff was appointed to gather material for a comprehensive, practical report on the mining and metallurgical industries of Canada:—

D. D. Cairnes—Yukon Territory.
R. R. Hedley—British Columbia, Alberta, Saskatchewan and Manitoba.
Fritz Cirkel and J. J. Bell—Ontario.
J. W. Bell—Quebec.
W. F. Jennison—Nova Scotia and New Brunswick.

When this enterprise was first planned, the magnitude of the work involved was not fully realized, consequently it was not until December, 1908, that copies of the report were available for distribution.

That this report with its 936 pages of text, 144 illustrations, and seven mineral maps of the respective provinces has met a long felt want, is manifest from the comparatively large number already issued and the daily increasing demand.

Although the volume is sold at a nominal price of $1—to cover cost of mailing, and to ensure it getting into the hands of genuinely interested parties—the circulation has evidently not been retarded thereby; for most of the requisitions made are accompanied either by cheque or money order. This timely work cannot fail to attract the attention of capitalists and prospective investors in Canada and abroad to the vast mineral resources of the Dominion.

In order to render the Report on the Mining and Metallurgical Industries of Canada of permanent value, it will be necessary to keep it up-to-date. This can be done by means of supplementary sheets until such time as the publication of a new and entirely revised edition of the whole report is warranted. To accomplish this, however, the office staff of the statistical section will necessarily have to be enlarged.

INVESTIGATION OF ELECTRIC HIGH-FURNACE, SWEDEN.

In consideration of the great importance which an economical process for the reduction of the Canadian iron ores, adjacent to water powers, but too distant from cheap metallurgical fuel, would be, I was instructed on November 23, 1908, to proceed to Sweden; for the purpose of investigating and reporting upon the operation of the new electric high-furnace recently erected at Domnarfvet.

The electro-metallurgy of the reduction of iron ores by the electro-thermic process having been established by the experiments made at Sault Ste. Marie, March 3, 1906,[1] the inventors of the Swedish furnace confined their efforts to the solution of the problem of constructing a commercial furnace along the lines suggested in the above report (p. 92). The furnace inspected is the result of over two years experimentation: during which period seven furnaces differing in design were erected and tried; each embodying all the good points and corrected faults of the previously tested furnaces.

When the inventors were convinced that they had at last succeeded in constructing a satisfactory commercial furnace, they tendered me an invitation to witness an experimental run, to take place early in December, 1908.

On receiving my instructions, therefore, I immediately made the necessary preparations, and sailed for Sweden via New York on November 25, 1908. Just as the steamer was about to start I received a cablegram from Sweden announcing the impossibility of running the furnace, on account of low water in the adjacent river. It was then too late, however, to cancel my passage, hence I decided to continue my journey, and obtain as much information as possible concerning the furnace.

Immediately on my arrival in Stockholm, where I met Mr. A. Grönwall—one of the inventors of the furnace—it was arranged that we should go to Falun for the purpose of impressing upon Mr. Ljungberg, the General Director of Stora Kopparbergs Bergslags Aktiebolag—at whose works the experimental furnace was erected—the importance to Sweden, as well as to other countries, of making, if possible, the contemplated special trials. As a result of this conference, he very kindly allowed the use of power to operate the furnace for twelve days. This concession, which entailed some inconvenience to the operations of the steel plant, shows the great importance attached to the solution of this problem by men competent to judge.

Although it was originally intended to make a continuous run of several weeks' duration, this comparatively short run was sufficiently long to demonstrate the commercial applicability of the furnace, and to point out some minor details in which improvements might be made.

DESCRIPTION OF THE ELECTRIC HIGH-FURNACE.

In general appearance, this electric furnace is unlike any hitherto constructed; being very similar in general design to an ordinary blast furnace. In fact, it might be described, without much exaggeration, as a blast furnace, in which the tuyères are replaced by electrodes.

The height of the furnace above ground level is about 25 feet. The melting chamber containing the electrodes is about 7 feet high, and is of greater diameter than any other part. The shaft is about 18 feet high; and immediately above the melting chamber—for a height of about 4 feet—has the form of an inverted truncated cone; but above this point assumes the usual form of the blast furnace. The lower portion of the shaft was given the form of an inverted truncated cone for the purpose of directing the charge into the melting chamber in such a manner that the electrodes, lining, and charge could not come in contact. It is this isolation of the charge from

[1] See Report (No. 16) on the experiments made at Sault Ste. Marie, Ont., under government auspices, in the smelting of Canadian iron ore by the Electro-thermic Process, 1907; p. 92.

the lining by a free space where the electrode enters the furnace, which constitutes the particular value of the construction in preventing the destruction of the lining, which occurred in all previous furnaces where the electrode came in contact with the charge and the lining.

ELECTRODES.

A three-phase current is supplied to three electrodes which penetrate through the roof into the melting chamber, and are inclined at a definite angle towards the centre of the furnace. The direction of the electrodes is fixed by means of guides on which they slide.

In this furnace three electrodes and a three-phase current are used, but it is the intention of the inventors, in designing furnaces of larger capacity, to employ four or more electrodes, with a two-phase current.

To prevent the roof of the melting chamber near the electrodes from becoming too hot, a system of cooling tuyères is arranged: whereby the gases generated in the reduction of the iron ore are drawn from the top of the furnace, and forced, by means of an electrically driven fan, against the lining of the roof of the melting chamber. In addition to this the circulation of the gases will not only permit of a more effective utilization of the reducing power of the CO, but produce a better distribution of heat throughout the charge in the shaft above than in any electric furnace previously tried.

The electrodes are cooled by means of cast-iron stuffing boxes built in the roof of the melting chamber, and through which cold water is continually flowing.

To protect those parts of the electrodes outside of the furnace from the oxidizing influence of the air a suitable covering is provided.

REGULATION OF ELECTRODES.

Regulation of the electrodes, when necessary, is accomplished by means of three hand wheels: which operate drums on which the cables secured to the tops of the electrodes are attached. During the run, however, it was observed that no regulation of the electrodes was necessary for five consecutive days; thus eliminating the necessity for automatic regulators, or for hand regulation.

In my report on the experiments made at Sault Ste. Marie, Ont.,[1] I cited important particulars in which the construction of the electric furnace would have to be modified, in order to make it commercial, viz.:—

(1) The top of the furnace requires to be modified to permit of the application of labour-saving machinery for charging.

(2) Provision requires to be made for the collection and utilization of the carbon-monoxide produced by the reduction of the ore. This involves also the protection of the charcoal of the charge from combustion on top of the furnace.

(3) The regulation of the electrodes should be effected automatically.

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[1] See Report (No. 16) on the experiments made at Sault Ste. Marie, Ont., under government auspices, in the smelting of Canadian ores by the Electro-thermic Process, 1907; p. 92.

(4) The shaft containing the charge should be sufficiently high to permit the heated CO to effect maximum reduction of ore, and the electrode should not be immersed in this shaft but contained in a side chamber supplied with the charge from the main shaft."

From a perusal of the above particulars, and a study of the foregoing description of the Electric High-furnace, it will readily be perceived that, all the modifications suggested in the report on the electric smelting experiments at Sault Ste. Marie, have been practically adopted by the inventors of this new furnace.

OPERATION OF THE FURNACE.

The experimental run was conducted under very unfavourable conditions. The brick work was new and damp, and the process of drying and heating had, of necessity, to be carried on with great precaution—thus consuming much time. The structural castings were entirely new and untested, which accounted for the failure of one of the water-cooled stuffing boxes—to be described later. In addition to the newness of the furnace, the ore and coke used in the greater part of the run—substituted later by charcoal—were in a very wet condition; the coke containing as much as 40 per cent water; thus precluding the possibility—even if the short time at our disposal permitted—of determining the output satisfactorily. Towards the end of the run, one of the water-cooled stuffing boxes—through which the electrodes enter the melting chamber—developed a flaw, admitting water into the furnace. Had the castings been tested prior to their installation in the furnace, this mishap would not have occurred.

These serious disadvantages affected, however, only the output and not the operation of the furnace, which was satisfactory. It was found that the charge did not jam in the lower contracted neck of the shaft, as I had feared, but moved with regularity down into the melting chamber. The contraction at the neck of the stack produced the desired effect of so directing the charge that, the free space above-mentioned was maintained. The charging of the ore, flux, and charcoal, was effected with perfect ease, by means of apparatus similar to that used in blast furnace practice. Although the gas generated in the reduction of the ore was not circulated through the cooling tuyères—as previously described—until near the end of the run, it was demonstrated that the lining of the roof of the melting chamber was effectively cooled by this means.

No trouble was experienced in tapping the iron—the temperature at the iron notch being always too high to permit of freezing.

It may be well to state that, this experimental run was conducted not for the purpose of determining the output of pig-iron per electrical horse-power year, but to demonstrate the commercial applicability of the furnace. The output which might be expected, even in a small furnace, was satisfactorily ascertained by the long series of experiments at Sault Ste. Marie. With this furnace, however, even a greater output than that obtained at Sault Ste. Marie can reasonably be expected. Even under the unfavourable conditions above-mentioned, the output was steadily increasing as the furnace became warmer, until the leakage of water through the defective electrode stuffing box necessitated the cutting out of an electrode.

A full report is in process of preparation.

ELECTRIC STEEL FURNACE.

The inventors of the Electric High-furnace: Messrs. Grönwall, Stalhane and Lindblad, have recently obtained patents for an electric steel furnace which embodies some novel features. The chief feature is the employment of a three-phase current, with but two electrodes; the bottom of the hearth—composed of magnesite and a small quantity of graphite—constituting the third. Magnesite when cold is not a conductor of electricity; but when heated becomes a good conductor.

This distribution of the electrodes causes the bath to rotate in a vertical plane: continually bringing new material in contact with the slag for purification; thus reducing to a minimum the time required for refining.

PROCESS FOR MANUFACTURING ELECTRODES.

The electrodes employed during the experimental run at Domnarfvet were of a very superior quality, no trouble being encountered from pieces breaking off and dropping into the furnace, and interfering with its operation—as was the case experienced with those used in our experiments at Sault Ste. Marie.

Since a plant for the manufacture of these electrodes is in operation in Sweden, I availed myself of the opportunity to obtain the necessary information—supplemented by drawings—concerning their manufacture. Unlike other processes, the raw material is moulded under a high hydraulic pressure, and then baked for a considerable time at a temperature of about 1,200 degrees Centigrade. This method ensures a product possessing the following qualities: homogeneity, great hardness, and excellent conductive power, which latter property allows of a smaller section being used than with all other electrodes, except those made of graphite.

COMMERCIAL APPLICATION OF THE ELECTRIC HIGH-FURNACE IN EUROPE.

Scandinavian capitalists have lost no time in taking advantage of the iron ore smelting tests made at Domnarfvet. A powerful company in Norway has already signed a contract with the patent right owners of the Electric High-furnace described above, for the construction and installation of a large electric smelting and steel making plant, and rolling mill for billets and flat bars. (See Appendix I, p. 80.)

PROCESSES FOR THE REDUCTION OF REFRACTORY ZINC ORES.

In view of the great importance that a successful process for the reduction of refractory zinc ores would be to British Columbia, where large deposits of zinc ores of this character exist, I obtained, while in Sweden, all necessary details, drawings, and results concerning the two processes at present employed in that country: both of which are electro-thermic.

One plant for the handling of large quantities of zinc ore—soon to undergo enlargement and improvement—is, and has been, in successful operation at Trollhatten, Sweden.

A demonstration plant, employing the De Laval process, for the smelting of refractory zinc ores is in process of erection in London; but as at the time of my visit it could not be completed for several weeks I was unable to witness a practical demonstration.

During my stay in London I received a letter from Lord Strathcona, High Commissioner for Canada, requesting me to examine a bisulphite process for the treatment of refractory zinc ores, invented in Australia, and about to be tested at Swansea, England. The inventors claim that this process is successfully employed in treating the zinc ores of Australia, and that a recovery of all the zinc and silver is possible. Owing to the fact that this plant would not be ready for several days, I was unable to investigate the actual working of the process—but obtained details, results and drawings concerning it. Unfortunately, all the information concerning these three processes is confidential and cannot, therefore, be published.

INVESTIGATION OF PRODUCER GAS PLANTS IN GERMANY.

In pursuance of instructions to investigate producer gas plants in Germany, in the interests of the experiment fuel testing plant to be erected at Ottawa, Mr. B. F. Haanel—who in 1907 inspected producer gas plants in the United States, and who assisted me in the electric smelting investigations in Sweden—was deputed to visit representative producer gas plants in Berlin and vicinity, on our way back from Sweden. The advantage of selecting German plants for investigation will be obvious. Inasmuch as Germany has not been so bountifully provided by nature with coal fuel as Great Britain, the United States, and other countries, the problem of conserving the natural resources received early attention. Low grade fuels such as lignite (brown coal) were utilized in Germany before the question of substitutes for common coals was even considered by the more favoured countries. For the foregoing reason, together with the fact that, German investigators and inventors having been trained for more than a generation, have achieved phenomenal success in solving the problem of the efficient utilization of the potential energy stored in coals, Germany is manifestly the best country in which to study the most advanced modern methods, and the most efficient machinery employed for converting the energy of coal into useful work.

Many plants, used for almost every variety of purpose, are dotted all over Germany, and it is no uncommon sight to see a store, warehouse, or other establishment, even in the smaller towns, generating its own power with a producer gas plant.

The limited time available for this investigation rendered the inspection of many plants out of the question. It was decided, therefore, to visit some of the plants operating on anthracite, and bituminous coals, coke, and lignite (brown coal) briquets erected by the Körting Brothers, of Hanover, Germany; mainly because the experimental plant to be erected in Ottawa by the Department of Mines for testing fuels was constructed by that firm, and particularly since a special study of installations operating on their system would doubtless greatly aid the experimental work about to be undertaken.

In addition to the numerous power plants operating with the fuels mentioned above, there were some using gas generated from peat: in fact a central power station is now being erected on an immense peat bog of several thousand acres; for the purpose of generating power from the peat, and distributing it in the form of electrical energy to surrounding towns. It is hoped that the tests shortly to be made in Ottawa with the experimental peat-producer-gas plant will lead in this direction; stimulating to greater activity and in the right direction, those owning large peat bogs, and who have so far failed from lack of a proper knowledge of the subject.

EXPERIMENTAL PEAT-FUEL PLANT.

In view of the growing scarcity of wood, and the steadily increasing cost of coal, the question of substituting peat in place of these fuels—to some extent at least—is becoming a matter of national importance. The cost, in Winnipeg, of the poorest quality of wood (spruce and tamarack) is from $6 to $8 a cord, and of coal $10.50 per ton; which plainly indicates that, the fuel question as affecting a large part of the population, especially in the western provinces, is a very serious one.

In Ontario, Quebec, and New Brunswick, wood and coal are somewhat cheaper; but considering the saving to the country if part of the imported coal used in these provinces could be substituted by peat, every effort should be made to establish a peat industry.

The attempts so far made in Canada to manufacture a commercial peat fuel have been chiefly failures, and very little, if any, peat fuel is at present available. The principal cause of most of these failures was the ignorance of the nature of peat of those who so far had engaged in the manufacture of peat products. In several instances the bogs chosen for development were unsuitable for the purpose in view. A proper investigation of the bog previous to the commencement of operations has in very few instances been made, hence methods entirely unsuitable for the bog in question were employed, and failure was the inevitable result. These failures, involving a considerable loss of capital, have created a pronounced distrust in everything connected with peat, and the utilization of the peat bogs; as a result, the peat industry in Canada is at the present time in a very unsatisfactory condition.

In order to assist Canadian manufacturers of peat products, a comprehensive report has already been published by the Mines Branch, giving descriptions of, and the results obtained with, the processes employed in those European countries where the peat industry has proved successful; and, owing to the renewed interest evoked, a systematic investigation of the Canadian bogs has been started with a view of ascertaining the quantity and quality of the peat contained in these bogs.

Any person desiring to start a peat plant can, upon application to the Mines Branch, have his bog investigated; and it is hoped that such failures as have been due to the choosing of a bog unsuitable for the purpose for which it was intended, will in the future be avoided.

Another object of these investigations is, the protection of the general public, as far as possible. The results obtained will be published from time to time in bulletin form, and interested parties will have an opportunity of judging, to some extent, of the feasibility of the project they have in view.

The most far-reaching and practical manner, however, in which to awaken interest in the utilization of our peat bogs is, the establishment of an experimental plant; where peat fuel can be manufactured on a practical scale. At such a plant interested parties will have an opportunity of ascertaining for themselves the working of the bog, as well as the suitability of the peat fuel produced.

With a view of starting the manufacture of peat fuel as soon as the bog required for this purpose has been examined, levelled and drained, it is proposed to employ a method which has already proved successful, namely, air-drying the peat on the surface of the bog after it has passed through a pulping machine.

This method, notwithstanding its dependence on favourable weather conditions, is the only one which so far has given economical results.

A number of more or less different pulping machines and appliances for handling the pulped peat are employed in Europe. The best of these machines, however, as well as the best methods for handling the peat, are those invented and introduced by Mr. A. Anrep in Sweden.

A small Anrep peat plant with a capacity of twenty to thirty tons of air-dried peat per day, costs in Europe about $4,200. To this must be added the cost of 200 acres of bog at about $10 per acre; storehouse, transportation equipment, working expenses, etc., thus bringing the capital required during the first year to about $10,000.

A similar plant is also needed to furnish a sufficient supply of peat fuel for the peat gas power plant, which is being erected in Ottawa for the Department of Mines.

The main difficulties in the way of developing a peat industry on a large scale are (1) dependence on favourable weather conditions for drying; and (2) the comparatively short season during which the bog can be worked. Any assistance that can be rendered inventors of promising processes aiming to overcome these difficulties in working out their ideas, would undoubtedly be of great advantage. The object of a government experimental plant should also be to assist such inventors as far as possible, and to ascertain the practical value of their inventions. In several European countries aid from the respective governments is obtainable by inventors of peat machinery and methods for utilizing the peat bogs. In Sweden, a special fund of 3,500,000 kronor (about $950,000) has been set aside for this purpose, and for rendering assistance to the manufacturers of peat products.

Drying conditions in Canada are at least as good—if not better—than in most European countries. And notwithstanding the higher rate of wages in Canada, a properly managed peat plant should give satisfactory economical results.

The introduction of a fuel like peat is, however, an undertaking that cannot be expected to be accomplished in a year or two, but will require a long and aggressive educational campaign, in order to demonstrate the value of the products, as well as their manner of manufacture.

FUEL TESTING PLANT.

The following paragraph clearly indicates the advantages of a national fuel testing plant, as proved by the United States Geological Survey:—

"Although in 1904 the production of coal was not quite equal to that of the preceding year, greater activity than in any previous year was manifest throughout the country in prospecting and developing new fields and in efforts to determine better methods of utilization. This was largely due to the establishment of a coal-testing plant at St. Louis, for which Congress appropriated the sum of $60,000. The interest taken in this work by coal operators, coal consumers, and the general public, shows that the people are keenly alive to anything that tends to the cheaper production and the better utilization of the fuels of the country. The immediate results obtained during 1904 resulted in an appropriation for 1905 amounting to $202,000 for the continuation of the coal-testing work, and incidentally an increase was made in the appropriation for geologic work of the Survey, with the express provision that this increase should be used in the investigation of the fuel resources of the country."

Since 1904 this fuel-testing work has been carried on steadily every year in the United States. At the present time the fuel-testing plant is installed in the old drill hall, Pittsburgh, which has been turned over to the United States Geological Survey.

The amounts appropriated for the testing of fuels by the United States Geological Survey, are as follows:—

1904	$ 60,000
1905	202,000
1906	250,000
1907	250,000
1908	250,000

which shows that this question is considered of considerable importance in the United States. The question is of no less importance to Canada, and a permanent testing plant equipped with the necessary apparatus and appliances for the proper testing of all kinds of fuels, will undoubtedly lead to greater economy in the use of our fuel resources, and assist in decreasing the present waste.

There is an unnecessary waste of fuels not only in the mining of same, but probably to an equal extent in their use. The latter waste could to a large extent be decreased if suitable apparatus were used for the effective and economical combustion of the different kinds of fuels.

The composition and quality of the different fuels vary widely: one coal, for example, is suitable for coking; while another cannot be used for this purpose—and so on.

Many of the coal fields of Canada are as yet only partially developed, and the probability is that coal deposits of which we at present know nothing, or very little, will in the near future be drawn upon. It is manifest, therefore, that the fuel-testing plant needs to be of a permanent character.

In order to procure reliable figures, it is, of course, necessary that the different tests should be made on a commercial scale, and with practical apparatus. In order to carry out this work properly, a special staff of men will be required, whose duty it will be to keep themselves well informed on all improvements and inventions for the better utilization of the fuels, as well as to co-operate with the field officers of the Department in making an intelligent estimate of the usefulness and value of the fuel resources of the country.

During the last two years, tests have been made at McGill University, Montreal, under the auspices of the Dominion Government—with some coals and lignites collected by an officer of the Mines Branch. The samples tested represent only a part of the known fossil fuel resources of the country; and since new coal fields are being frequently discovered, and those already partially developed will be rendered more accessible by the construction of railways, and hence become more productive, the work of testing will naturally increase in magnitude. Foreseeing this, it has been decided to continue the systematic testing of fuels by officers of the Mines Branch in the permanent building which is being erected by the Department of Mines at Ottawa.

Modern machinery and appliances will be installed, together with part of the plant now in use at McGill University.

This plan of concentrating these fuel-testing experiments, etc., at the most strategic centre, and having them conducted by the trained staff of the Mines Branch—under the immediate supervision of the Director of Mines, will, it is conceived, give more essentially practical results, capable of commercial application, than if the investigations were carried on in different parts of the country.

The first work will be to demonstrate the usefulness of the low grade fuels (peat and lignites) for power purposes. It is a well established fact that, the most efficient steam plant only utilizes about 15 per cent of the calorific value of the fuel, and a gas producer plant about 18 to 22 per cent. The saving in fuel obtained by the employment of the latter apparatus has, hitherto, not been duly appreciated in Canada; and it is hoped that by the publication of the results obtained with the government plant, as well as by practical demonstrations, this fact will be more widely known and utilized.

No peat-gas-power-plant exists as yet in Canada, although it has been proved that, in many cases, a suitable peat bog can compete as a source of power with more expensive water-powers. The fuel required can also contain a comparatively high percentage of moisture, hence the manufacture of peat fuel in accordance with the air drying processes, can be more thoroughly relied upon; even if the weather conditions are less favourable.

A practical demonstration of the use of the peat fuel which it is intended to manufacture at the experimental peat plant, will undoubtedly assist in placing the peat industry on a sound economic and commercial basis.

CHEMICAL LABORATORIES.

The two chemical laboratories were unusually busy during 1908. In the fiscal year ending March 31, 1908, 600 specimens were examined and reported upon; whereas in the nine months ending December 31, 1908, some 795 sent in, were identified or analysed.

The chief chemist—Mr. F. G. Wait—is engaged in the preparation of a detailed report of chemical analyses of special economic interest made during the last two years. This report will be a valuable acquisition to the Mines Branch list of technical publications of essentially practical interest.

DOMINION OF CANADA ASSAY OFFICE.

The report of the manager of the assay office, Vancouver, B.C., shows that a much larger volume of business was done during the nine months ending December 31, 1909, than in any year since the establishment of the branch—1901. The value of the gold bullion received was $1,583,138.43, while the total value of the business done in the fiscal year 1907-8, amounted to only $751,693.97. The largest previous total was in 1901-2, viz., $1,153,014.50. The main reason for the recent increase in the business done was, the diversion of Yukon gold to our Vancouver office; on account of the action of the Post Office authorities, in permitting the shipment of gold by registered mail to the amount of 70 ounces, which reduced the cost of transportation.

ON THE TRANSFERENCE OF GOLD TO THE ROYAL MINT, OTTAWA.

Gold, like any other commodity, is sold by the producers to the highest bidders. If, therefore, it is desirable to divert the gold of the Yukon and British Columbia to our assay office at Vancouver, or, to the Royal Mint at Ottawa, it will be necessary to offer the producers terms which are at least as advantageous as those offered by the United States mint at San Francisco.

Our assay office exacts ⅛ of 1 per cent on the gross value of each deposit. A like amount is exacted by the assay offices of the United States to defray the expenses of these collecting offices. The United States mints, however, *do not* make this charge; and since the mint at San Francisco is favourably situated as regards transportation of gold from the Yukon and Alaska, the producers save the charge of ⅛ of 1 per cent by sending their gold direct to the San Francisco mint, rather than to the assay offices in Seattle or Vancouver.

If this charge of ⅛ of 1 per cent, now exacted by our assay office were abolished, and the Post Office authorities consented to raise the limit of weight of individual parcels of bullion to be accepted by registered mail—when addressed direct to the Dominion of Canada Assay Office—from 70 ounces to 200 or 250 ounces, the shippers would prefer to send their bullion to Vancouver rather than to the United States mint, or the Seattle assay office. By the abolition of the charge of ⅛ of 1 per cent our loss on $10,000,000 would be $12,500. The silver content of the Yukon gold, however, averages about 17½, hence the loss indicated would be more than offset, if the gold-silver bullion is refined and coined at the Royal Mint, Ottawa; as will be evident from the following calculation:—

"Ten million dollars value of bullion at $16 per ounce would represent 625,000 ounces of bullion, and 17½ per cent of the bullion being silver would give 121,528 standard ounces of silver, which, at 45 cents per standard ounce equals $54,687.60, and a dollar (United States) weighs 412·5 grains, or approximately 86/100 ounces, so that 121,528 standard ounces which had cost us $54,687.60 would make $141,311.63, leaving a profit of $86,624.03."

PROPOSED NEW ASSAY BUILDING.

The plea urged in the Summary Report 1907-8, for the erection of a government owned assay building at Vancouver is more pertinent than ever. The rent paid for the building occupied by the Dominion of Canada assay office in Vancouver, B.C.—since its establishment in 1901, is as follows:—

July, 1901, to July, 1906, at $1,200 per annum.

July, 1906, to July, 1908, at $2,100 per annum.

July, 1908, to December, 1909, at $2,700 per annum.

During the seven years of occupancy the rent has increased 125 per cent.

The present lease expires December 1, 1909, when the probability is that the high rent charged will be still further increased. It is manifestly in the interest of economy, therefore, that immediate steps be taken to establish the Vancouver assay office in permanent quarters, by the purchase of a suitable lot, and the erection of a properly designed fire-proof building.

SCOPE OF INVESTIGATIONS IN THE FIELD.

The general field work during the past season consisted of the investigation of iron ore deposits in Nova Scotia and Ontario; examinations necessary for the preparation of monographs on the occurrence of tungsten, and on the gypsum deposits of Nova Scotia and New Brunswick; also additional work in the asbestos region of Quebec: having as its objective the publication of a second edition of the Mines Branch Report on Asbestos. Not the least important work achieved was an examination of the peat bogs of Ontario.

FIELD WORK.

The following is a brief synopsis of the work done by the respective field officers:—

Dr. J. E. WOODMAN spent the season gathering data necessary for completing his Report on the Iron Ore Deposits of Nova Scotia (Part II). Part I is now in the press.

Mr. B. F. HAANEL examined, and made a magnetometric survey of Huron Mountain mine in the Timagami Forest Reserve. On account of the supposed geological similarity between this formation and that of the Moose Mountain Iron mine, the Department of Mines was strongly urged to make the investigation.

In addition, Mr. Haanel witnessed tests of the electric smelting of titaniferous ores at Welland, Ontario; and visited producer gas plants in Germany.

Mr. HOWELLS FRÉCHETTE made a magnetometric survey of some iron ore deposits along the Central Ontario railway: including the Bessemer, the Child, and Rankin deposits. This work, which the Mines Department was also strongly urged to do, will be continued during the season of 1909.

Mr. EINAR LINDEMAN was engaged in the investigation of iron ore possibilities along the line of the Port Arthur and Duluth railway. The territory through which this railway passes was supposed by parties interested in its development, to be well mineralized with iron ores.

Dr. T. L. WALKER was engaged in examining the occurrences of tungsten ores in Canada, with a view of publishing a reliable, authentic report. The increasing demand for tungsten for electrical purposes, and in the manufacture of high speed tool steels; the lack of information with regard to known deposits of tungsten ores, and the difficulty of obtaining accurate knowledge concerning the metallurgical treatment necessary to prepare the tungsten for the market, rendered it imperative that a systematic investigation should be made.

Dr. Walker was originally instructed to include molybdenum in his investigation of tungsten; but the field work necessary to complete this urgent work, occupied so much time, that it was decided to reserve the examination of molybdenum until another season.

Mr. W. F. JENNISON examined the gypsum deposits of Nova Scotia and New Brunswick, with the object of preparing a monograph on the same.

The following prospectus—taken from the memorandum accompanying the petition for this investigation—will indicate the range of the inquiry:—

(*a*) History, and distribution of gypsum deposits.
Varieties of gypsum.

(*b*) The gypsum trade history of Canada.
Statistics, and graphic chart of gypsum production.

(*c*) The geography and topography of Canadian gypsum deposits: with maps and photographs showing extent of these deposits, and facilities for manufacture and shipping.

(*d*) Thermal spring deposits from sea water by the action of iron pyrites on the carbonate of lime.

(*e*) Gypsum as a fertilizer: its use among ancient nations. Experiments by well known authorities. Theory of the action of gypsum as a fertilizer.

(*f*) The chemistry of gypsum, plaster of Paris, and cement plaster, with methods of analysis.

(*g*) Technology of gypsum.
General and physical properties.

(*h*) General requirements of a plaster mill, with illustrations, specifications, and cost of construction.
Chemistry of the manufacture of plaster.
Retarders and accelerators.

(*i*) The methods of operating, with costs.

(*j*) Markets, and value of produce.

It is hoped the publication of this monograph on gypsum will aid in stimulating the industry to such an extent that, the product of the immense deposits of high-grade gypsum in the maritime provinces will be manufactured in Canada, instead of being exported as raw material.

Mr. W. W. Leach—of the Mines Branch staff—spent the past season in British Columbia, completing his work in delimiting the coal and copper areas on Bulkley river and its vicinity. Inasmuch as this work was begun by, and belongs to, the Geological Survey Branch, Mr. Leach's report was made to the director of the last named branch.

Mr. J. G. S. Hudson has been occupied since July 15, 1908, in the preparation of a report on the 'Coal Resources of the Province of Nova Scotia.'

Mr. Fritz Cirkel was engaged in the early part of the year, completing his data for the Ontario section of the Report on the Mining and Metallurgical Industries of Canada; and, in the preparation of his monograph on the Chrome Iron Ore deposits in the Province of Quebec—now on the press; also in the investigation of new discoveries of asbestos, and inspecting new mills for its manufacture, in the Eastern townships of the Province of Quebec; mainly with the object of preparing a second edition of the Mines Branch report No. 11 on 'Asbestos: its Occurrence, Exploitation and Uses'—published in 1905. This report has proved so interesting that, the entire first edition is exhausted.

The following petition was presented to the Honourable the Minister of Mines, asking for the above investigation:—

Letter of Transmittal.

CHATEAU FRONTENAC, QUEBEC, Canada, July 11, 1908.

The Honourable WILLIAM TEMPLEMAN, Esq.,
Minister of Mines, Ottawa.

DEAR, HONOURABLE SIR.—The undersigned begs to enclose a petition signed by a number of parties interested in the development of the asbestos industry. This petition sets forth the good services the Mines Branch under Dr. Eugene Haanel has rendered to this industry by issuing a monograph on the mineral asbestos, written by Fritz Cirkel. I may say that for the last three years, since that monograph was written, upwards of half a million dollars have been spent to advantage in new properties, mine and mill equipment in the asbestos district. As the conditions of this industry have changed a great deal since the writing of that monograph, which I think took place in the year 1904, a new edition of the same comprising the wonderful evolution of that growing industry, would be welcomed by every one who has the development of our asbestos resources at heart.

Canada is known to furnish for over 25 years the markets of the world with asbestos and as the demand for the Canadian article is steadily increasing, everything should be done that could contribute to the discovery and development of new ore bodies or to the manufacture of the ore into merchantable values.

I am only sorry that time does not permit to obtain additional signatures, as it is desired that this document should be presented before prorogation of parliament.

Trusting that the enclosed petition will receive your kind consideration.

I remain, honourable sir,
Yours most respectfully,
(Signed) P. ANGERS,
Notary.

BEAUCEVILLE, QUE.

Petition.

The Honourable WILLIAM TEMPLEMAN, Esq.,
Minister of Mines,
Ottawa.

HONOURABLE SIR,—The undersigned, who are interested in the operation of asbestos mines and the development of the asbestos industry in general, beg to submit to your kind consideration the following matter, viz.:—

For the last two years considerable activity has been displayed by capitalists, operators and prospectors in an asbestos field which by reason of its excellent asbestos fibre and the apparently large extent of the distribution of this mineral is destined to become a prominent factor in the production of asbestos in the Eastern Townships of the province of Quebec.

This new field—the Broughton Asbestos Serpentine Belt—has, as far as we know, not received the attention from the Department of Mines which its importance demands, and on this account much difficulty has been experienced in locating ore deposits. The economic possibilities are already evidenced by the fact that three mines and mills with a total capacity of 800 tons of asbestos rock per day are being operated now, while two more mills, those of the 'Frontenac Asbestos Mining Company, and the 'Boston Asbestos Company,' are in course of construction, adding when completed another 600 tons of rock per day. When these new mills are completed over half a million dollars have been spent in plant alone.

The undersigned have no doubt that if the boundaries of this new serpentine belt were properly mapped, thus giving much needed assistance to the operator, capitalist, prospector, as well as lot owners in the district under consideration, much more valuable virgin ground would likely be discovered, and if properly developed would thus considerably enlarge the scope and the capacity of this industry.

For this reason the undersigned take the liberty of submitting to your kind consideration the following suggestions:—

(1) To send out a mining engineer thoroughly conversant with this district and its economic conditions, with instructions to determine the approximate boundaries of this new Broughton asbestos belt with a view to complete a map thereon.

(2) To issue a new edition of the Monograph on Asbestos, which was compiled by your Department in 1905, embodying all results of such recent investigations in the field, and also the conditions governing the industry at the present time. We may say that this first Monograph on Asbestos of 1905, on account of the valuable data it contained, especially from a geological and mining point of view, has aided the development of this industry in no small measure.

We trust—Honourable sir—that the reasons above stated are of sufficient importance to grant the wishes of the undersigned as set forth in this document, at an early date.

And your petitioners will ever pray.

Respectfully submitted:

Quebec, East Broughton, Beauceville, Broughton and Montreal.

The ninth day of July, 1908.

(Signatures).

The publication of a second edition of the report on Asbestos (now exhausted) will not only bring it up-to-date; but will enable the Mines Branch to meet the constant demand for information on this subject.

Mr. Erick Nyström—assisted by Mr. S. A. Anrep—spent the summer months examining and defining the boundaries of as many peat bogs in the Province of Ontario as time permitted. In addition to the actual field work, about 70 tons of dried peat were prepared at Beaverton, for use in the peat-gas producer to be installed at Ottawa.

Mr. Theophile Denis was engaged collecting samples of coals from Canadian mines in both east and west; for the coal tests now nearing completion at McGill University.

Dr. R. W. Ells—on the staff of the Geological Survey Branch—was commissioned by the Mines Branch in May, 1908, (in compliance with the request contained in the following petition) to proceed to Scotland, Great Britain, with the object of witnessing and reporting on tests to be made with oil shales exported from New Brunswick; in order to ascertain their economic value: especially as regards the contents of crude oil and sulphate of ammonia:—

Petition.

Dr. Eugene Haanel,
Director of Mines,
Ottawa.

Ottawa, April 4, 1908.

My Dear Doctor,—Referring to our conversation this morning *re* the bituminous shales of New Brunswick, and my request for your Department to send a specialist to Scotland, I would say:—

That there are many reasons which may be advanced for the step which I have proposed, and which I think will be of benefit not only to the province of New Brunswick, but to the Dominion at large.

The distillation of shales in Scotland has grown to be a very large industry and also a very profitable one, and I am convinced that a similar industry can be established in Canada.

Dr. Ells, of the Geological Survey, in many reports from 1876 to the present time has set forth the value and the large quantities of these bituminous shales, and later he has stated they are one of our best assets in the province of New Brunswick.

We have forwarded to Scotland fifty tons for the purpose of making a special test of the different values contained in the shales. This distillation will be made for us under the supervision of Sir Boverton Redwood, of London, and Dr. Charles Baskerville, of the College of the City of New York. It is their purpose to submit this shipment to a most scientific test for all the valuable by-products. We think it will be of great value to the Geological Department of Canada, especially the economic feature of that department, that the government should send a representative to make an independent report on the distillation of this shipment. It will have the advantage of showing you the exact values of deposits of this nature, not only in our province, but in the whole Dominion. You have the asphalts of the northwest, the stellarite of Nova Scotia, with possibly many other undeveloped bodies of similar material in the Dominion, and all of which will have to be treated by the methods now employed in Scotland.

I, therefore, submit it is of the utmost importance your department should be thoroughly conversant with the development of this industry from its inception.

I trust that you will see your way clear to comply with our request and send your representative to Scotland to make an independent report upon the present shipment.

If you will kindly bring this to the notice of the government we will esteem it a great favour.

Yours truly,

THE ALBERTITE OILITE AND CANNEL COAL CO.

Per (Signed) M. LODGE.

(SIGNATURES).

A preliminary report on the tests made in Scotland, written by Dr. R. W. Ells, appears on page 64.

GENERAL CONSIDERATIONS.

Although the Mines Branch was hampered somewhat in the early part of the field season by the lateness in getting supplies; yet, substantial, practical work was achieved, as the list of preliminary reports shows.

The site for the fuel testing station at Ottawa was selected and bought; designs for the plant prepared, and the necessary apparatus and machinery purchased. During the summer of 1909, the building will be erected, and progress made with the installation of the experimental plant.

The work, however, which may have the most far-reaching results, was the examination of the Electric High-furnace in Sweden. This test of an electric furnace on a commercial scale, was the logical complement of the experiments made at Sault Ste. Marie in 1906: which settled once for all two important factors in the problem of electric smelting, (1) that sulphur can be eliminated from the bath down to a few one-thousandths of one per cent, and (2) that coke as a reducing agency is not necessary; but can be satisfactorily replaced by charcoal: thus enabling Canada to smelt high-sulphur and refractory ores economically, in regions where coal fuel is not available, or its price prohibitory on account of the long hauls necessary to carry it to the ore deposits.

The fact that the initial step in solving the metallurgy of the reduction of iron ores by the electro-thermic process was taken by the Dominion Government in the experiments at Sault Ste. Marie—results which have been universally accepted, and which have now been successfully applied in the construction of an electric furnace on a commercial scale at Domnarfvet—places Canada in the forefront of an industrial movement which is destined to be of supreme importance in all countries where coal fuel is scarce, or entirely absent; but water-power and iron ore deposits abundant.

This new metallurgical process is of special advantage to Canada: particularly in provinces like Ontario, where coal fuel is absent; but where extensive deposits of refractory iron ores exist in comparatively close proximity to water-powers.

Realizing the importance of an iron industry to Canada, one of the chief aims of the Mines Branch has been to anticipate practical needs. For example, by making special investigations of the occurrence, in the Dominion, of tungsten and chrome ores; since the metals of these ores enter into the composition of high-speed tool steels. But while many of the iron ore deposits in various parts of the country have been determined and defined by means of magnetometric surveys, the fringe of the national resources has only been touched. If the supply of iron ores for even our own imminent smelting demands is to be forthcoming, it is of supreme importance that, the constant work of systematically exploring, investigating, and magnetometrically surveying the iron ore areas of the Dominion, should be greatly accelerated. This, however, can not be done without adding to the permanent staff technical officers capable of carrying out this necessary work.

Many other important fields in the domain of mining and metallurgy await systematic investigation—the reduction of cobalt-silver, zinc, and kindred ores by the electro-thermic process, for example; but this work has of necessity to be delayed, owing to the limited staff of permanent technical officers at my disposal. A like remark applies to the publication of statistical reports by the Division of Mineral Resources and Statistics. The earnest appeal for additional assistance by the Chief of the Division, on page 32, has my unqualified endorsation.

The inquiries from all parts, with regard to the mineral and metal resources of the Dominion—particularly with reference to the electro-thermic process of smelting ores—have been increasingly numerous; and the demand for our technical publications has been greatly augmented; all evincing active interest in the industrial development of the country. In fact, so urgent and pressing are the applications for the Report of the Commission on Electric Smelting, No. 3—now out of print—that the desirability of reprinting the same is under serious consideration. The correspondence for the nine months ending December 31, 1908, amounted to 2,786 communications received, and 2,284 sent out. In addition to this, the correspondence of the Statistical Branch—outside of circulars—amounted to 1,807 letters received and sent.

I have the honour to be, sir,

Your obedient servant,

(Signed) EUGENE HAANEL,

Director of Mines.

REPORTS

ON

FUEL TESTING, CHEMICAL LABORATORIES, STATISTICAL DIVISION, AND ASSAY OFFICE.

COAL TESTS AT McGILL UNIVERSITY.

Considerable progress has been made during the past year in the systematic investigation of the coals of Canada—begun rather more than two years ago by Dr. A. P. Low, then Director of the Geological Survey, and now being continued by the Mines Branch—and which, it is hoped, will be completed in 1909.

The investigation has from the beginning been conducted at McGill University under the general direction of Dr. J. B. Porter, Professor of Mining Engineering; and the practical experimentation in 1908, as in 1907, was also done at that institution: the sampling, crushing, screening, washing, coking, and chemical analysis being under the immediate supervision of Dr. Porter; while the boiler tests, and producer and gas engine experiments were supervised by Mr. R. J. Durley, Professor of Mechanical Engineering. These professors were assisted by several members of the university staff, and by others specially appointed for this investigation.

CLASSIFICATION OF TESTS.

The work may be classified as follows: sampling, preparation and storage, washing, boiler tests, gas producer and engine tests, coking, and chemical analysis.

SAMPLING.

The samples were collected this year—as heretofore—by Mr. Theophile Denis of the Mines Branch, and in a few special cases by Dr. Porter and Mr. Stansfield. In all cases a responsible member of the staff supervised the work.

In accordance with last year's precedent, 19 ton samples were obtained from a number of representative mines; but in order to make a more detailed investigation without undue prolongation, or inordinate increase in expense, smaller samples were taken from many other mines; and in several cases, samples were taken from different parts of the same mine. In addition to the 19 samples obtained from Nova Scotia and New Brunswick last year (See Summary Report for 1907-8) 19 samples of from 7 to 10 tons; 12 samples of from 1 to 7 tons; and 3 samples of about half a ton weight have been obtained during 1908-9. Some 50 smaller samples—varying in weight from 500 to 2 lbs—have also been received. Of the 34 large samples, 6 are from Nova Scotia; 2 from Saskatchewan; 14 from Alberta; and 12 from British Columbia. Three of the 50 small samples were obtained by members of the Geological Survey staff from the Yukon; 14 are special samples taken in connexion with an investigation on the weathering of coals, and 18 are special samples procured for the coking tests.

PREPARATION AND STORAGE.

Each main lot of samples on arrival at the testing plant was unsacked, broken, passed through a 3″ bar screen, and well mixed and sampled: the sample being crushed to smaller sizes as the quantity was reduced. Finally, two samples of about 2 lbs. each, crushed to pass through a ⅛″ screen, were thus obtained for the chemist; and other portions reserved for heavy solution tests, and screen analyses. The remaining coal was re-sacked, and stored in a locked store house until required for the various tests.

In the cases where more than one sample had been taken from a mine which mixes its output before shipping, the several lots were separately sampled for the chemist, then thoroughly mixed and re-sampled. This re-sampling and mixing, although essential to a satisfactory study of the subject, greatly increased the work, not only in sampling, but also in the Chemical Laboratory.

The sampling was conducted by Mr. C. Landry, Chief Mechanic of the Mining Department, assisted by A. Lauriot and others.

COAL WASHING.

Before any coal was washed, research was carried on—chiefly by means of heavy solution separations—to determine the possibility of washing it to economic advantage. These experiments were made on 39 different coals: involving over 150 separations, and 300 determinations of ash.

Guided by these experiments, 10 coals were washed on a large enough scale to enable a full boiler trial to be made on the washed product.

Six small lots of coal were also washed. The method of washing was described in the Summary Report of the Mines Branch, 1907-8.

The various products of the washing plant were all sampled separately, and sent to the Laboratory for analysis.

An investigation was also carried on by means of mechanical crushing, followed by screening, to determine the friability of the coals and the proportion of ash carried in fine coal as compared with coarse. Thirty-two complete screen analyses were made, involving over 180 ash determinations. The relation between the constituents of coal —other than ash—before and after washing has also been under consideration.

The coal washing was conducted by Mr. H. G. Carmichael and Mr. C. Landry, assisted by a staff of mechanics and labourers.

BOILER TESTS.

Between the end of May, and the middle of September, 1908, a series of 37 boiler trials were conducted in the boiler room of the Department of Mechanical Engineering. The same boiler was used for each test, and the same methods employed as in the series of the previous year, described in the Mines Branch Report, 1907-8. The same fireman was employed throughout both series. The boiler, however, was completely overhauled, cleaned, and repaired before beginning this year's trial.

The equipment of the previous year was supplemented by the installation of a Simmance and Abady Automatic Carbon Dioxide Recorder; and a Randall and Barnhart Gas Analysis apparatus.

The two first trials made were repeat trials on coals tested the year before, in order to correlate the work of the two years. Twenty-five of the coal samples received this year were then tested in the boiler, and ten of these were re-tested after washing.

The testing staff comprised Mr. J. Blizard—in charge of tests; Mr. G. Killam and Mr. Geo. Guillet—observers and computers.

The actual working of the boiler plant was in the hands of F. Balmfirth—in charge of the boiler room, and J. Hoult—fireman.

The gas analysis was carried out by members of the Chemical Laboratory staff.

GAS ENGINE AND PRODUCER WORK.

The work of the gas producer plant during the year 1908-9, included the trials of the producer furnished by the Canada Foundry Company for the purpose of making the tests on bituminous coals, and the installation and placing in operation of a bituminous producer designed by Professor Durley. After prolonged experiment it was found that the producer first named did not fulfil the requirements of the specification. The producer built in Montreal, however, was satisfactory in operation, and after some modification was found capable of carrying out the work. It was started on regular service in October, and from that time to the present the producer tests on the lignites and bituminous coals have been proceeding regularly. In all, up to April 1, about 30, official 24 hour tests have been made on bituminous coals, and on lignites from the Lethbridge, Edmonton, and Souris districts. A large proportion of the coal samples tested have proved to be suitable for use in gas producers. This is especially the case with the western lignites, which have proved better as gas producer fuels than when used for steam raising purposes. It is expected that the series of tests will be completed about the end of April, 1909.

In view of the many difficulties surrounding the satisfactory conduct of a gas producer test, it was decided that the length of each trial should be at least 24 hours. For some reasons a longer trial would be preferable; but lack of time and means rendered this impracticable in the present case. The method adopted in running the tests is as follows: The producer having been cleaned after the previous trial, is lighted up about six hours before commencing the trial, the engine being started under running conditions as soon as possible. Observations of the fuel fired, gas produced, etc., are taken during this preliminary period, and such necessary changes made in the depth of fuel bed, draft, and steam supply, as are found expedient to suit the particular fuel being used. The engine and producer are then run at as uniform a rate as possible for a further 24 hours, at the expiration of which time the engine is stopped, the fire in the producer drawn and quenched as rapidly as possible, and the resulting mass of half burned material sampled for analysis. In view of the small size of the producer and the limited amount of coal of each kind available, it was found preferable to run the tests in this way rather than to adopt the system of continuous running without drawing the fire between trials. Auxiliary tests have, however, been made to test the capacity of the plant for continous running, and to give a check on the correctness of the shorter experiments. It will be noted that each gas producer test involves from 30 to 36 hours continuous work.

The staff employed on the gas producer and engine tests was as follows: Mr. J. Blizard, in charge of observations and computations; Mr. J. S. Gardner, in charge of the operation of the engine and producer; Messrs. D. W. Munn, G. Killam and J. C. Cameron, observers and computers. The producer room staff also included two firemen and one labourer.

The gas analyses, and the analyses of samples of coal and refuse were carried out by members of the Chemical Laboratory staff.

COKING TESTS.

A series of coking tests are at present being carried out. This work may be divided into two parts: (1) an investigation into the possibility of making practical tests on the coking properties of coals on a small scale, and (2) the application of such tests to the different Canadian coals.

To satisfactorily test a coal in duplicate in an ordinary commercial coke oven would require a sample of at least 30 tons, and the expense in time, labour, and transportation would prohibit making more than a very few such tests. The advantage of having a good method for small scale tests is thus apparent.

The method developed by Dr. Porter, and used, consists in putting about 50 lbs. of coal into a thin metal box with a perforated lid, and placing this in a commercial oven in regular commission, in such a way that the box is entirely surrounded by the coal charged into the oven.

The investigation included researches into the effect of—(*a*) the position of the box in the oven, (*b*) the time of coking, (*c*) the compression of the coal, (*d*) the moisture in the coal, (*e*) the use of different types of ovens, (*f*) the age of the coal sample, (*g*) the blending of a coking coal with a non-coking one.

Samples of the different cokes produced were kept for chemical and physical examination, and the yields of coke were also determined when possible. Samples of coke produced in the normal course in the ovens were taken for comparison with the test coke.

The preliminary investigations, which were carried out chiefly at Sydney in May and June, proved very successful, and tests have since been made on coals from all parts of the Dominion.

Altogether 124 boxes of coal have so far been coked:—

86 in Otto Hoffman ovens of the D.I. and S. Co., at Sydney, N.S.
28 " Bernard " N. S. S. & C. Co., at North Sydney, N.S.
2 " a Bauer oven " " " "
8 " a Beehive oven of the D. D. D. at Bridgeport.

Eight of these tests were carried out by Mr. Theophile Denis, and the remainder by Mr. Edgar Stansfield, at the works of the above named firms, who very courteously granted them every possible facility, and whose employees rendered great assistance. Thanks are also due to several colliery companies of Nova Scotia which supplied fresh samples of coals for comparison with older samples from the same mines.

The samples of coke have yet to be tested chemically and physically, and it is also proposed to conclude the main work by a series of tests in the Crowsnest district: to compare old and fresh samples of western coals.

The above coking tests are being supplemented by a special investigation which is being carried out in the Metallurgical Laboratories under the general supervision of Dr. Alfred Stansfield, Professor of Metallurgy. The object of this investigation is, to determine upon a satisfactory method of testing the coking properties of coal on a still smaller scale in the laboratory; and to ascertain the quantity and quality of gas and other by-products produced.

This work is being done by Mr. H. H. Gray, assisted by A. Hainsworth.

CHEMICAL LABORATORY.

The work in the Laboratory was continued in full force throughout the year. The most notable additions to the equipment were a gas analysis apparatus, by Messrs. Randall and Barnhart, and an apparatus for gas analysis over mercury, by Messrs. Bone and Wheeler. The work in the Laboratory is intimately connected with that of all the other branches of the investigation, and its scope may be gathered from the following list of samples received for each of the respective tests:—

Samples of coal.—One sample direct from mine.
One regular main sample of coal.

Washing tests.—Eight samples of 'floats' and 'sinks' from different specific gravity solutions.
One regular main sample of washed coal.
Three samples of washed coal of different sizes.
Nine samples of products from different parts of jigs.

Boiler tests.—One sample of coal charged.
One sample of refuse produced.
Twenty half hourly samples of flue gas.

Gas producer tests.—One sample of coal charged.
One sample of ash produced during run.
One sample of residue in producer at end of run.
Twenty-four hourly samples of gas

Coking tests.—One small sample for chemical tests.
One large sample for physical tests.
Gas samples.

The laboratory tests include determinations of carbon, hydrogen, nitrogen, oxygen, sulphur, carbon monoxide, carbon dioxide, ethylene, methane, hydrogen sulphide, sulphur dioxide, ash, volatile matter, fixed carbon, moisture, calorific value, specific gravity, friability, fusibility, porosity.

In addition to the regular work of the Laboratory, special investigations have been or are being carried out on the chemical methods employed, and on such points as the weathering and aging of coals, the calibration of gas meters, the drying of coals, the soluble constituents of coal, the determination of sulphur, the determination of volatile matter, water equivalent of calorimeter, etc.

The Laboratory staff is as follows: chief chemist—Mr. Edgar Stansfield; assistant chemist—Mr. J. H. H. Nicolls; and during parts of the year only—Messrs. R. T. Mohan, P. H. Elliott, R. S. Boehner, W. B. Campbell, E. J. Conway.

CHEMICAL LABORATORIES.

(a) SUSSEX STREET.

(b) WELLINGTON STREET.

F. G. Wait, M.A., F.C.S.

In carrying out the work outlined in the following report, both sections of the laboratory have been operated to their fullest capacity. The Wellington Street section has been under the direction of Mr. H. A. Leverin, M.E.; the Sussex Street section under that of myself, assisted by Mr. M. F. Connor, B. Ap. Sc.

By their zeal and close application, both Mr. Connor and Mr. Leverin have been able to perform a large amount of useful, directly practical work; but, with the services of only three chemists, it has not been possible to keep fully abreast of the work. The rapidly increasing number of specimens submitted to us makes it fully apparent that an additional skilled assistant will be required in the immediate future.

In the twelve months ending March 31, 1908, 600 specimens were examined and reported upon; whereas in the nine months, from April 1, to December 31, 1908—the period covered by the summary—795 were submitted to analysis, description or identification, as required.

A detailed report of such work as will be of public interest, which has been carried out during the past two years, is in course of preparation, and will be carried to an early completion.

The work embraced in this Summary may be conveniently arranged as follows:—

I. Fossil Fuels, comprising:—

(1) *Lignite*—11 samples from

(*a*) Saskatchewan—

i. Sec. 13, tp. 12, R. 24, west of 2nd meridian.

ii. Sec. 24, tp. 12, R. 24, west of 2nd meridian.

iii. Sec. 14, tp. 20, R. 16, west of 3rd meridian.

(*b*) Alberta—

i. From unsurveyed territory in the foothills of the Rockies, 200 miles west of Edmonton—4 samples.

(*c*) British Columbia—

i. Point Grey, near Vancouver.

(*d*) Yukon—

i. From a point four miles west of the 69th mile post from Whitehorse, on the Whitehorse and Dawson wagon road—2 samples.

(2) *Lignitic Coal*, 4 samples from:—

(*a*) Alberta—

i. From unsurveyed territory in the foothills of the Rockies, 200 miles west of Edmonton—4 samples.

(3) *Coal*, 14 samples from:—

(*a*) Newfoundland—

i. Alderly, St. George bay.

ii. Codroy.

iii. Grand lake.

(b) Alberta—
- i. From a 4 foot seam on Grave creek in the Bighorn coal basin.
- ii. From a 7 foot seam on the banks of an unnamed tributary of the Brazeau, in the Bighorn coal basin.
- iii. From an undefined locality south of Frank—2 samples.

(c) British Columbia—
- i. Goat creek, Omineca mining division—2 samples.
- ii. Morice river, Omineca mining division.
- iii. Clarks forks, Morice river, Omineca mining division.
- iv. Coal creek, Zymoetz river, Skeena River mining division.
- v. Zymoetz river, Skeena River mining division.
- vi. Vicinity of Vermilion forks.

(4) *Anthracitic Coal,* 2 samples from:—

(a) Alberta—
- i. Sec. 1, tp. 25, R. 11, west of 5th meridian.

(b) Yukon—
- i. From the outcrop of a 6 foot seam, situated one-quarter of a mile east of the roadway opposite the 114th mile post from Whitehorse, on the Whitehorse and Dawson wagon road.

(5) *Anthracite,* 1 sample from:—

(a) Quebec—Bonaventure county.
- i. From the north bank of the Restigouche river, some 10 miles from its mouth.

II. Peat—24 samples, from:—

(a) Ontario—
- i. Bruce county—East half, lot 9, con. 11, Greenock tp.
- ii. Perth county—Drummond township—3 samples.
- iii. Prescott county—Alfred township—2 samples.
- iv. Russell county—Gloucester township—'Mer Bleu'—7 samples.
- v. Stormont county—Newington peat bog—7 samples.
- vi. Victoria county—Victoria Road.
- vii. Welland county—Humberstone and Wainfleet townships—3 samples.

III. Iron Ores—101 samples, which may be classed as:—

1. *Magnetites,* from:—

(a) Nova Scotia—
- i. Cape Breton county—1 sample from Grand Mira.
- ii. Inverness county—1 sample from Whycocomagh.

(b) New Brunswick—
- i. Gloucester county—4 samples.

(c) Quebec—
- i. Timiskaming district—1 sample.

(d) Ontario—
- i. Hastings county—vicinity of the Orton mine.
- ii. Timagami district—claims 1346, 1347, 1348 of the Huron Mountain mine—40 samples.
- iii. Timiskaming district—locality not specified.

2. *Hematites,* from:—

(a) Nova Scotia—
- i. Antigonish county—1 sample.
- ii. Cape Breton county—22 samples.
- iii. Colchester county—7 samples.

iv. Cumberland county—2 samples.
v. Guysboro county—3 samples.
vi. Richmond county—10 samples.
(*b*) Ontario—
i. Thunder Bay district—Gunflint lake.
(*c*) Mackenzie district—1 sample from Gravel river.

3. *Limonite, bog iron ore and iron ochre,* from:—
(*a*) Nova Scotia—
i. Colchester county—1 sample.
ii. Lunenburg county—1 sample.
(*b*) New Brunswick—
i. Sunbury county—One mile from Tracey station, Canadian Pacific railway.
(*c*) Ontario—
i. Muskoka district—Lot 29, con. 5 of Oakley township.
(*d*) Yukon—
i. Vicinity of Takhini Spring.

IV. Copper Ores—24 samples from:—
(*a*) Nova Scotia—
i. Colchester county—Two miles north of Dekert station, Intercolonial railway. (Copper content 1·40 per cent.)
(*b*) New Brunswick—
i. Carleton county—Parish of Northampton. (Copper 4·60 per cent.)
(*c*) Quebec—
i. Compton county—Moes River valley.
ii. Megantic county—Southwest quarter of lot 14, R. 14 of Leeds.
" Southwest quarter of lot 14 B, R. 13 of Leeds.
iii. Sherbrooke county—Castle Brook township, near Orford mountain.
(*d*) Ontario—
i. Algoma district—Lot 10, con. 5 of Cobden township.
ii. Nipissing district—Lot 2, con. 6 of James township.
" Southeast quarter of the south half of lot 6, con. 6 of James township.
" Southwest quarter of the south half of lot 5, con. 6 of James township—2 samples.
" Lot 2, con. 3 of Field township.
iii. Timagami district—T. R. 1512.
iv. Five specimens, the locality of occurrence of which was not stated.
(*e*) Alberta—
i. Vicinity of Elden.
(*f*) British Columbia—
i. Certainty mine, Canyon creek.
ii. Canyon creek—locality not defined.
iii. United Empire group of claims.
iv. Moresby island—Pacific coast.

V. Ores of Nickel and Cobalt—3 samples from:—
(*a*) Ontario—
i. Nipissing district—James township—Lots 5 and 6, con. 6—2 samples.
ii. Nipissing district—Dundonald township—Lot and concession not specified.
(*b*) British Columbia—Locality not specified—1 sample.

VI. Manganese Ores—4 samples from:—

(a) Nova Scotia—
i. Cape Breton county—Boulardarie island.
ii. Lunenburg county—location not specified.

(b) British Columbia—
i. Hudson Bay mountain—Skeena River mining division.

VII. Limestones and Dolomites—206 samples from:—

(a) Nova Scotia—
i. Antigonish county—1 sample.
ii. Cape Breton county—100 samples.
iii. Colchester county—2 samples.
iv. Cumberland county—3 samples.
v. Guysborough county—8 samples.
vi. Inverness county—48 samples.
vii. Richmond county—13 samples.
viii. Victoria county—12 samples.
ix. Yarmouth county—1 sample.
x. Two samples, the locality of occurrence of which was not stated.

(b) New Brunswick—
i. Albert county—1 sample.
ii. St. John county—6 samples.

(c) Quebec—
i. Wolfe county—canton of Weedon—4 samples.

(d) Ontario—
i. Bruce county—Lot 9, con. 11 of Greenock township.
ii. Timagami district—1 sample.
iii. Manitoulin island—2 samples.

(e) British Columbia—
i. Vicinity of Trail—1 sample.

VIII. Brick and Pottery Clays—8 samples from:—

(a) Nova Scotia—
i. Inverness county—Diogenes brook, Denys River district.

(b) Ontario—
i. Bruce county—Lot 9, con. 11 of Greenock township.
ii. Manitoulin island.

(c) Manitoba—
i. Vicinity of Riding mountain, on Canadian Northern Railway land.
ii. Two specimens from undefined localities.

(d) Alberta—
i. From the Morden estate on sec. 22, tp. 30, R—1 sample from the east side, and one from the west side of the town site of Pincher Creek.

IX. Graphite, and Graphitic Schists—4 samples.

These were examined with the view of ascertaining the amount of the carbon contained in them. They were from:—

(a) New Brunswick—
i. York county—from Meductic, on the St. John river.

(b) Ontario—
i. Renfrew county—lots 9 and 10, con. 2 of Lyndoch township—2 samples.

(c) Manitoba—
i. Sec. 9, district of Riding mountain.

Summary Report of Mines Branch,
Department of Mines,
For nine months ending December 31, 1909.

ERRATA.

Owing to the change from fiscal to calendar year, some confusion has arisen in the compilation of Assay Office statistics; necessitating the following corrections:—$1,583,138.43, p. 11, line 5 from bottom; *read* $1,478,893.74.

For that part of Manager's report commencing on p. 34 and ending at line on p. 35 prior to statement on 'Credits and disbursements,' *substitute* the following:—

Report Covering the Operations of the Dominion of Canada Assay Office, Vancouver, B.C., during the Nine Months ending December 31, 1908.

A. Middleton, Manager.

There were 590 deposits of gold bullion received: Nos. 752 to 791 inclusive, and Nos. 793 to 1342 inclusive. The aggregate weight of the deposits before melting was 90,175·48 troy ounces, and after melting 89,117·76 troy ounces, showing a loss in melting of 1·1730 per cent. The average fineness of the resulting bullion was 0·801½ gold and 0·191 silver. The net value of the gold and silver contained in deposits was $1,478,893.74.

The gold bullion received during the nine months ending December 31, 1908, came from the following sources:—

Source.	Deposits.	Weights.		Value.
		Before Melting.	After Melting.	
		Ozs.	Ozs.	$ cts.
Yukon	188	60,132·56	59,985·62	1,000,296 11
British Columbia	351	24,429·21	23,536·64	392,930 28
Alberta	5	77·33	69.05	1,223 76
Alaska	16	5,536·38	5,526·45	84,443 59
	590	90,175·48	89,117·76	1,478,893 74

	Ozs.
Weight before melting	90,175·48
Weight after melting	89,117·76
Loss by melting	1,057·72
Loss percentage by melting	1·1730

The following table shows the business done by the Assay Office since its establishment:—

Fiscal Year.	Deposits.	Weights.	Value.
		Ozs.	$ cts.
1901-2	671	69,925·67	1,153,014 50
1902-3	509	36,295·69	568,888 19
1903-4	381	24,516·36	385,152 00
1904-5	443	29,573·73	462,939 75
1905-6	345	21,050·83	337,820 59
1906-7 (nine months)	269	20,695·84	336,675 65
1907-8	482	46,540·25	751,693 97
1908 (nine months)	590	90,175·48	1,478,893 74

Page 29: XII. Natural Waters—2 samples from:—

(*a*) Quebec—

*i. Cape Breton—East Bay—4 samples, *read:*

i. L'Assomption county—L'Epiphanie spring; in place of *.

Page 65: In schedule showing production of crude oil and sulphate of ammonia, the yield in gallons of crude oil per ton of shale is indicated under caption of sulphate of ammonia, and as gallons produced from total shale used; *read,* yield in gallons per ton of crude oil.

X. Rock and Mineral Analyses.

Two samples of chromite, and one of serpentine from the province of Quebec; and 1 of granite from Timagami district in Ontario have been analysed and reported. Much progress has also been made in the analysis of a series of 26 rocks from the Boundary district of southern British Columbia. The work upon these latter was not fully completed before the close of the period covered by this summary. They will appear in a subsequent report. This work has been carried out by Mr. M. F. Connor.

XI. Gypsum—8 samples from:—

(*a*) Nova Scotia—

i. Cape Breton county—East bay—4 samples.

ii. Victoria county—South bay, and Middle harbour—4 samples.

XII. Natural Waters—2 samples from:—

(*a*) Quebec—

i. Cape Breton—East bay—4 samples.

XIII. Furnace Assays for Gold, Silver, and Platinum—151 samples of material from all but one province of the Dominion, as follows:—

(*a*) Nova Scotia—3 samples.
(*b*) New Brunswick—12 samples.
(*c*) Quebec—29 samples.
(*d*) Ontario—48 samples.
(*e*) Manitoba—2 samples.
(*f*) Saskatchewan—6 samples.
(*g*) Alberta—2 samples.
(*h*) British Columbia—19 samples.
(*i*) Undefined localities—40 specimens.

XIV. 'Alum Rock,' so-called, from Vancouver island.

An interesting occurrence of what is locally known as 'alum rock,' has been met with in considerable quantity at Kyoquot sound, Vancouver island.

The first specimen sent, proved to be a partially altered feldspathic rock, containing no trace whatsoever of aluminium sulphate.

A subsequent sample—of the same general outward appearance—yielded, to hot water, nearly 10 per cent of its weight of aluminium sulphate,

A quantitative analysis of the material is under way.

XV. Miscellaneous Examinations.

Under this heading, are grouped upwards of 215 specimens—covering a wide range of material—which were not thought to be of sufficient importance to entitle them to be placed in the foregoing classification. In many instances no particulars of locality or mode of occurrence were furnished; in others a description, or identification of species sufficed: while in a few others, a determination of one or more constituents was required.

In all cases report was made, either orally, or by letter to the party most directly interested.

REPORT OF THE DIVISION OF MINERAL RESOURCES AND STATISTICS.

J. McLeish, B.A., Chief of Division.

The work of this Division was explained and reviewed at considerable length in the last Summary Report for the fiscal year 1907-8.

During the past nine months, 1908, the work of the Division has been carried on under difficulties similar to those existing during the previous year, viz., a smaller staff than formerly and a greatly increased volume of work. These conditions have resulted in undue delay in the completion of our final annual reports on mineral production. By exerting a special effort, however, we have succeeded in compiling and publishing a preliminary report on the mineral production of Canada on or about March 1, each year.

Our Preliminary Report on the Mineral Production of Canada in 1907 was completed and sent to press on February 27, 1908. The report was received from the printers and distributed during the following week. Copies were distributed at the annual convention of the Canadian Mining Institute held at Ottawa, March 3, 4, 5, 1908, and a paper on the mineral production during the year was also read at this meeting, thus placing information concerning our mineral output before the mining community and the public at the earliest opportunity.

In connexion with the early publication of this preliminary report acknowledgments are due to the various provincial mining bureaus for their hearty co-operation in furnishing estimates: and particularly to the Provincial Mineralogist of British Columbia for a detailed preliminary estimate of the mineral production in that province; also to several of the railway corporations for furnishing statements of the shipments of ores from stations on their lines. Although the figures of output are subject to some variation in the final report—necessarily published much later in the year—the early publication of the material in this form is very useful; since the statistics and general résumé of the mining progress given, furnish a fairly approximate estimate of the mineral output during the year.

It is the desire and object of the department not only to furnish the public with the means of obtaining a broad knowledge of Canada's mining industries and resources, and to supply information that will attract the investment of capital for the development of these resources; but also, to be of as great service as possible to those directly interested in our mining industries.

The revised Annual Report on the Mineral Production in Canada in 1906, the completion of which was delayed for reasons already set forth, was sent to the printers on July 23. The annual report for 1907 was well in hand toward the close of the year, but interference of other work and the absolute necessity of devoting our whole attention to collecting the statistics and compiling the preliminary report for 1908 caused it to be set aside for the time being.

Considerable time was devoted to the preparation of special statistical reviews, including a brief statistical review of mining in Canada; a statistical review of mining in Nova Scotia; statistical review of mining in Quebec, and statistical tables of mineral production in Ontario, etc. These were all incorporated and published in the Report on the Mining and Metallurgical Industries of Canada, 1907-8, recently issued by this department.

Commencing August 24, and continuing through September, the Canadian Mining Institute conducted an excursion through Canada, visiting nearly all the important mining districts, with the object of demonstrating to those taking part, Canada's mining possibilities. Accompanying the excursion as guests of the Institute were representatives of the chief mining and metallurgical societies of Great Britain and Europe, gentlemen of international reputation in the mining world; also a number of distinguished mining engineers of Europe and America travelling in a private capacity.

Acting on your instruction, I joined the excursion at Toronto on September 3, and accompanied them throughout the Ontario and western tour.

In Ontario, visits were made to the silver mines at Cobalt, the nickel-copper mines and smelter in the Sudbury district, and the iron mine at Moose mountain.

In the west, the itinerary included visits to the natural gas wells at Medicine Hat; coal mines at Coleman, Hosmer and Fernie; St. Eugene silver-lead mine at Moyie; Bonnington Falls power plant; metallurgical works of the Consolidated Mining and Smelting Company at Trail, B.C., and the gold-copper mines of Rossland: including the Le Roi; Le Roi No. 2; Centre Star and War Eagle mines. The Boundary district was next visited: the mines and smelters of the British Columbia Copper Company at Greenwood; the mines at Phœnix, and smelter at Grand Forks of the Granby Consolidated Mining, Smelting and Power Company receiving special attention. Returning to Nelson, a visit was made to the Blue Bell mine, Kootenay lake, after which the excursion proceeded to Victoria. On Vancouver island a short stay was made at the Tyee Copper Company's smelter at Ladysmith; the party then proceeding to the mines of the Western Fuel Company at Nanaimo.

On the return journey east, a visit was made to the anthracite coal mines and briquetting plant at Bankhead, Alta., operated by the Bankhead Mines, Limited.

The above is but a mere outline of a journey which has been fully described in a report of 370 pages by the secretary of the Canadian Mining Institute, and published as a quarterly bulletin of that society.

The objects of the excursion were well expressed by Dr. Willet G. Miller, Provincial Geologist of Ontario, when he said it was thought 'that it would be beneficial to the mining interest of this country if representative mining engineers of Great Britain and abroad could be given an opportunity of seeing for themselves something of the great and unique mineral resources of the Dominion: of noting the important developments that have taken place in recent years, and of thus carrying away with them a fair conception of the actual position of our mining industry.'

The results will no doubt be of great benefit in the development of Canada's mineral resources.

It was expected that representatives of most of the provincial mining bureaus would take part in this excursion, and that opportunities would be presented for the discussion of problems relating to the securing of greater uniformity in the collection, compilation, and publication of mining statistics, and mineral production generally.

Unfortunately the opportunities for such conferences were fewer than was anticipated; although much valuable interchange of opinion on the subject took place.

In order to give a better understanding of some of the difficulties to be overcome, attention is directed to the following facts:—

In Canada there are nine separate and distinct provincial legislatures; each of which—with two or three exceptions—has entire control of its mining lands, mining laws and regulations: while the Dominion Government controls the mining lands and administers the mining laws and regulations in the Yukon and unorganized territories; also the selling or leasing of mining lands or mining rights in the provinces of Alberta, Saskatchewan and Manitoba.

The provinces of Nova Scotia, Quebec, Ontario and British Columbia publish annual reports of their respective mining bureaus or departments: which contain annual statistics of mineral production, in addition to general information concerning the mining industry.

It is safe to say that, in no two of these provinces are the mineral statistics collected and presented in exactly the same way.

The Dominion Government also, through the Department of Mines, provides for the collection and publication of mining statistics (6-7 Edward VII., Chap. 29, sec. 6 (*a*)); and this work is to a large extent done independently of the provincial bureaus.

Some of the differences in the methods of collecting and publishing statistics are shown in the fact that, all the provinces do not use the same commercial or business year. For instance, in Nova Scotia the year used is the period of twelve months ending with September. In British Columbia, while the year used is ostensibly the calendar year, the figures of production of the metals represent the smelter returns received only during that year. In some cases the total output whether shipped or not is included as production; while in other cases, only the actual sales or shipments are included as production. Methods of valuation also differ. In Nova Scotia no attempt is made to value the production. In Ontario the shipping value, or the value computed at the mines or works is used. In British Columbia the metals are valued at the average price of the metal for the year in the New York metal market—as a basis, with a deduction in some cases of 5 or 10 per cent. Metallurgical products, made in Canada from imported ores, are in some cases included as a mineral production of the province in which they are manufactured, while in other cases they are not included.

It is not unreasonable to suppose that, the various provincial mining bureaus could agree on the calendar year as the period of time to be covered in the collection of statistics, and that they could also agree on a uniform method in their collection and publication.

The mining statistics collected by the Department of Mines, are, of course, collected and compiled on a uniform basis for the whole Dominion; but when these are given in detail there is sometimes an apparent conflict with the provincial statistics; whereas there is no conflict, only a different point of view.

In the absence of provincial uniformity, however, we shall endeavour to make the mining statistics published by this Division not only comprehensive, but also give the returns in as much detail as possible without disclosing the source of confidential returns.

In my Summary Report for 1907, attention was drawn to the fact that, owing to the reduction in the staff of this Divison (formerly three technical officers and two clerks; now one technical officer and two clerks) our work had fallen in arrears. It was also pointed out that, to properly discharge the functions of the Mines Branch, viz., 'To collect and publish full statistics of the mineral production, and of the mining and metallurgical industries of Canada, and such data regarding the economic minerals of Canada as relate to the processes and activities connected with their utilization, and to collect and preserve all available records of mines and mining works in Canada,' would at the very least demand the re-establishment of the Division to its former strength.

Our statistical work alone, is now at least three times as great as it was a few years ago, and requires to be done in much greater detail. Other functions have been added to our duties: such as the checking and entering up of the Vancouver assay office computations. Although a mere detail, this work alone occupies a considerable portion of the time of one clerk. Moreover, as pointed out last year, regular field work—in the shape of personal visits to mining localities and mining operators—is necessary to enable the compiler of statistics to properly understand and co-ordinate them. The majority of mining operators are willing to furnish very complete information concerning their operations to a personal applicant, while few will take much trouble to answer correspondence. The duty of keeping up to date the information published in the report on the Mining and Metallurgical Industries of Canada—which now devolves upon this Division, is a work which will require very considerable attention, while the republishing of this report, which will be required every few years, will necessitate special assistance for that purpose.

Although this report is intended to cover the calendar year, we may add that, during the months of January and February, 1909, we have, as usual, succeeded in collecting and compiling sufficient information on which to base a Preliminary Report on the Mineral Production in Canada in 1908. The revised statistics of production in 1907 were also included.

The report was completed and sent to the printer on February 25, 1909, received the following week, and immediately distributed to the mining community. In order that it may reach a wider circulation, it is re-printed herewith, as appendix II.

DOMINION OF CANADA ASSAY BRANCH.

VANCOUVER, B.C., February 26, 1909.

SIR,—As instructed in your valued favour of the 15th inst., I beg to enclose a Summary Report (in quadruplicate) covering the operations of the Assay Office for the nine months ending December 31, 1908, and embodying suggestions as to the future utility of the office to the public.

I have also enclosed reports from the Chief Assayer and Chief Melter for nine months ending December 31, 1908.

I regret that my report is not more complete, but the residues, etc., had not been sold and I did not have the necessary data in regard to expense for premium on bonds, stationery, telegrams, printing, etc., to show percentage of net expense to deposits. I have not entered any of the disbursements made at Ottawa for the Assay Office.

As instructed by your letter of January 9, I was arranging to dispose of residues, etc., so as to make a Summary Report at the close of the Fiscal Year on March 31, but will continue with these preparations and clear out everything so as to commence the new fiscal year with a clean slate.

I am, sir,
Your obedient servant,
G. MIDDLETON,
Manager.

E. HAANEL, Ph. D.,
Director of Mines,
Ottawa, Ont.

REPORT COVERING THE OPERATIONS OF THE DOMINION OF CANADA ASSAY OFFICE, VANCOUVER, B.C., DURING THE NINE MONTHS ENDING DECEMBER 31, 1908.

G. Middleton, Manager.

There were 590 deposits of gold bullion received; Nos. 752 to 791 inclusive, and Nos. 793 to 1342 inclusive. The aggregate weight of the deposits before melting was 90,175·48 troy ounces, and after melting 89,117·76 troy ounces, showing a loss in melting of 1·1730 per cent. The average fineness of the resulting bullion was 0·801½ gold and 0·191 silver. The net value of the gold and silver contained in deposits was $1,583,138.43.

The gold bullion received during the nine months ending December 31, 1908, came from the following sources:—

Source.	Deposits.	Weights. Before Melting.	Weights. After Melting.	Value.
		Ozs.	Ozs.	$ cts.
Yukon	188	60,132·56	60,092·84	1,002,176 84
British Columbia	351	24,429·21	29,549·94	494,121 76
Alberta	5	77·33	69·05	1,223 76
Alaska	16	5,536·38	5,597·00	85,616 07
	590	90,175·48	95,308 83	1,583,138 43

	Ozs.
Weight before melting	90,175·48
Weight after melting	95,308·83
Loss by melting	1,185·89
Loss percentage by melting	1·229

The following table shows the business done by the Assay Office since its establishment:—

Fiscal Year.	Deposits.	Weights.	Value.
		Ozs.	$ cts.
1901–2	671	69,925·67	1,153,014 50
1902–3	509	36,295·69	568,888 19
1903–4	381	24,516·36	385,152 00
1904–5	443	29,573·73	462,939 75
1905–6	345	21,050·83	337,820 59
1906–7 (nine months)	269	20,695·84	336,675 65
1907–8	482	46,540·25	751,693 97
1908 (nine months)	590	90,175·48	1,583,138 43

Credits and disbursements for the purchase of gold bullion and receipts from sale of same during the nine months ending December 31, 1908:—

	Credits.	Disbursements
	$ cts.	$ cts.
Credits established		1,500,000 00
Refund by draft No. 13736, July 14, 1908, to Deputy Minister, Ottawa, for overpayment on deposit No. 838		6 16
Disbursements for purchase of bullion:		
Cheques Nos. 752 to 791 inclusive	39,373 18	
Cheques Nos. 793 to 1342 inclusive	1,439,526 82	
Cheque No. 792, refund to U. S. Assay Office, Seattle, for overpayment to us on bar No. A–2, residue 1907–8	21 88	
Unexpended balance of credit Dec. 31, 1908	21,084 28	
	1,500,006 16	1,500,006 16
Proceeds from sale of bullion during nine months ending Dec. 31, 1908	1,431,967 60	
Value of bullion on hand Dec. 31, 1908—Bars Nos. 1295, 1296, 1298, 1299 and 1301 to 1342 inclusive	47,731 86	
Disbursements for purchase of bullion:		
Cheques Nos. 752 to 791 inclusive		39,373 18
Cheques Nos. 793 to 1342 inclusive		1,439,526 82
Cheque No. 792, refund to U. S. Assay Office, Seattle, for overpayment to us on bar No. A–2, residue 1907–8		21 88
Difference in favour of Dominion of Canada Assay Office		777 58
	1,479,699 46	1,479,699 46

Residue on hand December 31, 1908.

Slag from melting of bullion	350·00 lbs.
Granules	10·50 ozs.
Cornets	12·75 "
Silver	85·00 "
Mercury	9·00 lbs.

Thirty-eight empty Winchesters.

Contingent expenditures for nine months ending December 31, 1908.

Rent	$1,875 00
Fuel	274 11
Power and light	142 67
Postage and telegram	15 40
Telephone	44 00
Express charges	1,163 08
Assayers' supplies	179 50
Contingencies	117 56
	$3,811 32

CHANGES IN ASSAY OFFICE STAFF.

Miss Evelyn Tierney, Computer and Bookkeeper, resigned August 31, 1908.

Mr. Ross H. Fillion was employed as Temporary Clerical Assistant July 7, 1908, and appointed to succeed Miss Tierney as Computer and Bookkeeper, September 1, 1908.

Mr. Percy W. Thomas employed as Temporary Assistant Assayer July 22, 1908, and services dispensed with September 30, 1908.

IMPROVEMENT OF EQUIPMENT.

An electric burglar alarm has been applied to the vault and connected with the office of the British Columbia District Telegraph and Delivery Company.

ASSAY OFFICE BUILDING.

The lease of the building now occupied by the Dominion of Canada Assay Office, Vancouver, expires December 1, 1909, and I understand that a renewal may be refused unless at an advance over the present rent, which is $225 per month. I would, therefore, respectfully suggest that a lot not less than 50 × 120 feet be purchased, and a suitable building erected for the assay office.

SHIPMENTS OF BULLION BY REGISTERED MAIL.

Most of the bullion sent from the Yukon and Northern British Columbia to the Dominion of Canada assay office, Vancouver, is shipped by registered mail, and several of the largest shippers ask that the limit of weight of the individual parcel of bullion to be accepted in future by the Postal authorities for shipment by registered mail be increased from 5 to 15 pounds, but only ask for that privilege to be extended when the bullion is addressed to the Dominion of Canada assay office, Vancouver.

In explanation of the above they complain that it takes much time and expense to prepare bullion for shipment in 5 pound parcels, and as the Postal authorities place thirty 5 pound parcels of bullion in a mail sack, to make up the units of a large shipment to 150 pounds each, it would not matter, from a transportation standpoint, whether the individual parcel of bullion weighs 5 or 15 pounds, but the latter weight would be a valuable concession to the shippers, and would incidentally assist in diverting the output of the Yukon and Northern British Columbia gold mines from a foreign to a Canadian market.

MARKETING OF GOLD FROM THE NORTH.

Regrets are often freely expressed by our leading commercial citizens that San Francisco and Seattle instead of Vancouver have reaped the enormous trade benefits and financial prestige accompanying the marketing of the output of the Yukon and Northern British Columbia placer gold mines. The gold output of the Yukon is again on the increase, and in the course of another year or two it will probably be larger than at any time in its history. The bulk of the Yukon gold output apparently would have been marketed at the Dominion Assay Office, Vancouver, during the past season, if the charges imposed had been satisfactory to the shippers.

Practically the only difference between the charges imposed at the San Francisco mint and the Selby Smelter, and those in force at the Dominion of Canada assay office is the extra charge imposed at the latter of $\frac{1}{8}$ to 1 per cent on the gross value of the gold and silver contained in the bar. The greater part of the gold output of the Northern placer mines will likely be shipped to the Dominion of Canada assay office the coming season if the wishes of the shippers are met, in regard to increasing the weight of parcels of bullion to be accepted by registered mail, and if the following charges are imposed:—

1st charge.—Melting charge: $1 on each melt.

2nd charge.—Toughening and alloy charge: 2 cents per ounce on $\frac{1}{11}$ of the standard weight of gold contained in the deposit.

3rd charge.—Parting and refining charge: 4 cents per ounce on the weight after melt.

The first charge is not imposed at present on gold from the Yukon on which the Royalty has been paid. If we purchase bullion during the season to the value of say $5,000,000 we would receive $6,250 less in charges by not imposing the charge of $\frac{1}{8}$ of 1 per cent on the gross value of the deposit, which would be offset, to a certain extent, by imposing the melting charge of $1 on each melt.

Supplies on hand in the Melting Department on December 31, 1908.

3 sets of linings, supports and covers complete, for No. 1 size furnace.
4 " " " 2 "
3 " " " 4½ "
4 " " " 7 "

4 graphite crucibles	No.	6
22 "	"	10
77 "	"	16
37 "	"	30
28 "	"	40
61 "	marked	o o o o
3 crucible covers	No.	16
3 "	"	9
8 "	"	50

4 graphite stirrers. 10 lbs. of Carbonate of Soda.
4 lbs. of Pot. Nitrate. 9 lbs. of Borax Glass.

[Signed.] D. Robinson,
Chief Melter.

Inventory of Residues and Supplies on Hand in Assayers Department, Dec. 31, 1908.

Silver discs, 650 mgrm.	41·47	ozs.
" " 50 "	20·37	"
" " 25 "	2·84	"
" bars	85·00	"
Gold cornets	12·75	"
" proof	10·32	"

Lead foil, about	70·00 lbs.
Granulated zinc	1·00 "
" lead, about	6·00 "
Litharge	25·00 "
Calcic chloride	1·00 lb.
Copper wire	1 spool.
Cupels, about	8250
Bone ash, about	35·00 lbs.
Nitric acid	10 Winchesters.
Ammonia	1 Winchester.
Hydrochloric acid	$\frac{1}{8}$ "
Empty Winchesters	38
Extra muffles	8
Extra muffle doors	6
" supports	7
" plugs	20
" back stops	9
Scorifiers (4")	9
" (2¼")	62

(Signed.) J. B. FARQUHAR,
Chief Assayer.

FIELD WORK

PRELIMINARY REPORTS

PRELIMINARY REPORT ON THE TUNGSTEN ORES OF CANADA.

T. L. Walker, M.A., Ph.D.

In accordance with instructions received from you, I have, during the past six months, devoted myself to an investigation of the occurrence in Canada of ores of tungsten, with a view at an early date of making a report to you on this subject.

As is well known, the demand for tungsten for the manufacture of tungsten steel has caused a general search in recent years in various parts of the world for deposits yielding these ores. The production has rapidly increased, but has not kept pace with the demand, as indicated by the general rise in prices. Eighteen months ago, before the depression in the steel industry, tungsten ores carrying 60 per cent of tungsten acid were worth $11 per unit or $770 a ton for 70 per cent ore. The present world production of these ores is about 4,000 tons per annum.

It seemed strange that, while the many States of the American republic were steady producers, no record was available of the production of even a ton from Canadian territory. Ores of tungsten had been reported from several parts of Canada, but they were known only as mineral curiosities.

With a view to determining the distribution of tungsten ores in Canada, and in order to stimulate interest on the part of mining men and prospectors, I was requested to examine the known tungsten regions, also regions which, from their geological characteristics and mineral associations, gave promise as possible producers of these ores.

During the summer I accordingly visited all the known Canadian tungsten localities, with the exception of the Yukon, also most of the regions which produce gold from quartz veins or placer deposits. It is well known that in the United States there is a close parallelism between the distribution of tungsten and gold ores. In several of the old gold mining regions tungsten minerals were discovered. In some instances the tungsten values are by-products in the gold mining, in others the tungsten industry is now the more important.

The three known localities for these ores in Nova Scotia—Northeast Margaree, Cape Breton; New Ross in Lunenburg county; and Malaga Mines in Queens county—were visited. Samples of concentrates were collected from numerous gold mines with a view to chemical examination. At Moose River mines, Halifax county, I was shown some fragments of tungsten which had been broken from a boulder by some of the miners while out hunting. This mineral usually occurs as a decomposition product from wolframite or scheelite—the chief tungsten ores—and consequently the determination of tungsten meant a very strong probability of finding these ores in the vicinity. As soon as the nature of the mineral was known an active search was undertaken by these gentlemen, which was happily crowned with success. They located half a dozen quartz veins carrying scheelite about two miles west of the Moose River mines. Later in the season I again visited this region, and had an opportunity of studying the nature and extent of the deposits, which certainly promise considerable economic value.

The region around Murphys brook near Northeast Margaree, is well worth careful prospecting: the quartz veins which traverse the granite and altered slate should be closely examined for tungsten minerals.

In Beauce county, in the province of Quebec, the occurrence of scheelite was reported by Mr. Ferrier of the Geological Survey staff, in 1890. This is a region where argentiferous galena was found in quartz veins, and, in the gangue, scheelite was a frequent constituent. No mining had been done for many years, and little was to be observed.

In the Kootenay district, B.C., the ores of several of the gold quartz mines carry tungsten minerals, but the tungsten values have never been saved. This is true of the Kootenay Belle and Queen mines, near Salmo; the Granite-Poorman, five miles west of Nelson; and the Meteor mine on Springer creek, Slocan district.

The well known deposit of scheelite on Hardscrabble creek near Barkerville, Cariboo district, was visited. No work has been done there for years, and it was not possible to examine the underground workings. From the geological conditions, and from the appearance of the ore which I examined, this seems to be a probable producer. At present, owing to its being nearly 300 miles from the nearest railway station —Ashcroft, the cost of mining and shipping is bound to be exceedingly high, and it may well be doubted whether this property can be operated until better transportation facilities are provided. Scheelite was discovered in the heavy gravel and sands of several of the gold placer mines in the Cariboo district.

In accordance with your instructions I returned home through the United States in order to examine on the way the tungsten deposits in Boulder county, Colorado, and to study the methods employed in the concentration of the ore.

The information gathered as to the nature of the Canadian deposits, along with a general statement regarding the production prices and concentration of tungsten ores is being embodied in a report which I hope to be able to forward to you at an early date.

PRELIMINARY REPORT ON CHROME IRON ORES, AND ASBESTOS IN THE PROVINCE OF QUEBEC.

Fritz Cirkel, M.E.

I beg to submit herewith, a preliminary report of work done by me during the season 1907-8.

CHROME IRON ORES.

Having already visited in 1907 a number of chrome iron ore mines and prospects in the province of Quebec; with a view to writing a monograph on chrome iron ores, I continued this work in April, 1908. Nearly all the chrome iron ore deposits in the Eastern Townships were visited, the mills and mines inspected, and the mode of occurrence of this mineral closely studied.

The Monograph on Chrome Iron Ores was written during the months of May, June, July and August; a part of this time having been devoted to the gathering and preparation of data on the mines and metallurgical establishments of Ontario, for the general Report on the Mining and Metallurgical Industries of Canada, 1907-8, published December 31, 1908. A résumé of my work on the chrome iron ore resources may be given in the following words: The demand for Canadian chrome iron ores has steadily increased during the last four years; owing principally to the excellent quality now produced in the mines and mills, and also to the preference given by American buyers to the Canadian product on account of the proximity of the mines, and existing shipping facilities, compared with those of the New Caledonia resources.

In former years, while the presence of silica in the ores used for furnace linings—beyond a 4 per cent limit—was objected to; at present ore is sold containing over 8 per cent, and sometimes 10 per cent; since it has been found that the excessive amount of silica is after all not so detrimental to the operation of a blast furnace as originally supposed. This has greatly stimulated the demand for the Canadian article; and it may be confidently expected that, with the exploitation of the still dormant chrome iron ore resources, the ever increasing demand for these ores by United States consumers will be met in the near future. As a matter of fact, for the last two years the demand has been greatly in excess of the supply; the immediate cause of this condition was the extensive development work—preparatory to exploitation—undertaken in the existing mines. New compartment shafts have been sunk—in one instance to a depth of 400 feet—for the purpose of tapping the great ore bodies: diamond borings have been undertaken, and adits driven. All this work was done for the purpose of creating a broader working face, and a greater number of working points; thus enabling the producers to increase their output or to regulate the latter according to demand. The Canadian production of chromite for 1907 had a value of $72,901, whereas the value of chromite produced in 1901 was only $25,444.

ASBESTOS.

For the purpose of writing a second edition of my Monograph on Asbestos issued in the year 1905, I devoted part of August, October, and November to the examination of the working asbestos mines, and more particularly to the study of the lateral extension of the Broughton Serpentine range, with a view of mapping the latter. This new Broughton Serpentine range has lately come into prominence by reason of the considerable development carried on in ranges III, IV, V, VI, VII and VIII of the township of Broughton by a number of corporations and private individuals. Before the year 1907, only two mines and mills were working in that district; to-day, four are in operation, and before long two more establishments will be added to the list of producing mines. The Broughton Serpentine range commences in the third range, and traverses in southwesterly direction the township of Broughton as far as range XI. Its productive width varies from 100 to several hundred feet; the greatest width so far determined being on range VI, where it attains several hundred feet. Its total length is eight miles.

Since the last issue of the Monograph on Asbestos was written—1904, the industry has progressed as never before in its history: the production for 1904 being 35,479 tons valued at $1,199,919; whereas in 1907 the production amounted to 61,985 tons valued at $2,483,211, or an increase in production in three years of over 75 per cent, and in value 100 per cent. This unprecedented increase is due principally to the great demand during the last number of years from the United States and Europe. As a consequence thereof, the older establishments have largely increased their capacity, while new producers have been added to the list. In 1904 the total capacity of all the mills in the asbestos district was 3,500 tons of asbestos rock per day; at the present time about 6,000 tons of rock can be treated, and if all expectations are realized, several new milling plants now in course of construction will be added during the year 1909; which will mean a further increase of 1,000 tons per day, or a total capacity for all the mills of 7,000 tons. It is now acknowledged, that Canada supplies 90 per cent of the world's production of asbestos. In foreign countries new discoveries have been made from year to year, and great hopes as to the exploitation of these resources were entertained; but so far the asbestos market has been almost exclusively supplied by the Canadian mines. The future outlook of this comparatively young industry is indeed very encouraging, and as the deposits so far developed are mostly of large extent, showing practically an unlimited supply of the mineral, there seems to be no doubt that the capacity of the respective works can still gradually be enlarged in order to keep pace with the demand: prompted by the constantly increasing number of the commercial uses to which this important mineral is being applied.

PRELIMINARY REPORT—SECOND SEASON—UPON IRON ORES OF NOVA SCOTIA.

Dr. J. E. Woodman.

Under final instructions from you dated May 22, 1908, field work was begun on May 27, in completion of the task assigned in 1906. The first break occurred with the return of the party on September 19, and thereafter shorter trips were taken whenever weather conditions permitted. On account of unavoidable delays the month of May—which it had been planned to spend entirely in the field—was almost resultless. Throughout the season Mr. F. H. MacLaren, B.Sc., was employed as first assistant; and Mr. G. B. McCunn acted as second assistant for one month; the large extent of country covered making this necessary. Additional temporary assistance was frequently employed, chiefly in the form of guides. In many instances owners, or interested parties, rendered voluntary service when examination of their properties was in progress.

The field work covered (1) the remainder of the iron ore occurrences—with the exception of part of Pictou county, and scattered localities elsewhere; (2) the major part of the season was consumed in a study of the metallurgical limestones of the province, as having a most important bearing upon the iron and steel problem in eastern Canada.

Such figures as are used below; analysis averages, distances, etc., are preliminary.

IRON ORES.

The iron-bearing zone of the Cobequids does not extend as a definite unit east of Debert river. Many small veins of ankerite and allied minerals may be found across Colchester county, and into western Pictou; but they are isolated, and of no commercial importance. Nowhere is there a zone of fracturing filled in a way like that of the Londonderry district.

At Kemptown, northeast of Truro, and on the south flank of the Cobequids, is a local shear zone in which occur vein deposits of 'bottle' and dense limonite, also red, and specular hematite. The total length of the fissuring is several miles; but the productive part appears to be confined to a mile at the west end, in Upper Kemptown. The wall-rock—a quartzite, has been slightly replaced; but for the most part the deposits are mere veins, and depend for their size upon the original open spaces. Hence it cannot be expected that there are very large bodies; although 'float' of very pure ore up to 3 feet in thickness has been found. There may be enough to contribute to existing furnaces with some profit, if the present wagon haul of several miles to the railway can be overcome. The best of the specular hematite near the Munro shaft, Upper Kemptown, runs as high as 68·62 Fe. An average of several samples of limonite with small amounts of hematite, taken from the western openings, is 57·69. It would, however, be impossible at present to ship ore of this high grade, since wall rock is too much intermixed.

The limonite contact pockets and the carbonate ores of Pictou county are still under observation. In the Devonian of Antigonish and Guysborough counties are many occurrences of specular hematite: specimens of which are of very high grade, hence have caused undue optimism on the part of interested parties. Most of these were examined, and almost without exception were found to be veins of small extent, and no promise. The Burns mine at Erinville, Guysborough county, is the only deposit that showed evidence of more than a very limited tonnage, a few thousand tons having been taken out at various times. Transportation to tidewater was too expensive. The ore here is a very soft coarsely specular hematite of high grade, but containing an excess of sulphur. The body is in the form of a pocket, and the ore becomes lean and spathic toward the walls. A sample of the best obtainable on a large dump gave:—

Fe	67·88
Insol.	1·25
Phos.	0·018
Sul.	1·148

In Richmond county, Cape Breton, a large number of occurrences of hematite and limonite were investigated. A few showed magnetite. Some of the deposits are veins associated with the contacts of intrusive rocks; others are at unconformities between the Lower Carboniferous conglomerate and various pre-Cambrian formations; still others, as also in some parts of Cape Breton county, are in felsite. In all these the conditions are unfavourable to expectation of large quantities. In the conglomerate contact bodies there is in some places possibility of pockets of a few thousand tons, and it may pay to open up for shipment to existing smelters those situated close to transportation; but none are of such promise as to warrant placing a high selling valuation on the properties.

A few occurrences are interbedded hematites, little prospected; but having some promise, as in part of the Loch Lomond district. None are situated close to transportation at present. An interesting deposit is that of the Micmac mine, between Robertson and Soldier coves, a few miles southeast of St. Peters. It is a contact body of magnetite and hematite in limestone, lying at, and near the contact of, the Windsor series and the Devonian below. Since 1882 some little work has been done on these prospects. The sulphur and phosphorus are high; but this contact is well worth exploring for a mile to the east across the Indian reserve. An average of all the samples available to date gives:—

Fe	44·74
Insol.	7·80
Phos.	0·625
Sul.	0·726

The veins in felsite, mentioned above, may be typified by those south of Arichat, Richmond county, and those at Gabarus, Cape Breton county: the mineral being usually specular hematite. It should be unnecessary to say that there can be no hope for workable bodies under such conditions.

In various parts of Cape Breton county, notably along the range of the Boisdale hills, are deposits of hematite similar to the magnetite of Barachois, previously described (Report of the Superintendent of Mines, 1906, pp. 30-31). At the Curry property—halfway between East bay and Boisdale—is a pocket of this type, locally long known as the Mosely mine. Its longest axis is northeast, parallel to the strike of the crystalline limestone in which it lies. The ore is of good grade, but the tonnage is limited. Slight traces can be found northeastward for some distance, but for the most part the replacement has been too incomplete to give a high iron content. At the Campbell farm, three miles to the northeast and on the strike of the Curry ore, an impure replacement of limestone and quartzite gave 42·51 Fe. A general sample of the large dump at the Curry mine gave:—

Fe	56·790
Insol.	12·750
Phos.	0·008
Sul.	0·022

Along the south side of the Coxheath hills, and only a few miles west of Sydney, are a number of untested contact deposits of limonite, lying at the base of the Lower Carboniferous limestone and against the pre-Cambrian. The location of these is favourable to cheap mining and transportation, as they are of easy access to the Sydney furnaces; and well worth exploration. A general sample of one-half ton from one pocket gave:—

Fe..	54·700
Insol..	6·980
Phos..	0·092
Sul..	0·013

By far the largest district investigated during the season is the Mira field, in southern Cape Breton county. This lies on the east side of the Mira river, and extends from near the Roman Catholic church at Grand Mira, south, to below Marion Bridge on the northeast—a distance of eight or nine miles. The field has long been known, and in parts a considerable amount of surface exploration has been made—enough, at all events, to indicate quite definitely the characteristics and value of the deposit. The ore varies from a black magnetite to magnetic hematite, and thence to a non-magnetic phase. It is interbedded in quartzites and slates, and in many ways bears a close resemblance to the Arisaig ore. Several belts are uncovered, also more lines of partial replacement; and the mineralized zone can be traced, with perhaps a slight interruption by faulting, over the entire distance mentioned.

The largest amount of work has been done on the northeast end near Marion Bridge by the Dominion Iron and Steel Company, and on the south by the Nova Scotia Steel and Coal Company. The latter shows ore mixed with alternate bands of slate and quartzite up to several feet in width; but in no case does an ore band exceed two feet. The ore often grades into rock insensibly, becoming siliceous outward from the centre of the band. At Marion Bridge there is a tradition of a drift boulder showing 3 feet of hematite clear of rock, and much of the exploration evidently was based upon that theory. But no evidence could be secured of more than a few inches of clear ore.

The most marked peculiarity of the iron throughout the field is the discontinuity of the bands. Not only do they pass transversely into rock by insensible gradations, but they die out completely along both strike and dip, in many cases reappearing again within a few inches or feet as occupants of the same rock horizon. The evidence indicates incomplete replacement of siliceous strata by iron oxides. These occurrences are the best illustrations yet seen by the writer, which are of service in working out the genesis of the bedded or Clinton type of ores. From an economic point of view, however, the district is a disappointment, as the replacement is everywhere too incomplete to provide workable ore at anything like the present price of iron, in a field which for many years has been regarded as an important prospect. This is the more disappointing since the type is one from which much is usually expected, and the analyses made indicate an ore comparing favourably with any other bedded occurrences. The district is at all points very accessible to Sydney. The best ore, in which replacement was complete, gives over 60 per cent Fe; less than 10 per cent insoluble; a moderate amount of phosphorus (for a bedded ore); and a negligible quantity of sulphur.

The work of the season, then, may be summarized as regards iron ore by the statement that, no indications of large ore bodies were found; only a few which may upon proper exploration prove of value as contributors to smelters which are not obliged to depend upon them for their chief source of supply.

METALLURGICAL LIMESTONES.

The metallurgical limestones of Nova Scotia were examined in only a few localities during the previous investigation; but a considerable part of the season of 1908 was spent in studying them. They occur in so many, and such widely separated places that, full justice could not be done them except by at least one complete season of work.

GEOLOGICAL DISTRIBUTION.

While most of the great work systems represented in the province contain limestone horizons, those which are pure enough for furnace use occur chiefly in the pre-Cambrian (George River series) and the Lower Carboniferous (Windsor series). The former is limited to the island of Cape Breton, and contains both magnesian and non-magnesian varieties. In the Carboniferous limestones the magnesia is usually very low. In a few places it rises to a percentage approaching that in some of the pre-Cambrian magnesian limestones, but the rock never becomes a true dolomite.

PRE-CAMBRIAN LIMESTONES AND DOLOMITES.

Having regard to availability of situation, the most important district is that of North mountain, on the north side of St. George channel and south of Denys river. It embraces a zone one and a quarter miles broad and at least ten miles long: in one place being connected with another extensive zone on the Denys River side of the mountain. Much of it is close to deep water at the lake front, and all within feasible tramming distance. The limestone occurs in a series of irregular bands which vary greatly in breadth. The front or south band contains the Marble Mountain quarries of the Dominion Iron and Steel Company and the Bras d'Or Lime Company; the former shipping to the Sydney furnaces during the open season a maximum of 20,000 tons per week. It is a very long zone of sediments; but the workable limestone portions are the shortest of the three. Parts are dolomitic, in some cases individual strata being thus characterized, in others the magnesia being very local and erratic in distribution. The chemical irregularity mentioned above is characteristic of the pre-Cambrian limestones everywhere, as is well shown at St. John, N.B., also at New Campbellton. The rock is completely crystalline, and while in places certain strata are even in texture, in others the grain changes rapidly from fine to coarse. The same may be said as to colour: it may, or may not be, characteristic of certain strata, its changes may be sudden or gradual, and may, or may not be, connected with structure. Thus in the main quarry at Marble mountain, where stratification is absent in places, the colour changes erratically from white to gray, dark blue to pink. So far as can be learned, the chemical quality is not a function of either texture or colour, or a combination of these. The insoluble matter of this band runs as low as 0·82 per cent and as high as 4·66 per cent in the main quarry, an average of six samples giving 2·63 per cent. This zone extends altogether from the extreme northeast end of the range for 7·5 miles, its westerly extremity being west of Lime Hill. The limestones become siliceous west of Marble mountain, and are soon replaced largely by other sediments.

The second zone begins at the east on the 'Squire McDonald' property, one and a half mile east of Marble mountain, and approximately three-quarters of a mile from the shore. It varies greatly in breadth: from a few yards to hundreds, and extends west to a brook near Lime Hill church—a distance of nearly six miles, gradually approaching the shore, so that where last seen at the west it is but half a mile back. Like all the limestones of this district, its stratification is rarely distinct. The magnesia content is variable, but always low; the silica runs from 0·64 to 5·26 per cent—averaging 3·20 per cent.

A third band lies at a maximum distance of one mile from the shore, and like the other is variable in breadth. Its length corresponds closely to that of the middle zone. The silica runs from 1 20 per cent up, averaging about 4·20 per cent. Magnesia is generally low. South of the middle band described above, a few yards distant, and on the west side of a farm locally known as the McRae grant, is an isolated patch of dolomite approximately 450 by 250 feet, surrounded by granite. Its insoluble matter averages only 0·88 per cent and its magnesia ($MgCO_3$) is 42·12 per cent. Thus it is an almost pure dolomite.

From the old Morrison quarry at Lime Hill, lying one-quarter of a mile back from the shore, a band of dark blue limestone of great purity runs westward obliquely across the mountain for nearly three miles to the Denys River side. In places it attains a breadth of several hundred yards. At its eastern end, and until it plunges into the mountain it averages 1·58 per cent silica, becoming quite impure in places farther west. Its convenient situation makes it an unusually good shipping proposition. The Morrison quarry has a back-wall of fine trap, and a very few thin dikes cut the limestone at Marble mountain; but as a whole this region is remarkably free from basic intrusions, especially when contrasted with St. John, N.B.

West of this band, near the head of the channel, at West Bay marshes, various linear deposits were found. Several gave very excellent analytical results. The total amount of limestone, magnesian and non-magnesian in the North Mountain range is very great, and much of it is of a high degree of purity. The highest altitude reached by the limestone outcrops of the district is approximately 670 feet, while the middle and north ranges are over 600 feet, except at the west end at Lime Hill. Owing to the fact that the pre-Cambrian sediments are almost everywhere surrounded and invaded by granites, it is impossible to tell how deep the limestone goes, or the attitude of its igneous contacts in general. Outcrops show the granite locally underlying the former rock in one place, but distinctly overlying it in another. For the most part, the contacts as exposed, are vertical; hence it is fair to presume, since the present surface of the ground, is a temporary and accidental erosion surface and as the limestone outcrops now extend from sea-level to at least 670 feet, that as a whole, any limestone band will be found to reach fully as deep as quarrying operations are feasible.

Three features connected with prospecting for limestone may be of interest. (1) The relation between the forest growth and bed-rock. It was found in the North Mountain field that in first or virgin growth the limestone is covered almost entirely with hardwood, while the granite is protected by evergreens to a great extent. Whether this can be used as a guide in other similar regions could not be determined, since most of the limestones of the province are on second growth land or are so remote from transportation that they were not visited. (2) That outcrops of all varieties and ages of limestones tend to assume a bouldery aspect on account of the method of weathering; and it often happens that a few detached boulders of limestone are as reliable for tracing a formation as detached bed-rock outcrops of a less soluble rock would be. (3) A most satisfactory method was discovered for distinguishing dolomite from limestone in the field: namely, the roughness of the weathered surfaces of the former. Indeeed, small amounts of magnesia very locally distributed often suffice to bring out the contrast in surface between pure and magnesian phases in the same ledge. The dolomite when coarse weathers so rough as to look superficially like a fine granite. When the weathering becomes extreme the calcite dissolves out completely at the surface, and the rhombohedrons of pure dolomite disintegrate from the face of the rock, forming a coarse gravel.

A second important area is that of New Campbellton, at the mouth of the Great Bras d'Or. Here a narrow band of crystalline limestone, in part dolomitic, lies between the granites of St. Anne mountain and the Carboniferous on the east; and in one place a dolomite quarry has been opened scarcely 250 yards from the slope of a coal mine. The aggregate quantity of available limestone is regarded as being many millions of tons in a total length of less than 3·5 miles, although the district is but a fraction of the size of the North Mountain field. The silica varies widely, from

0·50 to quite unworkable amounts. The dolomite is very local, but there is a large body entirely surrounded by limestone, opposite an old slope at the end of the coal tram line northward from Kelly cove.

The Boisdale hills, which furnished the Barachois magnetite, have a large amount of crystalline limestone and dolomite, and these have been extensively worked at the northeast end, on George river, by the two steel companies. At this point the rock is very variable in silica, frequently becoming almost pure serpentine; hence, except for certain narrow bands, has been abandoned. Limestones are found intermittently for sixteen miles, to the north side of East bay at MacIntosh brook, nearly as far west as Eskasoni. For the most part, except for a mile at the northeast end, they lie on the top of the mountain, and are less accessible to transportation than some others. In many places the quality of the stone is excellent; in others the silica is high. At Eskasoni a wedge-shaped band of limestone starts northeast from the shore at the east end of the Indian reserve, and runs obliquely up the mountain for 2·5 miles. In parts its quality is good, and it is close to shipment, although the water is not deep. The silica is high near the shore; farther inland it averages 3·30 per cent.

One mile west of the village of Whycocomagh, at the head of St. Patrick channel, is a promising deposit of coarse white dolomite of some magnitude, having less than one per cent silica, and 42·00 per cent magnesia. It could be quarried and delivered at the wharf at Whycocomagh very cheaply.

As it is impossible in a summary report even to mention all the deposits, the foregoing are given as typical examples.

In view of the possibility of smelting operations in the western part of the proince, special mention must be made of the limestone of St. John, N.B., from which shipments are even now being made to the furnaces at Sydney. In, and near the city are, apparently, two zones of the so-called George River series, which at the northeast merge, and extend for many miles. They are much more profusely intruded by basic rocks than in Cape Breton, and the dikes interfere in places with the quarry work, even making the rock unsaleable. Nevertheless an extensive business is carried on by a number of firms, in 'pulp lime' (dolomite) and 'plaster lime' (ordinary limestone). The rock is for the most part distinctly stratified, fine-textured, and inclining to dark colours. While varying in composition it is of great purity in most of the places worked, and doubtless is equally good in the still greater territory which has not yet been touched. Thus at Drury cove, north of the city, an average of three samples by the writer gave 1·68 per cent insoluble matter. In the quarries of Stetson and Cutler the silica ranges from 0·70 to 2·75 per cent. A dolomite quarry gave 0·56 per cent silica; but the composition in this quarry is variable. Other properties east of the St. John river averaged 0·69, which is remarkably low for an area of several miles. West of the river, and on an extension of the same strata is very pure lime, both ordinary and magnesian. A sample analysed by the author, gave:—

	Per cent.
$CaCO_3$	55·26
$MgCO_3$	41·55
SiO_2	0·50

At Green head—the northernmost land west of the river on which the rock outcrops, and in a range west from the Drury Cove quarries—an average of 2·00 per cent silica was found.

The quantity of good limestone in the St. John district is enormous, its situation with reference to transportation is good, and the field is capable of supplying not only western Nova Scotian smelters, but eastern ones as well.

CARBONIFEROUS LIMESTONES.

These differ from the pre-Cambrian in being always distinctly stratified and relatively thin. Workable deposits are confined to the Windsor series—as far as now known. Often of a high degree of purity, they present difficulties in furnace practice because of the different composition of adjacent beds, so that a horizon of, say, 15 feet thick may give several silica proportions in various parts of its cross-section. While all the strata may be usable, and a general mixture excellent, it is difficult to avoid high variability in the shipments, and hence in the furnace charges. A second cause of uncertainty is the thickness of the deposits. Thus, where the dip is low a large area must be stripped; where high, a depth below ground-water level is quickly reached in quarrying. A third difficulty sometimes encountered is, the tendency of the rock—downward, to become siliceous; turning rather suddenly into a sandstone or grit. A large number of deposits, however, are of sufficient size and purity to supply a single furnace, or for mixing with pre-Cambrian rock for large plants.

The distribution of the limestone is very wide, practically co-extensive with that of the Windsor series, although but a small part of the area is occupied by this rock. The series also contains a vast amount of gypsum; and in some deposits—as between Iona and Little Narrows, C.B.—the two occur in juxtaposition. In appearance the rock is usually gray, sometimes dense and flinty, sometimes less dense, and full of small cavities, sometimes composed almost entirely of shell fossils. Much of it gives out a more or less fetid odour when struck.

Beginning at the west there are many occurrences in Hants county; but most of them too thin, too erratic in composition, too low in topography, or too far from transportation. With the opening up of smelting operations at Annapolis or Parrsboro they might in some cases be available; but for this purpose, so large in quantity and excellent in quality is the limestone to be had from St. John, that it is doubtful whether they could withstand the competition.

In Colchester county are a number of small deposits near the Intercolonial railway, which could be employed in any smelter situated on that line, as at Londonderry. They are often very pure, like that long worked at the McDonald quarry, Lanark: a sample of the refuse from which gave 3·40 per cent silica. A small quarry one mile west of Brookfield station gave 0·30 per cent silica. At Anthony's Nose, on the Shubenacadie river, and within reach of the Midland division of the Dominion Atlantic railway, the rock runs 2·30 per cent silica, but has 5·60 per cent of iron and alumina.

The ankerite fluxes of the Londonderry district have already been dealt with (Vol. 1 of the iron report). Eastward to Pictou county there is little along the railway line. The limestones south of New Glasgow are still under observation. At and near Antigonish are several deposits of good grade. All the occurrences on the mainland, however, suffer the disability of expensive rail transportation.

In the island of Cape Breton are many good deposits. Small ones are situated along the Sydney and Louisburg railway at Catalone lake; analyses of three of which gave, respectively, 4·00, 2·00 and 0·86 per cent of silica. The Sydney district is dotted with local deposits. The most extensive is that operated by the Nova Scotia Steel and Coal Company at Point Edward, opposite Sydney. It extends from the shore of Northeast Arm, southeast and south to South Arm opposite the city—a distance of four miles. It is, or has been worked in three quarries, located about halfway across the peninsula. The rock here dips northeast at a very low angle, necessitating wide stripping. The horizon is 12 to 15 feet thick at the quarries, and consists of at least three strata, differing chemically, and stripped in separate bunches. Samples gave 5·60 per cent silica in the lower bench, 3·38 per cent in the middle, and 1·50 per cent in the upper; but furnace charges averaged only 1·60 per cent for fifteen days in March, 1907. At George river, west of the pre-Cambrian quarries, two openings are now supplying Carboniferous limestone to the Dominion Iron and Steel Company. A combined sample of the two gave silica 1·04 per cent.

Part of the New Campbellton district contains good Carboniferous limestone. A large cliff of shell rock at the northern end of the field gives 0·48 per cent silica. The main limestone hill, lying one-half mile north of Kelly cove, and made of massive rock, averages 3·87 per cent of silica. It is admirably situated for cheap handling, and contains a large body of rock.

The north side of the Bras d'Or lakes has—in a few places—much lowland limestone: as between Little Narrows and Iona; but too impure, or too remote, or low, for operation. On the south side, however, are several important deposits. At Morley brook, south of the village of East Bay, a large and accessible body lies in the form of a shallow syncline. Its northern edge is 1·75 miles south of the line which will be taken by the St. Peters-Sydney railway when built. An average of the samples taken, exclusive of those close to the lower contact, gives only 2·72 per cent silica.

Westward along the lake front, and directly on the line of the proposed railway, are several smaller deposits. One of these, east of Ben Eoin, averages 0·28 per cent silica, over its full breadth. A shell limestone at Irish cove, extending for a length of half a mile, gave 0·76 per cent insoluble; and at and near the settlement of Red Islands a belt of shell limestone gave in one sample 2·44 per cent. Shipment averages quoted by the Nova Scotia Steel Company, which controls the deposit, are 0·90 per cent for two shipments. The band averages 30 to 50 feet in thickness; and although not high above the water over most of its exposure, gives a large tonnage on account of the great length of outcrop.

Taking into account all the limestone and dolomite of Cape Breton which may be usable in furnace practice, the total is almost beyond calculation. It has been estimated by one of the most competent engineers engaged in the development of metallurgical limestones in eastern Canada that, one-twentieth of the total occurrences may be good; the remainder too poor, or variable, or too remote. Some very large deposits known to be of great extent, and of high quality have not been examined during this investigation, merely because they were too far inland.

But even deducting the unsaleable portion, Nova Scotia, and especially Cape Breton island, has a great asset in these limestones, which are of such quality as to be suitable for pulp clarifying, land plaster, cement, or furnace use as the case may be. And it is not unlikely that it would materially benefit the province if some of the attention concentrated, and money expended hitherto, in fruitless attempts to build up large enterprises in certain other mineral resources, were diverted to the further exploitation and development of the limestone and gypsum industries.

INVESTIGATION OF IRON ORE DEPOSITS IN NEW BRUNSWICK AND NORTHWESTERN ONTARIO.

Einar Lindeman, M.E.

In accordance with your instructions, I visited—during the first part of the summer—some iron ore claims in the counties of Northumberland and Gloucester, New Brunswick; and on July 28, left Ottawa for Port Arthur, Ont., in order to investigate some reported occurrences of iron ore alongside the Port Arthur and Duluth railway; closing the season's field work by examining some alleged iron ore deposits near Mokamon station—Canadian Northern railway—twenty-five miles west of Port Arthur, Ont.

IRON ORE CLAIMS ON NORTHWEST MIRAMICHI RIVER, NORTHUMBERLAND AND GLOUCESTER COUNTIES, NEW BRUNSWICK.

In the hope of finding commercial iron ore deposits, a large area of land has been taken up in the counties of Northumberland and Gloucester, N.B., by a syndicate represented by Mr. James Ferguson, of Newcastle. The land is held under what the Provincial Mining Act calls 'license to search,' and includes an area of about thirty-five square miles, situated on the northwest Miramichi river and its tributaries; Little river; Tomogonops river; West brook; Portage river; and also on the headwaters of Gordon brook—a tributary of Nipisiguit river.

GENERAL GEOLOGY.

In general the formation is well covered by glacial debris, and densely wooded. Few natural exposures are to be found, except in some of the rivers and creeks, where the covering of drift has been cut through by the streams. The prevailing rocks of the district are gray quartzites and reddish and gray slates, which in places become schistose with irregular veins of quartz. Occasionally these schistose rocks contain iron pyrites, which gives them a rusty appearance.

PROBABLE VALUE OF THE REGION.

A few years ago a discovery of several magnetite deposits was made at Austin brook, a tributary of Nipisiguit river, and situated about two miles northeast of the area under consideration. These deposits, occurring in a mica schist, have—by a magnetometric survey, and diamond drilling—been proved to contain a large tonnage of ore. The successful development of the Austin Brook property has undoubtedly stimulated the speculative buying-up of practically all the surrounding land; and although no discovery of commercial importance has so far been made by the prospectors on these newly acquired lands, the fact that, the geological formation is very similar to that of Austin brook warrants the probability that, by close and systematic prospecting deposits of iron ore may be found there. The vast area, the difficulties of travel, and the drift-covering, all combine to make prospecting a difficult matter, and may explain why the search is not further advanced.

ELLIS IRON CLAIM.

This claim is situated about four miles west of St. Rosette, which is about nine miles north of Bathurst, Gloucester county, N.B. Along the flank of a ridge running about east and west, several outcrops of magnetite occur in an altered siliceous schist. By means of these outcrops and the magnetic attraction, the ore formation can be traced for about 950 feet along the ridge. Several open-cuts and a tunnel have been made into the hill, showing the width of the ore formation to be from 4 to 14 feet. While high-grade magnetite can be picked in places, the ore, as a rule, is interstratified with the same siliceous material forming the walls. Four average samples taken in different places across the ore body give the following analysis:—

	I.	II.	III.	IV.
Insoluble matter	58·6	21·000	27·7	28·900
Iron	19·2	48·200	45·2	48·400
Sulphur	....	0·819	....	0·231
Phosphorus	....	0·036	....	0·023

These analyses show—as might be expected from the admixture of the country rocks—that the iron content is rather too low for the utilization of the ore in its natural state. By magnetic concentration, however, the commercial value of the ore can undoubtedly be raised, since nothing in the composition of the ore seems to prevent this; but unless other discoveries are made, the limited quantity of ore in sight seems hardly to warrant this.

INVESTIGATION OF THE IRON ORE POSSIBILITIES ALONG THE LINE OF THE PORT ARTHUR AND DULUTH RAILWAY.

The area embraced in this investigation, is the country around the railway line of the Port Arthur and Duluth railway, from the International Boundary Line eastward to Whitefish lake, a distance of about thirty-three miles.

Economic Geology.

The great similarity of the iron-bearing rocks of the district with those of the Mesabi range has often stimulated the hope that, similar deposits existing in Minnesota, may also be found here. With the exception, however, of some enrichment of thin layers of magnetite interbanded with chert, no second concentration of the iron ore formation seems to have taken place, and so far no commercial ore deposits have been found. The same condition seems to exist on the eastern part of the Mesabi range where the eruptive greenstones also are numerous. It has been assumed that these eruptive magmas have metamorphosed the iron formation, and thereby caused the development of magnetites and amphiboles, and that these minerals having been able to resist the surface alteration have remained practically unaltered.

The weight which must be given to this assumption can only be ascertained after extended explorations. At Loon lake, about twenty-six miles east of Port Arthur, where eruptive greenstones are also intruding the Animikie iron-bearing rocks, considerable exploratory work has been done by test-pitting and diamond-drilling. The result of this work shows that the iron-bearing rocks here have been subject to a secondary concentration, and altered to hematite, although, as a rule, this is reported to be low grade.

CLAIMS T. B. 41; T. B. 42; AND T. B. 60 IN THE TOWNSHIP OF CONMEE, WESTERN ONTARIO.

Before leaving for Ottawa, the writer received instructions to visit the abovementioned iron claims. They are located about a mile west of the Canadian Northern railway at Mokamon station in the township of Conmee, about twenty-five miles west of Port Arthur, Ont. A belt of interbanded jasper and siliceous magnetite outcrops on several places along a hill through all the claims. The strike of the rock is somewhat N.E.—S.W. with a steep dip. An average sample of the iron-bearing formation gave only 9·06 per cent iron. Owing to the large amount of siliceous matter present in the ore, and the low iron content, these claims have so far not proved to be of commercial importance.

PRELIMINARY REPORT ON A MAGNETIC SURVEY OF THE HURON MOUNTAIN, TIMAGAMI FOREST RESERVE.

B. F. Haanel, B.Sc.

In accordance with your instructions, I left Ottawa on August 8, 1908, for the Timagami Forest Reserve for the purpose of making a magnetic survey of the Huron Mountain mine. On account of the supposed similarity, geologically, of this iron ore occurrence to that of the Moose Mountain iron mine, this Branch was strongly urged to make this examination.

SITUATION.

Huron Mountain mine is situated on the northwest shore of Manitopipagi lake, approximately thirty-five miles southwest of Timagami station, which is situated on the northeast arm of Lake Timagami.

ROUTE TO PROPERTY.

To reach this property, it is necessary to take one of the regular steamers plying between Timagami station and Bear island, where is situated a Hudson's Bay Company's post. Here one can obtain all necessary camping outfits, canoes, guides, etc., From Bear island it is necessary to travel by canoe for a distance of seven miles in a southwestern direction on Lake Timagami, to a point on the mainland where there is a good portage of half a mile, which leads into a small lake. From the opposite shore of this lake another portage of about half a mile leads to Gull lake, a rather large lake. After crossing this lake, one long portage or two shorter ones, and crossing two small ponds, brings one to the east shore of Manitopipagi lake, on the opposite shore of which is situated the Huron Mountain mine.

TOPOGRAPHY OF PROPERTY.

This property comprises three lots: recorded claims T. R. 1346; T. R. 1347; and T. R. 1348. But the iron ore occurrences are confined almost entirely to a hill which is approximately 1,800 feet long by 700 feet wide. The highest point of this hill is 260 feet above the level of Manitopipagi lake. At its northwestern extremity the hill is precipitous, while on the south and southeast, north and northwest it is flanked by massive ledges of rock, which rise in both cases almost perpendicularly to a height of about 160 feet above the level of the lake.

TIMBER, WATER, ETC.

This property is well wooded with red and white pine, balsam, birch, and maple, and the water supply is abundant, there being in addition to Manitopipagi lake, which skirts the southwestern boundary of the property, a small lake within the property itself.

MAGNETIC SURVEY.

A base line was run in a northwest, southeast direction, starting at the shore of Manitopipagi lake. The entire base line, about 2,500 feet long, was divided into 60 ft. spaces, and cross lines run from these divisions. The cross lines, which in some instances were over 1,000 feet long, were divided into 30 ft. spaces, thus dividing the property to be surveyed into rectangles 60 by 30 feet. Observations were taken at the corners of all these rectangles, and at intermediate points whenever necessary.

LEVELS AND CONTOURS.

To facilitate the interpretation of the magnetic measurements, levels were taken at every peg on which a magnetic observation was taken, and these levels were then plotted as 10 ft. contours on the map of the vertical intensity. This was necessary on account of the uneven character of the ground.

GEOLOGY.

The iron ore occurs in the Keewatin iron formation, massive exposures of which flank both sides of the hill previously mentioned. Calcite and garnet are the most common accessory minerals associated with the iron ore. Calcite is also found in patches on both of the exposed ledges of the Keewatin formation. An intrusive sheet of greenstones cuts across the iron formation in a north-northwest and south-southeast direction. The maximum width of this intrusive sheet, as measured where exposed by trenching, is 170 feet. At the north-northwest this intrusive sheet terminates in a precipitous bluff, and could be traced for a few hundred feet in a south-southeast direction.

SAMPLES COLLECTED FOR ANALYSIS.

Forty samples of iron ore were collected for analysis, together with some representative rock specimens. The analysis of the samples of iron ore show the ore to be fairly high in iron and free from any deleterious ingredients.

MAP OF VERTICAL INTENSITY.

A map of the vertical intensity, and a layout showing the location of drill holes for proving the property were made on my return to Ottawa. Besides these two maps, two copies of the map of the vertical intensity were made for the owners, to enable them to properly develop their property.

DIAMOND DRILLING.

Since diamond drilling is now being prosecuted by a gang of sixty men, it seemed advisable to hold over the full report until the details of the drill cores could be obtained. I was, therefore, instructed to delay the full report until after examination of these drill cores, which are expected to be shipped to us early in the spring.

MAGNETITE DEPOSITS IN MAYO TOWNSHIP, HASTINGS COUNTY, ONTARIO.

By Howells Fréchette, M.Sc.

In accordance with your instructions I left Ottawa on August 9, to visit some of the iron ore deposits along the Central Ontario railway, in Hastings county, Ontario.

The summer was devoted to examining deposits in Mayo township, near Bessemer and Hermon, and making magnetometric surveys of a number of them.

The Bessemer deposits were discovered in 1898, but no ore was shipped until 1903. At that time the ore had to be hauled by team to L'Amable station, a distance of about five miles. In 1906, a railway was built from a point on the Central Ontario railway near L'Amable to Bessemer, under the charter of the Bessemer and Barry's Bay railway, making it possible to ship on a larger scale, and at a lower cost.

The deposits at Bessemer are owned by the Mineral Range Iron Mining Company, Limited, and were operated by them until the beginning of 1908, when certain mines were taken over, on a royalty basis, by the Canada Iron Furnace Company, Limited, under a fifteen year lease.

During the past year this Company operated two mines, known as No. 3 and No. 4. No. 3 was only worked for a short period, while No. 4 was in operation steadily until the middle of November, when it was closed for the winter. No. 4 shipped, on an average, about 125 short tons of ore per day, to the Company's blast furnace at Midland, Ontario.

GENERAL.

The ore deposits in the district visited are all magnetites and are situated in a belt of amphibolites, which has a general strike about northeast and southwest, as shown on the Bancroft Map, No. 770, of the Geological Survey, by Drs. Adams and Barlow.

The ore zone roughly follows this strike, and was traced from lot 1, concession VI, to lot 12, concession IX, in Mayo township, a distance of about four miles.

In this report the deposits will be dealt with in order from southwest to northeast, though the following reservation is made: between the deposits known as No. 4 and the Child, no systematic search was made for iron, owing to the lack of time; therefore, it must not be inferred that the single deposit mentioned in this interval is the only one.

No. 1.

A magnetometric survey was made on the north half of lot 1, concession VI. This survey indicates the presence of a number of very small pockets of magnetite, one of which has been opened and a small quantity of ore removed. This pit is known as No. 1. The ore is badly intermixed with rock and is cut by a dike.

Forty-five feet to the east of this opening there is a larger deposit, running east and west, 250 feet long with an average width of about 30 feet. No sample of this ore could be taken as it is completely covered with soil and broken rock.

The following analysis is from a picked sample taken in No. 1 pit and would indicate what might be expected in the larger deposit:—

	Per cent.
Insoluble matter	29·92
Iron	49·41
Phosphorus	0·027
Sulphur	0·004

The country rock is amphibolite changing to hornblende schist in the neighbourhood of the ore.

No. 2 and No. 3.

In several places alongside the railway, outcroppings of magnetite are found on lots 2 and 3, concession VI.

No. 2.—On lot 2 an opening, known as No. 2, has been made, a short distance north of the railway, from which 1,500 tons of ore have been shipped. The ore in this pit is much intermixed with rock, making culling expensive and wasteful.

Owing to the irregular shape and the condition of the pit it was impossible to get an average sample of the ore. A picked sample was taken and gives the following analysis:—

	Per cent.
Insoluble matter	15·36
Iron	52·46
Phosphorus	0·004
Sulphur	0·006

No. 3.—About 1,300 feet east of No. 2, two pits have been opened on the south side of the railway, which are, together, known as No. 3 mine. From these pits a considerable quantity of ore has been shipped. As in the case of No. 1 and No. 2 the ore contains a large proportion of rock, though not to such a great extent. The ore, here, may be easily hand picked; as the rock is well defined from it. The ore dips at about 70° to the south, having a hanging wall of mica schist. The included rock is principally fine grained quartzite, and some calcite. The foot-wall was not uncovered, but a few hundred feet to the northwest a mass of crystalline limestone is cut through by the railway.

The following analysis is from an average sample taken across the body in No. 3 West:—

	Per cent.
Insoluble matter	20·82
Iron	49·33
Phosphorus	0·002
Sulphur	0·059

The following analysis is from a picked sample from No. 3 West, showing the grade of the shipping ore:—

	Per cent.
Insoluble matter	10·92
Iron	59·56
Phosphorus	0·007
Sulphur	0·06

A magnetometric survey was made extending from 150 feet west of No. 2, to 450 feet east of No. 3 East, a distance of 2,010 feet.

This survey indicates that No. 2 has been opened on a small pocket. It also shows the presence of a larger deposit of ore 100 feet north of the railway and 300 feet east of No. 2. It is about 120 feet long and 50 feet wide. Nothing can be said as to the grade of this ore, as no sample could be got. There is another deposit about 100 feet long and from 10 to 30 feet wide, 600 feet east of No. 2 and 150 feet north of the track.

On the south side of the railway the only ore of any consequence is that in which No. 3 is sunk. Here there are two deposits: the east pit in one and the west pit in the other. They are separated by about 50 feet of rock in which are small patches of ore.

The west deposit is about 120 feet long and 60 feet wide at the widest point, and the east deposit is about 150 by 120 feet. Besides these two deposits there are a few small pockets, on a line extending east and west through these two main deposits.

No. 4.

No. 4—the principal deposit at Bessemer—is situated on lot 4, concession VI. Its eastern extremity is about 500 feet from a small lake, under which it extends for some distance.

The ore is a close grained magnetite, fairly free from intermixed rock, and lies between clearly defined walls. The deposit is from 40 to 60 feet wide, and dips 65° to the south. Several core drill holes have been sunk on this body; but unfortunately, the logs are not available for this report.

The following analysis is from a sample taken across the face of the open-cut at the time the mine was closed for the season:—

	Per cent.
Insoluble matter	12·01
Iron	57·76
Manganese	4·26
Phosphorus	0·008
Sulphur	0·007

Average analysis of 25 carloads shipped to Midland, during 1908[1]:—

	Per cent.
Iron	54·0
Sulphur	0·075
Phosphorus	0·022

The main part of the ore removed has been from open-cut workings. At the west end of the open-cut, which is about 260 feet long, 60 feet wide and 40 feet deep, a shaft has been sunk with a level at 60 feet. From the east end of this level a raise was driven to the open-cut and a new working face, about 25 feet high, was developed.

The ore is hoisted from the 60 foot level, and dumped into the crusher hopper. From the crusher it is delivered direct to the railway cars. The ore is culled in the mine and again in the cars. In this way the sulphur content can be kept down, as the pyrites, from which it comes, occurs in well developed streaks and masses of sufficient size to make culling easy.

LOT G, CONCESSION VII.

On the north side of the surveyed line for the proposed extension of the Bessemer and Barry's Bay railway, on lot 9, concession VII, about one mile from No. 4 mine, there is a deposit of magnetite, of which no detailed survey was made; but readings taken with the dip needle indicate that the body is about 100 feet long and but little over 15 feet at its greatest width, and hardly likely to be of great depth. No outcrop was found, so the grade of the ore is not known. There are other small patches of ore in this vicinity, but none of sufficient size to be of commercial interest were observed.

CHILD AND RANKIN PROPERTIES.

A magnetometric survey was made on lots 10, 11 and 12, concession IX, extending over onto lots 11 and 12, concession VIII. Lot 10, concession IX, is owned by Wm. Rankin, and lots 11 and 12, concession IX—known as the Child property—are owned by the Mineral Range Iron Co., Ltd. The Canada Iron Furnace Co., Ltd., by the terms of their Bessemer lease, hold the option on this property until the summer of 1909.

Child property.—Three openings have been made on the Child property, from which about 1,000 tons have been raised. The ore has not been shipped, but remains in

1 Kindly furnished by Mr. George E. Drummond of the Canada Iron Furnace Company, Limited.

stock piles at the mine, awaiting better transportation facilities. The existing roads are very poor, being hilly and rough.

When the properties in this vicinity are opened and ready to ship regularly the Bessemer and Barry's Bay railway will be extended to them from Bessemer, a distance of two and a half miles. The line has been located and the right-of-way cleared.

The main deposit of the Child property runs northeast and southwest. It is of irregular shape, about 1,000 feet long and varying in width up to nearly 200 feet, in places. It dips to the southeast at a very steep angle.

The three openings which have been made on this body are along its foot-wall, where it outcrops from the hillside.

The ore, a coarse grained magnetite mixed with hornblende, is easily crushed and well adapted to magnetic concentration. An average sample taken from the two southernmost pits gives the following analysis:—

	Per cent.
Insoluble matter	33·46
Iron	40·61
Phosphorus	0·108
Sulphur	0·004

The following analysis is from an average sample of the stock pile at the north pit:—

	Per cent.
Insoluble matter	31·43
Iron	41·93
Phosphorus	0·038
Sulphur	0·005
Titanic acid	trace.

Extending in a line from the north end of the main deposit are two smaller deposits: the first one being about 125 feet by 40 feet, and the second 60 feet long and 30 feet at its maximum width. About 60 feet northeast of the main deposit are two deposits of workable size. One is about 110 by 60 feet and the other 75 by 60 feet.

There is a large area, about 450 feet to the northwest of the western portion of the main deposit, where uniform readings with the magnetometer of from 30° to 50° were observed. This would indicate the probability of a large deposit of a decidedly low grade magnetite. There is a heavy covering of sand and loam over this entire area, so that there was no exposure of ore. A pit had been started here, but owing to the running nature of the sand, and to water encountered, it was not carried deep enough to reach the ore.

At the western side of lot 11, concession IX, is a body of magnetite about 275 feet long by about 70 feet maximum width. This deposit extends over onto the Rankin property. About 120 feet of it is on the Child property, where it attains its maximum width; 66 feet on the road allowance and 90 feet on the Rankin property.

The *Rankin property*, owned by Wm. Rankin, Hermon, consists of lot 10, concession IX. Considerable surface work has been done, such as trenching and digging of test pits.

The main deposit is about 400 feet long × 130 feet wide. A number of test pits on this show ore of varying quality, from a high grade clean ore to a low grade ore containing considerable sulphur.

This low grade ore is on the north, or foot-wall of the deposit and seems to change gradually into amphibolite and bands of hornblende schist impregnated with magnetite. A sample from the low grade portion of this deposit taken in one of the trenches which cuts across the ore body, gives the following analysis:—

		Per cent.
Sample 1.	Insoluble matter	52·00
	Iron	28·11
	Phosphorus	0·167
	Sulphur	1·360

The following analysis is from an average sample across the main portion of the deposit taken from the same trench:—

		Per cent.
Sample 2.	Insoluble matter	37·72
	Iron	41·31
	Manganese	3·24
	Phosphorus	0·208
	Sulphur	0·430

There are portions of the deposit which would, undoubtedly, give much higher percentages of iron.

The trench from which the two foregoing samples were taken is 122 feet long. Sample No. 1 represents 22 feet at the north end of the trench, and sample No. 2 the remaining 100 feet.

To the east of the main deposit is another, about 270 feet long and up to 60 feet wide. It is quite likely that this deposit is connected to that indicated above by rock carrying magnetite disseminated through it, as is shown in a test pit about midway between them. No sample was taken from this body.

MAGNETIC CONCENTRATION.

In order to determine the suitability of these ores to magnetic concentration, experiments were made on the three having the lowest iron content.

It was attempted to crush the ore to about 40 mesh, but on sizing, it was found that about 50 per cent passed through the 100 mesh sieve. The ore was concentrated dry, by means of a very strong bar magnet. The concentrates and original ore were weighed and the percentage of concentrates from the ore was calculated.

ANALYSES OF ORE AND CONCENTRATES.

Ore.	Percentage of Concentrate.	Ore.			Concentrate.		
		Iron.	Phosphorus.	Sulphur.	Iron.	Phosphorus.	Sulphur.
Child (South pits)	60%	40·61	0·108	0·004	63·5	0·05	0·027
Rankin. Sample 1	40%	28·11	0·167	1·36	71·7	0·039	0·233
Rankin. Sample 2	60%	41·31	0·208	0·430	67·0	0·05	0·089

It will be noted that the phosphorus is much reduced in actual percentage and very greatly in its ratio to the iron. In two of the cases the sulphur is reduced, but in the third is increased; due, probably, to magnetic iron sulphide. If the concentration were followed by briquetting, such as in the Gröndal process, the sulphur would be further reduced.

As already mentioned, the ores in this locality are coarse grained and friable. The phosphorus exists probably as apatite, and may be partially eliminated in the process of magnetic concentration.

Although these ores are of too low a grade for direct reduction, they are very well suited to magnetic concentration and should furnish a high grade product at a comparatively low cost.

NOTES ON THE SMELTING OF TITANIFEROUS IRON ORES IN THE ELECTRIC FURNACE AT WELLAND, ONTARIO.

By B. F. Hannel, B.Sc.

Early in October, 1908, the Electro-Metals Company, Limited, of Welland, Ont., invited the Mines Branch of the Department of Mines to send a representative to Welland to witness the smelting of titaniferous iron ore in their electric furnace. I was, accordingly, instructed to proceed to Welland and report upon this experimental run.

The furnace used during these experiments was similar in construction and design to that employed at Sault Ste. Marie during the experiments carried on by the Dominion government in 1906, hence a description is unnecessary.

The ore—which was sent by the Union Pacific railway from their property in Wyoming—contained as high as 2 per cent titanic acid (TiO_2), and the object of the experimental run was to show that, an ore high in titanium could be successfully reduced in the electric furnace.

The principal figures relating to the run are as follows:—

Length of run (deducting stoppages)	22 hrs. 45 min.
Mean volts on furnace—	
High tension side	10,800
Low tension side	35·6
Mean amperes on high tension side	25·0
Power factor	0·91
Power used $\frac{10,800 \times 25 \times 0{\cdot}91}{746}$	329 h.p.
Pig iron obtained	3,317 lbs.

	Short tons.
Output of pig iron per 1,000 electrical horsepower days:	5·040
Electrical horsepower years per ton of pig iron =	0·543

The analyses of the iron ore, charcoal, lime, slag, and pig iron produced, have not yet been made by the chemists of the Mines Branch; but some analyses made in the laboratory of the Electro-Metals Co., Ltd., of Welland, show that with a charge containing 35 lbs. of lime, only a trace of iron was found in the slag, and that the iron content of the slag increases with the increase of lime.

In the runs containing 50 lbs. of lime, the amount of slag produced was very large. In future runs on this ore, however, the amount of lime per charge will be reduced to 25 lbs., which, it is calculated, will greatly reduce the amount of slag.

The lime was only reduced to 35 lbs. in runs subsequent to, or after my visit. The charges used during the run witnessed by me were as follows:—

10 charges.—	Iron ore	200 lbs.
	Charcoal	60 "
	Limestone	50 "
3 charges.—	Iron ore	200 "
	Charcoal	65 "
	Limestone	50 "
22 charges.—	Iron ore	200 "
	Charcoal	70 "
	Limestone	50 "

making a total of 35 charges.

Some analyses of the pig iron obtained showed only a trace of titanium.

The output in pig iron per 1,000 horsepower days for this run must not be considered as the best result that can be obtained, as the furnace during the first seven hours of the run operated very badly. To arrive at definite and reliable results as to output, the furnace should run continuously for at least three days.

On the completion of the analyses of the ore, lime, pig iron, etc., a full report will be prepared.

ON THE COLLECTION OF COAL SAMPLES FOR TESTING CANADIAN COALS AT McGILL UNIVERSITY.

Theophile C. Denis.

The greater part of the spring and summer of 1908 was devoted to the collection of coal samples for the series of tests of Canadian coals now being conducted at McGill University for the Department of Mines, to which reference was made in last year's Summary Report of the Mines Branch.

The same method of collecting samples was employed as during the previous season. The object being to obtain a 10 ton sample of coal under precisely the same conditions that it is put on the market from the various mines. Hence coal was taken in the ordinary course of operation of the mine—usually at the end of the picking belt. This method has the advantage of not interfering with the day's work of the colliery. The coal was obtained and sacked under my immediate supervision: tags and lead seals being affixed to each sack.

In some cases, when it was judged that the coal did not require washing, or in the case of the lignites on which coking tests were not conducted, smaller samples than the standard 10 tons were taken. The collieries of the following companies were visited, and samples obtained from each:—

BRITISH COLUMBIA.

Extension colliery, Wellington Coal Company.
Cumberland collieries, Wellington Coal Company.
Western Fuel Company.
Nicola Valley Coal and Coke Company.
Coal Creek colliery, Crow's Nest Pass Coal Campany.
Michel colliery, Crow's Nest Pass Coal Company.

ALBERTA.

International Coal and Coke Company.
Hillcrest Coal and Coke Company.
West Canadian Coal Company.
Leitch Collieries, Ltd.
Alberta Railway and Irrigation Company, Lethbridge.
Canada West Coal and Coke Company.
Breckenridge and Lund Coal Company.
Bankhead Collieries, Ltd.
H. N. McNeil Coal Company.
Parkdale Coal Company.
Standard Coal Company.
Strathcona Coal Company.

SASKATCHEWAN.

Western Dominion Collieries Company.
Eureka Coal and Brick Company.

In addition to the above, samples were secured from the Dominion Coal Company's mines, as follows:—

Colliery No. 1; Colliery No. 5, or Reserve; Colliery No. 7, or Hub; Colliery No. 9; Colliery No. 10, and Colliery No. 12.

During a great part of the summer the western coal industry was not very active. The effects of the financial and industrial depression of the previous winter had not completely disappeared, and in consequence some of the collieries were only working a few days a week during the summer months. It was felt, however, that this was only a temporary depression, and the coal operators were all looking to an early resumption of activity. This is borne out by the figures of production for the year received by the Statistician of the Mines Branch, which show that the total output of the western collieries is higher than the previous year.

In British Columbia several new collieries were being opened up on Vancouver island; in the Nanaimo field, and also on the mainland. The work of development on the Nicola Valley Coal and Coke Company's properties had so far progressed that they were equipped to mine and ship 300 tons a day; and could have kept up this rate of output had the market demanded it. The Diamond Vale Coal Company—controlling coal areas adjacent to the Nicola Valley Coal and Coke Company—sank a shaft some 70 feet deep, and reached a good workable seam. They expected to be in a position to begin shipping as soon as the coal trade resumed its activity.

In Alberta and Saskatchewan the same conditions prevail to a great extent. In the lignite districts, such as Edmonton, Lethbridge, and in the Souris field, the demand for fuel is always very light during the summer months; as the greater part of the output is used for domestic purposes. But it was expected that the mines would soon resume their full activity, to meet the usual heavy autumn demand. Industrial development in the prairie provinces is also greatly helping to establish a more even and steady production throughout the whole year. The consumption of coal by manufacturers is more uniform than the consumption for domestic purposes; the latter being very much less in summer than in winter.

One of the important results of the coal tests now being conducted at McGill University for the Mines Branch will be to show the suitability of low grade lignites in the manufacture of producer gas; which offers the best means of getting the greatest efficiency out of these low grade fuels, and of economically putting them to industrial uses. Owing to the present method of distributing electrical energy at high voltage over long distances, central power stations using producer gas could be established at the mines themselves; thereby ensuring a greater efficiency from the fuel, and effecting a marked saving in heavy transportation charges.

PRELIMINARY REPORT ON TESTS MADE IN SCOTLAND OF OIL-SHALE SENT FROM NEW BRUNSWICK IN THE SPRING OF 1908; WITH A VIEW OF ASCERTAINING ITS ECONOMIC VALUE, ESPECIALLY AS REGARDS THE CONTENTS OF CRUDE OIL AND SULPHATE OF AMMONIA.

Dr. R. W. Ells.

In connexion with the recent investigation of the bituminous, or oil-shales of Nova Scotia and New Brunswick, a shipment of some 45 tons of material obtained from, and representative of, the rich bands of oil-shale which occur at Baltimore, Albert county, N.B., was made to Glasgow, Scotland, by the Albertite, Oilite and Cannel Coal Company, Ltd., with headquarters in New York, U.S.A., but represented in New Brunswick by Mr. Matthew Lodge, of Moncton.

The importance of such a practical test of the oil-shales of the province by one of the leading Scotch companies engaged in the oil-shale industry, in order that the actual contents of crude oil and sulphate of ammonia might be determined, and its possible benefits to other parts of Canada ascertained, were so evident that, on the matter being referred to the Honourable the Minister of Mines—Hon. William Templeman—and to Dr. Eugene Haanel, Director of the Mines Branch of the Department of Mines, I was commissioned to proceed to Scotland to witness and report on the distillation tests about to be made. In pursuance with this work, I beg to submit the following report:—

I left Ottawa on May 29, 1908, for Glasgow, and arrived there on the 9th of June. I found that the shipment of shale had arrived some weeks previously, but through the absence of any order from the President of the Company in New York to obtain possession of it, several weeks elapsed before the actual business of retorting was commenced. The interim was spent in a study of the Scotch oil-shales in the field, also of the several plants, and in gathering information as to the industry generally. Arrangements were made with Mr. W. Fraser, Manager of the Pumpherston Oil Co., Glasgow—where the head office of the Company is situated—to undertake the contemplated tests both for the retorting, and the subsequent fractionation of the resulting crude oil, the whole of which was carried through with the greatest care and attention to details, hence the results may be accepted as perfectly reliable. I may say that, throughout the entire tests, invariable courtesy was extended to us. In this work I was assisted by Mr. W. A. Hamor, of New York, a chemist on the staff of Dr. Charles Baskerville, of the College of the City of New York, who was sent over to watch the process in the interest of the Company, and of whose ability I can speak very highly.

On July 13, the official order for the shale from the shipping company reached me via New York, but owing to various other delays which seemed unavoidable the material did not reach the works near Uphall until July 23. The process of distillation in the experimental Bryson retort was commenced at 4 P.M. on Friday, July 24, and continued without interruption until the 12th of August. These retorts have a capacity of 4 tons of Scotch shale per day of 24 hours; but owing to the somewhat different nature of the New Brunswick shale, as contrasted with the Scotch shale, the capacity was only about 2¼ tons per 24 hours. The shale worked readily in the retort, without clogging.

The whole process of initial retorting was most satisfactory throughout.

The official report of the Pumpherston Oil Company, Scotland, on the retorting, is as follows:—

Yield of crude-oil and sulphate of ammonia obtained from New Brunswick shale, passed through the experimental retort at the Pumpherston works, Scotland.

Date.	Shale used.		Crude Oil.		Sulphate of Ammonia.		Remarks.
			Make.	Sp. Gr.	Yield.	Yield.	
1908.	Tons.	Cwt.	Gals.		Gals.	Lbs.	
July 25........	2	4	95·85	·885	43·57	58·55	Not included in average, as shale in previous test was not all out of retort until July 26.
" 26........	2	6	99·45	·907	43·24	60·51	
" 27........	2	0	74·44	·920	37·22	75·38	
" 28........	2	5	86.13	·917	38·28	70·62	
" 29........	2	7	90·37	·911	38·88	70·01	
" 30........	2	3	81·80	·920	38·04	83·18	
" 31........	2	5	84·63	·916	37·61	67·46	
Aug. 1........	2	3	96·87	·918	45·06	82·73	
" 2........	2	3	84·32	·921	39·22	79·58	
" 3........	2	4	89·42	·927	40·64	81·88	
" 4........	2	4	79·56	·918	34·59	79·27	
" 5......	2	3	86·75	·910	40·35	55·47	
" 6........	2	5	88·70	·922	39·42	82·81	Condenser chest choked.
" 7........	2	3	87·38	·918	40·64	100·69	
" 8........	2	4	88·43	·921	40·19	62·45	Condenser chest cleared.
" 9........	2	3	95·72	·918	44·52	79·63	
" 10........	2	3	91·28	·911	42·46	81·31	Total shale received—41 tons 5 cwt.
" 11........	2	0	79·90	·925	39·95	71·14	
" 12........	2	0	87·58	·925	43·79	85·03	Put through before test—4 tons 10 cwt.
	36	15	1,473·28	·919	40·09	76·94	Put through during test—36 tons 15 cwt.

(Signed) For the Pumpherston Oil Co., Ltd.

G. M. McCulley,

Assistant Secretary.

August 13, 1908.

On the whole it may be safely stated that, the results of the retort tests of these shales, on the working scale, are eminently satifactory: both as regards the yields of crude oil and sulphate of ammonia; exceeding in these respects the greater part of the Scotch shales, which have been worked for many years.

The peculiar difference in the yield of these products from day to day, is inexplicable, except that it may be due to variation in the nature of the material as taken from the bed itself, or possibly to carelessness in mining, or to the inclusion of portions of the wall rock in some part of the shipment. It may also be stated that, the bed selected for this shipment at Baltimore is, judging from the physical character of the shales, by no means one of the best, being what may be regarded as a medium grade of oil contents, as contrasted with several other thick beds in the immediate vicinity; so that on the whole it may be safely asserted that a test of other beds in this area would have given even larger results in oil than the one selected, since the rich, blackish nature of some of these beds, with their jet black streaks of mineral somewhat resembling albertite in general aspect, and their curly character clearly indicate their superior quality.

At the close of the process of retorting the crude oil was ready for the fractionation test. This was carried on in the laboratory of the Pumpherston Co., by the chief chemist Mr. E. M. Bailey. Here also several delays occurred which were practically unavoidable: (1) through the absence of the chemist on his three weeks holidays, and (2) through his serious illness for several weeks after his return, so that the final results were considerably protracted. In this stage of the tests Mr. W. A. Hamor—my associate throughout the work—remained to supervise the final results. The report of the chief chemist, Mr. Bailey, here follows. It is endorsed by the manager, and may be regarded as very satisfactory. The fractionation was of necessity conducted entirely in the laboratory; since it was impossible to make such a test in the large works, owing to the necessity in such a case, of stopping the regular process of manufacture by the Company of their own oil-products. The fractionation report is as follows:—

'The Pumpherston Oil Co., Ltd.

'Test of shale received from Canada, through Dr. R. W. Ells.

'Crude oil made from July 27 to August 12, 1908, in the Pumpherston Retort.

REPORT ON CRUDE OIL.

'The crude oil was dealt with by two different methods for the purpose of obtaining refined products of good quality.

The liquid products produced by both methods were practically identical in quality when finished, but the colour of the crude paraffin wax or 'Scale' derived from method B, was much superior to that produced by the use of method A, a point of considerable practical importance when the conversion of the crude wax into refined wax of marketable quality comes to be considered.

It is probable, however, that further treatment with acid (before the soda treatment) of the crude distillate obtained by method A would have the effect of securing that a crude wax of good colour could be subsequently extracted.

So far as the percentage yields of refined products are concerned, these are very similar, whichever method of refining is adopted.

The following is an outline of the scheme of refining the crude oil:—

Method A.

The crude oil was distilled and fractionated into crude naphtha (1) and crude distillate (2). The crude distillate was treated with sulphuric acid (1·84 sp. gr.) and caustic soda solution (1·35 sp. gr.) and again distilled, fractionating into crude burning oil (3) heavy oil (4) and residuum (5).

Nos. (1) and (2) were further refined by treatments with acid and soda and distillations. No. 4 was cooled to a low temperature, and filter pressed to extract the solid paraffin (6). The blue oil (7) was filtered from (4), was treated with acid (1·72 and 1·84 sp. gr.) and soda (1·34 sp. gr.), distilled off solid caustic soda, and fractionated into various products, the refining of some of these being completed by a final treatment with acid and soda.

Method B.

The crude oil was treated with sulphuric acid (1·22 sp. gr.) and distilled and fractionated into crude naphtha (1) and crude distillate (2). The crude distillate was treated with sulphuric acid (1·72 and 1·84 sp. gr.) and caustic soda solution (1·35 sp. gr.) and again distilled, fractionating into crude burning oil (3), heavy oil (4) and residuum (5).

No. 4 cooled and filtered gave solid paraffin (6) and blue oil, 7. No. 7 was treated with acid (1·84 sp. gr.) and soda, distilled off solid caustic soda, and fractionated into various products, the refining of some of these being completed by a final treatment with acid and soda.

TABULAR STATEMENT OF REFINED PRODUCTS.

Method A.—Product.	Gallons per 100 Gallons.	Sp. Gr. at 60° Fahr.	S. P. Fahr.	M. P. Fahr.
Heavy naphtha	1·62	·7670	......	......
Burning oil	10·04	·7954	......	......
Gas oil	14·87	·8431	25°	......
Cleaning oil	2·83	·8713	25°	......
Lubricating oil	9·58	·8957	30°	......
Crude wax	2·26	......	......	112·26°
" "	0·93	......	......	101·00°
" "	......	......	......	......
Residuum from blue oil (refined)	0·28	......	......	......
Residuum from treated crude distillate (refined)	1·27	......	......	......
	43·68	......	......	......

Total crude wax containing 4 p. c. oil = 3·19 gals. = 2·907 gals. refined wax. Melting point, 108·98°.

Sulphuric acid used in refining 100 gals. crude oil. = 4·705 gals. (1·84 sp. gr.)

Method B.—Product.	Gallons per 100 gallons.	Specific gravity at 60° Fahr.	S. P. °Fahr.	M. P. °Fahr.
Heavy naphtha	1·45	·7670		
Burning oil	11·50	·7955		
Gas oil	13·04	·8450	25°	
Cleaning oil	1·56	·8705	26°	
Lubricating oil	11·03	·8935	30°	
Crude wax	2·21	......	......	111·34°
"	0·60	......	......	104°
"	0·16	......	......	84°
Residuum from blue oil (refined)	0·57			
Residuum from treated crude distillate (refined)	1·95			
	44·07			

Total crude wax containing 4 p. c. oil = 2·97 gals. = 2·707 gals. refined wax. Melting point, 108·38° F.

Sulphuric acid used in refining 100 gals., crude oil = 4·68 gals. (1·84 sp. gr.)

Flash point of burning oil = 117° Fahr. (Abel Close test).

Viscosity of lubricating oil=200° F. (seconds) at 70° F. (Redwood's apparatus).

REMARKS ON QUALITY OF PRODUCTS AND SAMPLES.

Considering the character of the crude oil, and the nature of the material (which we do not consider a true oil-shale) whence it is derived, I consider the quality of the refined products very satisfactory.

The samples are representative of the products obtained by both methods of refining. It will be easily understood, however, that it is impossible to mix these in precisely their due proportions, so that the physical constants of the samples are not perfectly identical with those given in the tabular statement, but only close approximations thereto.

As it is impossible on a small scale to extract all the lower melting point portions of the crude wax by direct cooling and filter-pressing, the sp. gr. and setting point of the cleaning oil and lubricating oil given in the statement differ somewhat from those of the samples submitted, the sp. gr. of these oils and yield of low M. P. crude wax (equivalent to 0·93 and 0·76 on the crude oil) being calculated to what would be obtained by a reduction in setting point to that obtainable on the manufacturing scale. The calculation is based on data derived from actual experiment, and is perfectly reliable.

It must be understood, however, that the yield of high M. P. crude wax (equal to 2·26 and 2·21 per cent) is that actually extracted and determined.

(Signed) EDWIN M. BAILEY,
Chemist.

PUMPHERSTON OIL WORKS,
MID CALDER,
SCOTLAND.

September 21, 1908.'

"The Pumpherston Oil Company, Limited.

Test of Shale received from Canada through Dr. R. W. Ells.

Crude oil made, from July 27, to August 12, 1908, in the Pumpherston Patent Retorts.

The retort gases, if passed through an oil scrubber, would yield some crude naphtha.

Analysis of uncondensed gas, after leaving ammonia water scrubber and returning to retort combustion chamber.

(Average of three analyses of five samples).
(Air-free).

	Per cent.
Carbon dioxide (CO)	29·67
Carbon monoxide (CO)	5·06
Olefines (C_nH_{2n})	1·33
Methane (CH_4)	11·02
Hydrogen (H_2)	52·92
	100·00

Calorific value = 305·1 B.T.U. per cubic foot (N.T.P.)
Specific gravity = 0·613 (Air = 1).
Weight per cubic foot = 0·0492 pounds.

(Signed) EDWIN M. BAILEY,
Chemist.

(Signed) For the Pumpherston Oil Co., Ltd.,
R. G. MCCULLEY,
Assistant Secretary.

PUMPHERSTON WORKS,
MID CALDER,
SCOTLAND.

September 19, 1908."

REMARKS ON CHARACTER OF THE SCOTCH SHALES.

In preparing this report, which it will be understood is merely preliminary to the complete report on the industry—which will appear in regular order—it has been deemed best to give only the main features of the Scotch shale industry: the commercial importance of which is very great; so that it may be classed as one of the great mineral industries of that country. The improved plants for retorting and subsequent distillation have now reached such a state of perfection that, the leading operators are able to compete successfully with Russia and the United States. The production of crude oil in Scotland for the last few years reaches annually more than 60,000,000 gallons. The production of sulphate of ammonia—now over 50,000 tons annually—and of paraffin wax and other by-products, is also very large, while the oil-shale industry, as at present conducted, is exceedingly profitable.

It is only fair, however, to emphasize the point that, the present satisfactory condition has been attained chiefly through close attention to the details of the industry; by the adoption of the most improved methods of manufacture; and by strict attention to economy in all its branches. Without all these it may be said that, in the face of the present close competition—through the production of crude native oils—any company undertaking the distillation of crude oils from shale will be seriously handicapped: and as in the case of many of the former Scotch companies, will probably be doomed to failure. This will be seen by a glance at the history of the Scotch shale-oil companies. The statistical records show that, 117 works have been in operation since the commencement of the industry nearly 60 years ago. These by 1894 had been reduced to 12, while in 1906—according to the statements published in the Bulletin on the oil-shale industry by the Geological Survey of Scotland, (1906)—they had suffered a still further reduction to six; of which two were engaged only in the business of retorting the shale for crude oil and sulphate of ammonia; the further work of fractionation or refining being carried out by another corporation. It may be said, however, that owing to the many improvements made in plants and methods, and the better organization of the companies interested, the total yield of crude oil and of the by-products has, in recent years, increased rather than diminished.

The failure of so many companies in the earlier period of the industry was stated to be due in many cases to bad management, and lack of economy in details of manufacture.

While it has been impossible to obtain full statistics of the industry in all its branches, the following figures, taken from the article written by Mr. D. R. Stuart, chemist to the Broxburn Company, and published in the official bulletin of the Geological Survey of Scotland (1906), and from other reliable sources, may be regarded as fairly accurate, as covering the two years 1903 and 1904:—

1903.

Shale mined and distilled	tons.	2,400,000
Crude oil produced	gals.	54,000,000
This was fractionated into—		
Burning oil and naphtha	"	19,000,000
Gas oil	"	6,000,000
Lubricating oils	"	8,800,000
Paraffin wax	tons	22,000
Sulphate of ammonia	"	40,000
Total value of products		£1,800,000

1904.

Shale mined	tons.	2,709,840
Value of		£544,346
Crude oil produced	gals.	62,932,400
Fractionated into—		
Naphtha	"	2,517,296
Burning oils	"	16,991,748
Gas oil	tons.	37,997
Lubricating oils	"	39,487
Paraffin wax	"	22,476
Sulphate of ammonia	"	49,600

1905.

Returns not fully available, but about the same as 1904.

As showing the gradual increase in the industry from time to time, the following may be given:—

1871, 51 works in operation—

Shale mined	tons	800,000
Crude oil produced	gals	25,000,000
Naphtha, burning and gas oils	gals	11,250,000
Lubricating oils	gals	2,500,000
Paraffin solid	tons	5,800
Sulphate of ammonia produced	tons	2,350

1879, 18 works in operation—

Shale mined	tons	850,000
Crude oil produced	gals	29,000,000
Naphtha, burning and gas oils	gals	11,400,000
Lubricating oils	gals	5,000,000
Paraffin solid	tons	9,200
Sulphate of ammonia	tons	4,750

1887, 13 works in operation—

Shale mined	tons	1,869,300
Crude oil produced	gals	52,876,700
Naphtha, burning and gas oils	gals	21,680,000
Lubricating oils	gals	9,000,000
Paraffin solid	tons	22,846
Sulphate of ammonia	tons	18,483

1893, 13 works in operation—

Shale mined	tons	1,947,842
Crude oil produced	gals	48,696,050
Naphtha, burning and gas oils	gals	20,452,341
Lubricating oils	gals	8,765,289
Paraffin solid	tons	19,130
Sulphate of ammonia	tons	28,000

In a subsequent paper by Mr. Stuart, published in 'Economic Geology' Oct.-Nov. 1906, the following statistics for 1906 are given:—

'There are at present only seven paraffin oil works in Scotland. Three are small and produce only crude oil and ammonia. Four are large and have fully equipped refineries. Two of them have candle works attached. Together they distil more than two and a half million tons of shale in a year.

1906—

West Lothian or Linlithgowshire produced	tons	1,791,896
Mid Lothian or Edinburghshire produced	"	732,635
Lanarkshire	"	21,051
		2,545,582

In 1906 the refined products were:—

Spirit or naphtha, sp. gr. 0·680 to 0·750	imp. gals.	about	2,500,000
Burning oils, sp. gr. 0·790 to 0·830	"	"	17,000,000
Gas or intermediate oils, 0·850 to 0·870	tons	"	38,000
Lubricating oils, 0·865 to 0·900	"	"	40,000
Solid paraffin wax, m. pts., 100° to 130° F.	"	"	22,500
Sulphate of ammonia	"	over	50,000
Still coke, selling 60 to 70 shillings a ton	tons		5,000

The production of oil-shale in Scotland for 1907 amounted to 2,675,799 tons. The average yield of oil was 23 gallons.

He also adds that, 'the total paid up capital of the four refining companies is about one and a half million pounds sterling. The dividends last year were 5, 15, 15, and 50 per cent respectively; for this year 7, 15, 17·5 and 50 per cent; but for many years the dividend from most works was nil. The wages paid by the companies are about £700,000 a year. There are 8,300 men employed, including 3,380 miners.'

PRICES OF VARIOUS PRODUCTS AT INTERVALS FROM 1873-1903.

—	1873.			1883.			1893.			1903.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Burning oil, gal	0	1	5	0	0	5¾	0	0	5¼	0	0	5¾
Heavy oil, ton	20	0	0	9	10	0	5	0	0	6	0	0
Refined paraffin, lb	0	0	10	0	0	4	0	0	5	0	0	3
Crude paraffin scale, lb	0	0	5	....			0	0	2½	....		
Sulp. ammonia, ton	20	0	0	17	0	0	10	0	0	12	10	0

Shale mining, as already mentioned, is carried on much in the same manner as ordinary coal-mining. The roof is supported by timber props, where possible, or by pillars, and a regular system of driveways, haulage, and other mine roads, etc., is installed. Powder in small charges is usually employed as an explosive. The foot and hanging-walls, usually separate readily from the richer oil-bearing lands.

In the regular process of mining the broken down shale is brought to the surface in small cars by wire haulage, and conveyed direct to the breakers into which it is discharged and reduced to a proper size; the breaking being done by large toothed drums which revolve upon each other. Then the broken material is conveyed to the top of the retort bench or battery in small cars, also by means of wire haulage. Here, through the application of heat, the bituminous portion is driven off as gas, which is passed through condensers, and the hydrocarbons precipitated in the form of crude oil. The resulting ammonia and water is conveyed in pipes to the ammonia house, where it is treated with sulphuric acid. The crude oil is conveyed through another set of pipes to the distillation or fractionation plant; while the waste or spent shale from the retorts is conveyed by an endless wire tram to the dumps, called 'bings,' which, through the growth of years, have become mounds of enormous size. Throughout, the whole series of operations are continuous, and the fires under the retorts are never extinguished except for necessary repairs. This part of the process will be treated in detail under the head of chemistry of the oil-shales.

The first result, therefore, in the retorting of the shale, is the yield of crude oil, and sulphate of ammonia, which varies somewhat according to the quality of the shale treated. As already noted the ammonia water—which results largely from the constant injection of steam into the retorts during the process of combustion—is converted into sulphate of ammonia through the agency of sulphuric acid, and gas; and by successive distillations and chemical treatment the resulting crude oil is made to produce the following:—

(1) Shale spirit or naphtha.

(2) Burning or lamp oil of various specific gravity, the average being about 0·800.

(3) Gas or intermediate oils, sp. gr., 0·840 to 0·860 with properties intermediate between those of burning and lubricating oils and used for gas making, gas enriching and for cleansing purposes.

(4) Lubricating oils, sp. gr. 0·865 to 0·895, of high boiling point and viscosity, used for lubricating machinery.

(5) Solid paraffin, melting point from 100° to 130° F., used for candle making and various other purposes.

(6) Still coke, still grease, tars, etc.

From the ammonia water is obtained—

(7) Sulphate of ammonia.

The history of the oil-shale industry in Scotland will be reserved for the complete report. It may be said, however, that this industry was commenced about 60 years ago, and passed through various stages of success and failure, until at the present time—due to the manifold changes and improvements in connexion with the industry as a whole—it has reached the present satisfactory condition.

In recent years through the exhaustion of the vast guano deposits—principally of the Pacific islands—attention has been specially directed to the manufacture of sulphate of ammonia, which is so extensively employed at the present day as a fertilizer. The distillation or retorting of shale has now become one of the leading branches of industry, and one of the principal sources of profit. With the more modern styles of retorts the yield of sulphate from certain grades of the shale has markedly increased: 60 to 70 pounds per ton being now obtainable in places. The price of this material has fluctuated widely, as shown by the table already given. At the present prices, high profits are realized from its manufacture from shales comparatively lean in oils, but correspondingly rich in ammonia.

The principal Scotch plants are designed on a large scale, and include everything necessary for the mining, retorting and fractionating of the oil-shales, and production in the most economic way of the various by-products, all of which tends very materially to enhance the profits of the business.

The retorting plants are made up in aggregates of single retorts, connected in groups of fours, and these groups assembled in batteries, or benches. One complete battery sometimes comprises 160 individual retorts, each having a capacity of four tons of Scotch shale per day of 24 hours, or a total per battery of 460 tons per day. These retorts are connected to batteries of condensers, in which the gases generated by the retorting of the shale are reduced to crude oil. The capacity of these plants can be estimated from the fact that, in several of them more than 500,000 tons of crude shale are treated yearly.

The cost of these plants is very large: which—from figures furnished me by several of the managers—may be approximately estimated: the initial unit, or single retort, being taken as a basis.

Thus, the price of a single retort with a capacity daily of four tons Scotch shale, erected on the ground in Scotland, is stated to be £65 to £70 per ton capacity. This single retort is furnished with a condenser plant and all necessary appliances, and may be styled an experimental retort, with which it is possible to make complete tests of any shale deposit required, in so far as the crude oil and sulphate of ammonia are concerned. It was in one of these experimental retorts at the Pumpherston Works that the tests made of the New Brunswick shale were carried out. At present this Company is apparently the only one which has a spare retort that can be used for commercial work. These retorts are charged regularly at intervals of six hours.

COST OF PLANTS.

(1) The cost of plants for the industry was furnished me by one of the leading managers, and is applicable to Scotland only. It is manifest that, for Canada this cost will be somewhat increased, owing to freight, difficulty of transport, extra cost of labour in fitting up, etc.

Assuming the cost of the initial retort at from £60 to £70 per ton of shale treated, the cost per unit of four tons capacity will be from £240 to £280. Hence, if a plant of 200 tons capacity per day is required, the cost would be 200 multiplied by say £65=£13,000, and so on in proportion to the size of the plant required. It may be remarked, however, that in our test of the New Brunswick shale, the 4 ton retort used was able to handle about 2¼ tons per day.

(2) The cost of a sulphate house with a working capacity of 1,200 tons of shale for conversion into sulphate of ammonia would be say about £5,000: so that the cost of the sulphate would be 1,200 tons into £5,000 (or $25,000), which would be about $21 per ton produced.

(3) The cost of a refining plant will be about £11,000 per million gallons of refined crude oil per annum. A refining plant, therefore, having a capacity of ten million gallons per year should cost £110,000.

At Tarbrax, some miles south of Pumpherston, where retorting only is carried on, with a capacity of from 700 to 800 tons per day, the cost of such a plant would be say £100,000—everything included, viz., crude oil plant of retorts, and fittings, sulphate house, and paraffin works.

(4) The cost of a paraffin house for such a refinery will be from £5,000 to £7,000 in Scotland. As in the case of other parts of the general plant, the figures will be somewhat greater for Canada.

On the whole, therefore, to meet contingencies, the cost of retorts, condensers, etc., can be placed at say, £70 per ton of shale capacity. In the case of the Baltimore shales tested, the reduced charge from 4 to 2½ tons would probably add somewhat to the cost of the plant.

PRELIMINARY REPORT ON THE PEAT BOGS OF CANADA.

Messrs. E. Nyström and S. A. Anrep.

In accordance with your instructions, we started during the season of 1908 a systematic investigation of the peat bogs, in order to ascertain the extent, depth, and quality of the peat contained therein. Those first dealt with were favourably located as to transportation and market. A great number of such bogs undoubtedly exist in every province of the Dominion; but very little information in regard to their exact location is at present in our possession. A proper nvestigation of a peat bog, especially one covering thousands of acres, occupies considerable time, and before any conclusions can be arrived at as to the average suitability for the manufacture of fuel or other peat products, many seasons' work will be required.

INVESTIGATION IN ONTARIO.

During the season of 1908 the following bogs—all located in the province of Ontario—were investigated:—

(1) The Mer Bleu peat bog, situated in Gloucester and Cumberland townships.
(2) The Alfred peat bog, situated in Alfred and Caledonia townships.
(3) The Newington peat bog, situated in Osnabruck and Cornwall townships.
(4) The Perth peat bog, situated in Drummond township.
(5) The Victoria Road peat bog, situated in Carden township.
(6) The Welland peat bog, situated in Wainfleet and Humberstone townships.

Part of the summer was spent at Victoria Road peat plant, which is the only factory in Canada where we could obtain adequate power and drying arrangements for the manufacture of some air-dried peat fuel with the Anrep peat machine imported from Sweden. The peat machine itself fulfilled every expectation; but the rest of the work had to be done under great difficulties on account of the poor condition of the plant, and the work had finally to be given up. Enough fuel was made, however, to start the gas producer plant now being installed at Ottawa.

During the year, only one peat plant in Canada was in operation during part of the season. This plant, which is operated by Dr. J. McWilliam, of London, Ontario, is situated near Dorchester Station, some ten miles from London.

PRELIMINARY REPORT ON COAL AND COAL MINING IN NOVA SCOTIA.

Joseph G. S. Hudson, M.E.

In compliance with your instructions, I have—since July 15, 1908—been almost continuously occupied in the preparation of material for a report on coal and coal mining in tre province of Nova Scotia. The following list of sub-titles will indicate the scope and character of the work:—

(1) Area and extent of the coal field.

(2) Early history of mining in Nova Scotia.

(3) Development and expansion of the coal trade.

(4) Coal companies, railways, and shipping piers.

(5) Descriptive articles on the works and mines of the coal companies operating in the province of Nova Scotia.

(6) Mode and method of working coal; sections of the coal seams, together with information and data on coal cutting, haulage machinery, and general appliances.

(7) Accidents in mines; the use of safety explosives, and rescue stations.

(8) Tabulated rates of wages, and employees' contracts.

(9) On screening and coal handling appliances; also on the improvement in value of secondary coals, by means of wash plants.

(10) Advisability of indirectly transforming slack coal into electrical energy at the mine, for transmission to manufacturing centres.

(11) The working of coal seams under submarine areas.

PRELIMINARY REPORT ON THE GYPSUM DEPOSITS AND INDUSTRY OF NOVA SCOTIA AND NEW BRUNSWICK.

W. F. Jennison, M.E.

Gypsum in the provinces of Nova Scotia and New Brunswick has been known to exist since the discovery of the country, and the deposits have been operated to a more or less extent for nearly a century.

The development of this mineral in Canada to-day, is only in the primary stage, and has not made the same progress exhibited by other countries.

The operations are carried on almost exclusively by American capital, and the product of the quarries is shipped to the United States in a crude condition for further treatment.

The deposits occur as huge masses, some of which cover square miles in area, having exposures of over 100 feet in height—above water level—and extending several thousand feet. They may be considered practically unlimited, with a quality unsurpassed anywhere in the world.

During the past decade there has been a great increase in the production of gypsum, and in the demand for the various articles manufactured from gypsum. Production in the United States increased over 500 per cent. This fact, and the promising outlook that the demand will continue to increase, make these deposits of great economic value, and one of the most important natural resources of the country.

Realizing these conditions, and perceiving that the comparatively small development of these deposits is due to the lack of information already obtained, and also that it is very important our own citizens and all others interested, should have full information as to the extent and uses of gypsum, and demand for the many products manufactured therefrom, I was instructed July 16, 1908, to prepare a monograph showing:—

(1) History and distribution of gypsum deposits.
Varieties and distribution of gypsum.

(2) The trade history of Canada.
Statistics and graphic charts of gypsum production.
The geography and topography of the Canadian gypsum deposits, with maps and photographs, showing extent of deposits and facilities of manufacture and shipping.

(3) Origin of gypsum, general theories.

(4) Deposition from sea water, by thermal springs by the action of iron pyrites on the carbonate of lime.

(5) Gypsum as a fertilizer. Its uses among ancient people.
The experiments by well known authors.
Theories of action on gypsum as a fertilizer.

(6) The chemistry of gypsum, plaster of Paris, cement plaster, methods of analysis.

(7) Technology of gypsum.
General and physical properties.

(8) General requirements of a plaster mill, with cuts and specifications and costs of construction.
Chemistry of the manufacture of plaster.
Retarders and accelerators.

(9) The methods of operation, with costs.

(10) Markets, and value of product.

Up to date, the following important deposits have been examined, viz.:—

In Victoria county, N.S.: North and Middle harbour, Aspy bay; South bay, Ingonish; Goose cove, North Gut, and South Gut, St. Ann bay; St. Ann Glen, Port Bevis, Bevis point, McKenzie point, Plaster Mines, Baddeck bay; Island point, Boularderie island; deposits on Baddeck and Middle rivers, at Nyanza, Little Narrows, Jubilee, Washaback river, Estmere, Ottawa brook, McKinnon harbour, McKinnon Intervale, Red point, Jamesville, Iona, Grass pond, and Gillis pond.

In Cape Breton county, N.S.: The Curry deposits and Steel deposits at East bay; the deposits on Morley's road, and the north side of East bay.

In Richmond county, N.S.: the deposits at River Town, Bar point, Grandique, and at the head of Arichat harbour.

In Inverness county, N.S.: Little harbour, Militia point, Gillis pond, Donald McKinnon's, Malagawatchkt harbour, Plaster island, McKenzie brook, East side of the mouth of Denys river, The Boom, Alba, West Alba, and the south side of Whycocomagh bay.

Many of these deposits are of great magnitude, practically inexhaustible, and all within a reasonable distance of water transportation.

A few, particularly those in the vicinity of Bevis point, Malagawatchkt, and McKinnon harbour, show anhydrite in considerable quantities. At Bevis point it predominates, destroying the value of the deposit.

At other points, for example those on the south side of Bras d'Or lake, no anhydrite is visible.

The greater part of these deposits is very well exposed and shows a soft white compact variety, excellent for manufacturing purposes.

The following analyses made by Mr. F. G. Wait, Chemist for the Department of Mines, will serve to show the chemical composition of some of these deposits—all located in Nova Scotia:—

No.	1	2	3	4	5	6	7
Lime	32·87	33·10	41·30	31·62	33·12	33·62	32·97
Sulph. anhyd	46·07	45·95	57·81	42·96	45·88	45·28	46·16
Water-loss by ignition	20·89	20·85	·82	20·44	21·10	21·06	21·00
Ferric oxide	....	....	....	·95	....	....	....
Insoluble mineral matter	·12	0·07	·07	3·60	·22	·05	·15
Bitumen	....	....	·08	....	....	....	....
	99·95	99·97	100·08	99·57	100·32	100·01	100·28

No. 1, Gypsum, Alex. Curry deposit, East bay, Cape Breton.
No. 2, " Alex. Steel " " "
No. 3, Anhydrite, McLeod lot, Middle harbour, Cape North, Victoria county.
No. 4, Gypsum (dark), north side of East bay, Cape Breton.
No. 5, " Donovan lot, South bay, Ingonish, Victoria county.
No. 6, " McPherson lot, Middle harbour, Cape North, Victoria county.
No. 7, " McLeod lot, " " "

REPORT OF A VISIT TO SOME PRODUCER GAS PLANTS IN AND AROUND THE CITY OF BERLIN, GERMANY.

B. F. Haanel, B.Sc.

Five gas producer plants were visited; four of which were situated in Berlin and vicinity. Of the four inspected in Berlin and vicinage, two were equipped with anthracite producers; one with a coke producer; and one with a lignite (brown coal) briquet producer. The fifth was installed at the plant of the Körting Brothers at Hanover, and was equipped with a producer for gasifying badly caking bituminous coal.

COKE PRODUCER GAS PLANT.

This plant is situated at Wilmersdorf, a suburb of Berlin, and is used for pumping water for city purposes.

The equipment consists of four 400 h.p. two cycle, Körting gas engines—using either producer or illuminating gas—and two large coke gas producers. Under ordinary circumstances coke would never be used whenever cheaper fuel is available, inasmuch as its cost is prohibitive. In this case, however, the municipality operating this pump station also operates an illuminating gas plant, the coke from which is used to generate gas for the pumping engines.

This plant has been operated continuously for several years, and the cost of repairs and up-keep is said to be extremely low: much below that for a steam plant of like capacity, used for a similar purpose.

It may be of interest to note that, the number of revolutions of the engine varies according to the work done: from 30-90—the efficiency of the engine remaining constant.

The consumption of coke per effective horsepower hour is 1·5 kg. (3·3 lbs.), which seems excessive, and as it costs at Wilmersdorf from 30 to 40 marks ($7.20 to $9.60 per ton), coke—especially at this place—cannot be called an economical fuel.

ANTHRACITE PRODUCER.

A plant, consisting of three gas engines of 110 effective horsepower each, and three anthracite gas producers, was installed in the basement of the warehouse of A. Yandorf and Company, Berlin. The power developed was used for generating electricity for light and power purposes.

This plant has been in operation for four years, and employs a chief engineer, one assistant engineer and one stoker. The cost of repairs during the four years it has been running is said to be very low.

The consumption of fuel per effective horsepower hour is 0·38 kg. (0·836 lbs.), which is very satisfactory, the builders in this case guaranteeing one lb. per horsepower hour.

No trouble at all is experienced from any source with these producers, and the labour of stoking and cleaning of ashes is almost negligible.

An interesting feature of this installation is the arrangement of the charging hoppers of the producers. As described above, the producers are situated in the basement of the building, and the roof of that part containing the producers is level with the ground above, and constitutes the driveway for trucks, etc. The charging hoppers of the battery of producers project through this roof into this open court or driveway, and the fuel is simply hauled beside the charging hoppers and dumped into the coal boxes contiguous to them.

By this method, the cost of stoking—in addition to being accomplished in the open air—is reduced to a minimum.

The waste gases of the engine exhaust—which are a nuisance in most gas engine plants, owing to the odour and noise—are in this plant discharged at the top of the building, which is four stories high.

The cost of fuel delivered is 19 marks ($4.56) per metric ton. A metric ton corresponds to the English long ton, from which it will readily be seen that the plant is very economical.

The second anthracite gas producer plant visited was that of the Spindlershof Geschaftshaus, Berlin.

This installation is composed of two engines of 110 h.p., running at 160 revolutions per minute—used for lighting; and one engine 180 h.p., 140 R.P.M., used for power purposes. The anthracite gas producers in this plant are identical with those employed in that described above. The engines and producers have been in constant use for six years, during which time no troubles of any kind have been experienced, and during this period the cost of repairs was remarkably low.

The average consumption of fuel per effective horsepower is 0·40 kg., about 0·88 lbs. The price of coal delivered at this plant is about 19 marks ($4.56).

LIGNITE PRODUCER GAS PLANT.

Several plants operated by means of lignite producer gas, are scattered throughout Germany, all of which are said to give entire satisfaction. Since these plants do not differ in any salient feature, the examination of one installation was deemed sufficient.

The plant visited was that of the O. Jachmann Foundry Co., Berlin. The installation consisted of one gas engine of 110 h.p., and one of 210 h.p., the gas being supplied by two lignite (brown coal) gas producers. Lignite (brown coal) briquets are used.

The plant has been in use for some years, and during this period has given complete satisfaction.

The Körting lignite producer is a combination of the up-draft and down-draft types, air being supplied at both top and bottom. The producer gas is drawn off from the middle.

Reliable data on the fuel consumption could not be obtained.

CAKING BITUMINOUS COAL PRODUCER.

The only producer gasifying caking bituminous coal inspected was at the workshops of the Körting Brothers, Hanover, and was utilized as part of the permanent power installation, for generating electricity. This producer is of 150 h.p. capacity, and has been run for a period of six weeks—twelve hours per day—without closing down. The only reason for terminating the run at the end of that period was, an accident to the electric generator. During the entire length of the run, no trouble of any sort was encountered, scarcely any poking of the fuel bed was resorted to, and the gas delivered to the engines was of a uniform quality. While no trouble was experienced in the running of the gas engines on account of tarry matter, an inspection after closing down disclosed the fact that, about 3 mm. of tar and soot were deposited on the walls of the cylinder, and in the entry and exhaust pipes.

The fuel consumption during the run was about one lb. per effective horsepower hour.

The smallest producer which the Körting Brothers guarantee to operate successfully on caking bituminous coal, is of 150 h.p. capacity; any smaller generator will not operate for any length of time, owing to the fusing of the coal.

APPENDIX I.

PROGRESS OF ELECTRIC SMELTING IN NORWAY.

Extract from letter to Dr. Eugene Haanel, Director of Mines, from one of the inventors of the Electric Shaft Furnace, Sweden.

LUDVIKA, March 9, 1909.

'As I believe it to be of interest to you, I can tell you that we recently made a contract for an electric smelting plant in Norway. The first installation will be built this summer, and includes two high furnaces, 2,500 h. p. each, and two steel furnaces, 600 h. p. each. All the furnaces are to be supplied with two-phase current. The plant will later be extended with four more high furnaces of the same size, and four steel furnaces of larger size.

At present we are busy with the working out of the drawings and specifications for this plant. Besides the electric smelting plant, the installation will include also a rolling mill for billets and flat iron. We have every reason to suppose that the plant will be erected in a perfectly modern and commercial way, as everything is newly designed.

As soon as the drawings are ready, we shall be glad to send you an outline drawing of the whole plant, from which you will be able to see the arrangement of the different parts.

(Signed.) OTTO STALHANE.'

APPENDIX II.

MINERAL PRODUCTION OF CANADA 1907-8.

EUGENE HAANEL, Ph.D.,
Director of Mines.

SIR,—I beg to submit herewith the annual preliminary report on the mineral production of Canada in 1908, including a table showing the revised statistics of production in 1907.

The figures of production given for 1908 are, of necessity, subject to revision, since at this time, in many instances, producers of metallic ores have not themselves received complete returns from smelters. For these and other reasons, estimates have to be made. It is hoped, however, that this preliminary statement may serve to give a general idea of the gross output of the mineral industry during the year.

When more complete information is available, the annual report will be prepared. It will contain the final statistics in greater detail, as well as information relating to exploration, development, prices, markets, imports and exports, etc.

Acknowledgments are due to the various operators who have promptly furnished statements of their production, to the Provincial Mineralogist of British Columbia for a complete preliminary statement of mineral production in the province, and to the other provincial mining bureaus for assistance kindly rendered.

I am, sir, your obedient servant,

(Signed) JOHN MCLEISH.

DIVISION OF MINERAL RESOURCES AND STATISTICS,
February 25, 1909.

(Continued.)

APPENDIX II—*Continued.*

THE MINERAL PRODUCTION OF CANADA IN 1907.

(Revised.)

Product.		Quantity. (a)	Value. (b)
METALLIC.			$
Antimony ore	Tons.	2,016	65,000
" refined	Lbs.	63,850	5,108
Copper (c)	"	56,525,541	11,307,369
Gold	Ozs.	405,553	8,382,780
Pig iron from Canadian ore (d)	Tons.	107,599	1,982,307
Iron ore (exports)	"	25,901	45,907
Lead (e)	Lbs.	47,738,703	2,542,086
Nickel (f)	"	21,189,793	9,535,407
Cobalt		....	72,133
Silver (g)	Ozs.	12,779,799	8,348,659
Zinc ore	Tons.	1,573	49,100
Total		....	42,335,856
NON-METALLIC.			
Arsenic		....	41,303
Asbestos	Tons.	62,130	2,484,768
Asbestic	"	28,296	20,275
Chromite	"	7,196	72,901
Coal	"	10,511,426	24,381,842
Corundum	"	1,892	177,922
Feldspar	"	12,584	29,819
Graphite	"	579	16,000
" artificial	Lbs.	407,779	....
Grindstones	Tons.	5,414	60,376
Gypsum	"	485,921	646,914
Limestone for flux in iron furnaces	"	395,503	298,097
Manganese ore	"	1	22
Mica	"	774	312,599
Mineral pigments—Barytes	"	2,016	4,500
" " Ochres	"	5,828	35,570
Mineral water		....	110,524
Natural gas (h)		....	815,032
Peat	Tons.	50	200
Petroleum (i)	Bls.	788,872	1,057,088
Phosphate	Tons.	824	6,018
Pyrites	"	46,243	212,491
Quartz	"	56,685	124,148
Salt	"	72,697	342,315
Talc	"	1,534	4,602
Tripolite	"	30	225
Total		....	31,255,551

(a) Quantity of product sold or shipped.

(b) The metals, copper, lead, nickel and silver, are, for statistical purposes, valued at the final average value of the refined metals in New York. Pig iron is valued at the furnace, and the non-metallic products at the mine or point of shipment.

(c) Copper contents of ore, matte, etc., at 20·004 cents per pound.

(d) The total production of pig iron in Canada in 1907 was 651,962 short tons, valued at $9,125,226, of which it is estimated about 107,599 tons valued at $1,982,307 should be attributed to Canadian ore, and 544,363 tons, valued at $7,142,719, to the ore imported.

(e) Lead contents are of ore, matte, etc., at 5·325 cents per pound.

(f) Nickel contents of matte shipped at 45 cents per lb.

(g) Silver contents of ore, etc., at 65·327 cents per lb.

(h) Gross returns from sale of gas.

(i) Deduced from the amount paid in bounties and valued

THE MINERAL PRODUCTION OF CANADA IN 1907—*Concluded.*

(Revised.)

Product.		Quantity. (a)	Value. (b)
STRUCTURAL MATERIAL AND CLAY PRODUCTS.			$
Cement, natural	Bls.	5,775	4,043
" Portland	"	2,436,093	3,777,328
Clay products—			
Bricks, Common	No.	439,015,556	3,455,524
" Pressed	"	78,922,092	794,722
" Paving	"	3,617,720	72,354
" Moulded and ornamental			47,288
" Fire-brick and fire-clay shapes			131,322
Other clay products, including fire-proofing bricks and blocks			89,389
Pottery			253,809
Sewer pipe			667,100
Tiles, drain			288,018
Lime	Bushels.	5,103,316	1,035,795
Stone—			
Building stone			1,830,000
Flagstones	No.	3,000	2,250
Granite	Tons.	151,136	194,712
Slate	Squares.	4,335	20,056
Sand-lime brick	No.	16,492,971	167,795
Sand and gravel (exports)	Tons.	298,095	119,853
Total, structural material, etc			12,951,358
" all other non-metallic			31,255,551
Total, non-metallic			44,206,909
" metallic			42,335,856
Estimated value of mineral products not reported			300,000
Total value, 1907			86,842,765

Annual Mineral Production in Canada since 1886.

1886	$10,221,255	1898	$38,412,431
1887	10,321,331	1899	49,234,005
1888	12,518,894	1900	64,420,983
1889	14,013,113	1901	65,804,611
1890	16,763,353	1902	63,211,634
1891	18,976,616	1903	61,740,513
1892	16,623,415	1904	60,073,897
1893	20,035,082	1905	69,525,170
1894	19,931,158	1906	79,057,308
1895	20,505,917	1907	86,842,765
1896	22,474,256	1908	87,323,849
1897	28,485,023		

PRELIMINARY REPORT ON THE MINERAL PRODUCTION OF CANADA IN 1908.

(Subject to revision.)

Product.		Quantity. (*a*)	Value. (*b*)
METALLIC.			$
Copper (*c*)	Lbs.	64,361,636	8,500,885
Gold	"	....	9,559,274
Pig iron from Canadian ore (*d*)	Tons.	99,420	1,664,302
Lead (*e*)	Lbs.	45,725,886	1,920,487
Nickel (*f*)	"	19,143,111	8,231,538
Cobalt	"	1,853,286	112,253
Silver (*g*)	Ozs.	22,070,212	11,667,197
Total value, metallic		....	41,655,936
NON-METALLIC.			$
Arsenic	Tons.	699	38,054
Asbestos	"	65,534	2,547,507
Asbestic and asbestic sand	"	25,239	25,829
Calcium carbide	"	6,864	417,150
Chromite	"	7,225	82,008
Coal	"	10,904,466	25,567,235
Corundum	"	1,039	100,389
Feldspar	"	7,877	21,099
Graphite	"	251	5,565
Grindstones	"	3,843	45,128
Gypsum	"	340,964	575,701
Limestone for flux in iron furnace	"	418,661	289,705
Magnesite	"	120	840
Mica	"	....	191,602
Mineral pigments—			
Barytes	"	4,091	18,265
Ochres	"	4,746	30,440
Mineral waters	"	....	109,391
Natural gas (*h*)	"	....	1,012,060
Petroleum (*i*)	Bls.	527,987	747,102
Phosphate (apatite)	Tons.	1,596	14,794
Pyrites	"	47,336	224,824
Quartz	"	27,134	32,277
Salt	"	79,975	378,798
Talc	"	1,076	3,048
Tripolite	"	30	195
Total value, non-metallic		....	32,479,006

(*a*.) Quantity of product sold or shipped.

(*b*.) The metals, copper, lead, nickel and silver are for statistical and comparative purposes valued at the final average value of the refined metal in New York. Pig iron is valued at the furnace and non-metallic products at the mine or point of shipment.

(*c*.) Copper contents of ore, matte, etc., at 13·208 cents per pound.

(*d*.) The total production of pig iron in Canada in 1908 was 630,835 short tons valued at $8,111,194, of which it is estimated about 99,420 tons valued at $1,664,302 should be attributed to Canadian ore, and 531,415 tons valued at $6,446,892 to the ore imported.

(*e*) Lead contents of ore, matte, etc., at 4·200 cents per lb.

(*f*.) Nickel contents of matte shipped at 43 cents per lb.

(*g*.) Silver contents of ore, etc., at 52·864 cents per lb.

(*h*.) Gross return from sale of gas.

(*i*.) Deduced from the amount paid in bounties and valued at $1.41½ per barrel.

PRELIMINARY REPORT ON THE MINERAL PRODUCTION OF CANADA IN 1908—*Concluded.*

(Subject to revision.)

Product.	Quantity. (a)	Value (b)
STRUCTURAL MATERIAL AND CLAY PRODUCTS.		$
Cement—natural ..... Bls.	1,044	815
" Portland ..... "	2,665,289	3,709,063
Flagstones ..... No.	4,000	3,600
Sand and gravel (exports) ..... Tons.	298,954	161,387
Sewer pipe		514,042
Clay products, stone, lime, etc., Estimated		8,500,000
Total structural material and clay products		12,888,907
All other non-metallic		32,479,006
Total value non-metallic		45,367,913
Total value metallic		41,655,936
Estimated value of mineral products not reported		300,000
Total value, 1908		87,323,849

REMARKS.

A preliminary review of the mineral production in Canada in 1908 shows a total mineral output valued at slightly over $87,000,000, as compared with a little less than $87,000,000 in 1907.

The industry has, therefore, in the aggregate more than held its own despite the large decreases in the prices of the metals. That this falling off in the prices of the metals has been an important and serious question for the metal mining industries, will be better realized when it is stated, that had the metals, copper, silver, lead and nickel maintained as high average prices in 1908 as in 1907, their total production in Canada in 1908 would have been worth over $8,000,000 more to the producers than was actually the case.

A comparison of average monthly prices of metals in 1907 and 1908 as quoted by the Engineering and Mining Journal of New York, showing the decreases in 1908 both in price and percentage, is given hereunder:—

COMPARISON OF PRICES OF METALS, 1907 and 1908.

	1907.	1908.	Decrease in 1908.	Percentage of Decrease.
	Cts.	Cts.	Cts.	%
Copper	20·004	13·208	6·796	33·97
Lead	5·325	4·200	1·125	21·12
Nickel	45·000	43·	2·	4·44
Silver	65·327	52·864	12·463	19·07
Spelter	5·962	4·726	1·236	20·73
Tin	38·166	29·465	8·701	22·79

The outstanding feature of the mining industry during the year has undoubtedly been the silver production, a total increase of over 72 per cent being shown in the number of ounces produced. The metals copper and gold also show important increases in quantity produced, whilst iron, lead and nickel were produced in slightly smaller quantity than in 1907.

In the non-metallic class, decreases in gypsum and petroleum are more than counterbalanced by increases in coal, asbestos, natural gas, salt, etc. The Portland cement industry shows a small increase in sales, and a large increase in quantity of cement made with large stocks on hand at the close of the year.

The two following tables will illustrate these special features of increases and decreases more clearly, the first showing the total increases or decreases in value of some of the more important products and the second the percentage increase or decrease in quantity as well as value.

Product.	Increase.	Decrease.
Copper		$2,806,484
Gold, Yukon	$ 450,000	
Gold, all other	726,494	
Pig iron, from Canadian ore		318,005
Lead		621,599
Nickel		1,303,869
Silver	3,318,538	
Asbestos	62,739	
Chromite	9,107	
Coal	1,185,393	
Gypsum		71,213
Natural gas	197,028	
Petroleum		309,986
Portland cement		68,265
Pyrites	12,333	
Salt	36,483	

Product.	Quantity.		Value.	
	Increase.	Decrease.	Increase.	Decrease.
	%	%	%	%
Metallic—				
Copper	13·86			24·82
Gold	14·03		14·03	
Pig iron (from Canadian ore only)		7·60		16·04
Pig iron (from home and imported ore)		3·24		11·11
Lead		4·22		24·45
Nickel		9·66		13·67
Silver	72·69		39·75	
Non-metallic—				
Asbestos and asbestic	0·38		2·73	
Coal	5·21		5·27	
Feldspar		37·40		29·27
Gypsum		29·83		11·01
Natural gas			24·00	
Petroleum		33·07		29·32
Salt	10·01		10·66	
Portland cement	9·41			1·81

Gold.—For the first time in nine years the gold output shows an increase over the previous year. The Yukon output in 1908 is estimated at about $3,600,000 as compared with $3,150,000 in 1907, while a considerably increased production is also shown in the province of British Columbia, derived chiefly from the Trail Creek ores, the placer workings having shown a smaller output.

In Nova Scotia the output in 1907 was $282,686. Complete returns are not yet available for 1908, but the output was probably not over $225,000.

Of the total gold output in 1908, over 44 per cent was obtained from placer and hydraulic workings and 56 per cent from sulphuret and quartz ores.

Silver.—The estimated silver production of Canada in 1908 was 22,070,212 ounces, shipped as fine bars, silver bullion, and obtained in matte, ores, etc.; as compared with 12,779,799 ounces produced in 1907, an increase of over 72 per cent. Owing, however, to the much lower price received in 1908, the total value shows an increase of only 40 per cent. Over 87 per cent of the output was obtained from Ontario, and the increase is all to be credited to this province, since there was a slight falling off in the silver output of British Columbia.

The price of refined silver varied between a maximum of 57 cents on January 8, and a minimum of 47⅝ cents on December 2, the average monthly price being 52·864 cents per ounce, as compared with 65·327 cents in 1907.

The output from the Cobalt district in the province of Ontario again shows a very large increase over the previous year, nearly twice as much silver having been produced. Returns from 29 shipping mines show the ore and concentrates shipped, as approximately 25,497 tons, containing 19,296,430 ounces of silver; as compared with 14,644 tons containing 9,982,363 ounces in 1907. Valued at the average price of refined silver for the year, the production in 1908 would be worth $10,200,865, and it represents an average return of 756 ounces of silver or $400 per ton of ore shipped; as compared with an average return of 681 ounces of silver or $445 per ton of ore shipped in 1907.

If the output of this district continues to increase at the present rate, Canada will, in the immediate future, become one of the chief silver producing countries of the world. The total silver production of the world in 1907 was approximately 193 million ounces, the chief contributing countries being, Mexico 65 million ounces, United States, 59 million ounces, Australia 17 million ounces, Canada nearly 13 million ounces, Germany 12 million ounces. With an output of 22 million ounces in 1908 Canada probably moves up to third place, but still does not produce more than from 10 to 12 per cent of the world's output.

Copper.—Statistics of copper production in 1908 show a total output of 64,361,636 lbs., an increase of over 14 per cent over the production of 1907. There was an increase of over 900,000 lbs. in the copper from the Sudbury mines, while preliminary statistics of production in British Columbia appear to show a very important increase in production in that province of over 7,000,000 pounds.

The New York price of electrolytic copper varied but slightly during the year, the lowest being 12 cents in February and the highest 14¼ cents in December, the average for the year being 13·208.

The total exports of copper in ore, matte and blister were, according to Customs Department returns, 25,568 tons.

Lead.—All of the lead production shown in the general table, viz., 45,725,886 pounds valued at $1,920,487, was obtained in the province of British Columbia. The production in 1907 was 47,738,703 pounds valued at $2,542,086, a decrease in quantity being therefore shown of about 4 per cent.

The total amount paid as bounty on lead production was, during the twelve months, $139,064.57.

The exports of lead in ore, etc., during the year were 2,256 tons, and of pig lead 6,971 tons or a total of 9,227 tons.

The price of lead in New York during the year varied between 3·60 and 4·60 cents, averaging about 4·2 cents per pound.

Nickel.—With the exception of the nickel contained in the ores shipped from the Cobalt district, the production of nickel in Canada is derived entirely from the well-known nickel-copper deposits of the Sudbury district. Previous to 1906 the output had been increasing steadily for a number of years. During the past three years, however, the production has not varied very greatly. About 815 tons less matte were shipped in 1908 than in 1907. The nickel contents were also somewhat lower in 1908, averaging about 45·1 per cent as compared with 48·1 per cent in 1907. On the other hand the copper contents were higher in 1908.

Two companies are carrying on active operations: The Mond Nickel Co., at Victoria Mines, and the Canadian Copper Co., at Copper Cliff. The ore is first roasted and then smelted to a Bessemer matte containing from 77 to 80 per cent of the combined metals, copper and nickel, which is shipped to the United States and Great Britain for refining.

The following were the aggregate results of the operations on the nickel-copper deposits of Ontario in 1906, 1907 and 1908:—

—	1906. — Tons of 2,000 lbs.	1907. — Tons of 2,000 lbs.	1908. — Tons of 2,000 lbs.
Ore mined	343,814	351,916	409,551
Ore smelted	340,059	359,076	360,180
Bessemer matte produced	20,364	22,041	21,179
" " shipped	20,310	22,025	21,210
Copper contents of matte shipped	5,265	6,996	7,503
Nickel " "	10,745	10,595	9,572
Spot value of matte shipped	$4,628,011	$3,289,382	$2,930,989
Wages paid	1,117,420	1,278,694	1,286,265
Men employed	1,417	1,660	1,690

According to Customs returns exports of nickel in matte, etc., were for twelve months ending December 31, as follows:—

—	1906. — Pounds.	1907. — Pounds.	1908. — Pounds.
To Great Britain	2,716,892	2,518,338	2,554,486
To United States	17,936,953	16,857,997	16,865,407
	20,653,845	19,376,335	19,419,893

The price of refined nickel in New York, was quoted during the first nine months at from 45 to 50 cents per pound, and during the balance of the year from 40 to 45 cents according to size and terms of order.

The above figures do not include the nickel contents of the silver-cobalt ores from the Cobalt district, of which it is difficult to obtain satisfactory returns. The shippers of silver-cobalt ores receive little or no return for the nickel contents although this metal forms an important constituent of the ore.

Iron Ore.—The total shipments of iron ore from mines in Canada in 1908 were 203,490 short tons, valued at the mine at $486,857, as compared with 312,496 tons valued at $666,941 in 1907. The greater part of this production was from the Helen mine, Michipicoten, delivered to Midland and Hamilton. During 1908 very little Canadian ore was exported.

Pig Iron.—The total production of pig iron in Canada in 1908, from both Canadian and imported ores, according to direct returns from nine plants comprising 16 furnaces, was 630,835 short tons valued at $8,111,194, as compared with 651,962 tons valued at $9,125,226 in 1907. These figures do not include the output from the two electric furnace plants, making ferro-products, which are situated at Welland, Ontario, and Buckingham, Quebec. Of the total output of pig iron during 1908, 6,709 tons, valued at $171,383 were made with charcoal as fuel, and 624,126 tons valued at $7,939,811 with coke.

The amount of Canadian ore, including mill cinder, etc., used was 219,266 tons; while the quantity of imported ore was 1,051,445 tons. The total amount of coke used during the year was 817,746 short tons valued at $1,770,320. The total amount of charcoal used was 1,121,990 bushels valued at $85,738. The quantity of limestone flux charged was 483,065 tons.

The plant of the Atikokan Iron Co., Ltd., was out of commission throughout the year, while a number of others were operated for a part of the year only. The blast furnace at Londonderry was in blast for little over a month and the furnace of the Deseronto Iron Co., Ltd., for about two months.

Steel.—The returns for the year from eight companies making steel showed a total output of ingots and castings of 588,763 short tons valued at $9,233,602; as compared with 706,982 tons valued at $15,612,590 from seven companies in 1907.

These figures are made up as follows:—

—	1907.		1908.	
	Tons.	$	Tons.	$
Ingots—Open-hearth (basic)	459,240	9,157,703	443,442	6,001,277
Bessemer (basic)	225,989	4,293,791	135,557	2,535,287
Castings—Open-hearth (acid and basic)	20,602	2,031,380	9,051	617,126
Other steels	1,151	129,716	713	79,912
	706,982	15,612,590	588,763	9,233,602

Iron and Steel Bounties.—Following is a statement of the bounties paid on iron and steel during the calendar year, as kindly furnished by the Trade and Commerce Department:—

—	1907.		1908.	
	Quantity on which Bounty was paid.	Bounty.	Quantity on which Bounty was paid.	Bounty.
	Tons.	$ cts.	Tons.	$ cts.
Pig iron made from Canadian ore	95,914·97	201,421 47	101,647	213,458 34
Pig iron made from imported ore	537,803·45	591,583 80	517,427	569,166 93
Total, pig iron	633,718·42	793,005 27	619,074	782,628 27
Steel ingots	666,589·87	1,099,873 37	556,289	917,876 63
Steel wire rods	68,738·22	412,417 26	49,630	297,778 68
Total bounty paid on iron and steel	....	2,305,295 90	....	1,998,283 58

Asbestos.—Returns of shipments of asbestos for the Eastern Townships, province of Quebec, were received from twelve operating companies employing 2,643 men in mine and mills, and paying in wages $1,002,768. Several other companies were engaged in development work and preparing to make shipments during the coming year.

The total shipments divided into crude and mill stock were in 1907 and 1908 as follows:—

—	1907.		1908.	
	Tons.	Value.	Tons.	Value.
		$		$
Crude	4,327	830,633	3,346	692,232
Mill stock	57,803	1,654,135	62,188	2,855,275
Total asbestos	62,130	2,484,768	65,533	2,547,507
Asbestic and asbestic sand	28,296	20,275	25,239	25,829
Total products	90,426	2,505,043	90,772	2,573,336

Exports of asbestos, according to Customs returns, were:—

—	Tons.	Value.
		$
Twelve months ending December, 1906	59,864	1,689,257
" " " 1907	56,753	1,669,299
" " " 1908	61,210	1,842,763

Coal and Coke.—Each of the coal mining provinces except British Columbia, contributed an increased output to the coal production of Canada in 1908. The total sales and shipments of coal, including colliery consumption and coal used in making coke, were 10,904,466 short tons, an increase of about 5 per cent as compared with 1907. Of the total, Nova Scotia contributed over 59 per cent, Saskatchewan and Alberta over 19 per cent and British Columbia 21 per cent.

The production by provinces was approximately as follows, the figures, of course, being still subject to correction:—

Province.	1907.		1908.	
	Tons of 2,000 lbs.	Value.	Tons of 2,000 lbs.	Value.
		$		$
Nova Scotia	6,354,133	12,764,999	6,539,866	13,138,124
New Brunswick	34,584	77,814	60,000	135,000
Saskatchewan	151,232	252,437	130,000	214,500
Alberta	1,591,579	3,836,286	1,845,000	4,899,611
British Columbia	2,364,898	7,390,306	2,329,600	7,280,000
Yukon	15,000	60,000	*	*
Total	10,511,426	24,381,842	10,904,466	25,567,235

The total production of oven coke in 1908 was approximately 865,257 short tons, valued at $3,668,974, being an increase of about 3 per cent over the quantity produced in 1907. The coke was made in the province of Nova Scotia, Alberta and British Columbia and entirely from Canadian coal. At the end of the year there were in Nova

* No production reported.

Scotia about 659 ovens in operation and 173 idle, and in Alberta and British Columbia on the same date 916 in operation and 528 idle, not including the ovens at Hosmer and Comox in British Columbia, from which no returns have yet been received.

Petroleum and Natural Gas.—The production of crude petroleum is as usual practically all derived from the Ontario peninsula. Direct returns from the producers have not been obtained, but the production has been estimated on the basis of the bounty of 1½ cents per gallon paid by the Dominion government. The total bounty paid in 1908 was $277,193.21, representing a production of 527,987 barrels, compared with a bounty of $414,157.89 paid in 1907 representing a production of 788,872 barrels. A decreased production of 33 per cent is, therefore, shown.

Natural gas was produced in the counties of Welland, Haldimand, Norfolk, Kent, Essex and Bruce, in Ontario, and at Medicine Hat, Alberta; the sales from the Ontario fields constituting over 95 per cent of the total.

The total receipts from gas sold in 1908 show an increase of about 24 per cent over the receipts of 1907 and are now larger than at any time since the gas was first used.

Portland Cement.—Complete statistics of cement production in 1908 have been received from twenty-three operating plants.

The total quantity of cement made was 3,495,961 barrels, as compared with a total 2,491,513 barrels made in 1907, showing an increase of 1,004,448 barrels or over 40 per cent.

The total sales were 2,665,289 barrels, as compared with 2,436,093 barrels in 1907; an increase of 229,196 barrels or over 7 per cent. The total daily capacity of the 23 plants was about 27,500 barrels, as compared with an operating capacity of 14,300 barrels, 1907. The operating plants were distributed as follows:—One each in Nova Scotia, British Columbia and Manitoba, the latter manufacturing a natural Portland; two in Alberta; three in Quebec Province and 15 in Ontario.

Of the 23 operating plants, twelve use marl and clay, ten use limestone and clay, and one blast furnace slag.

Detailed statistics of production in 1907 and 1908 are as follows:—

—	1907.	1908.
	Barrels.	Barrels.
Portland cement sold	2,436,093	2,665,289
" manufactured	2,491,513	3,495,961
Stock on hand, January 1	299,015	383,349
" " December 31	354,435	1,214,011
Value of cement sold	$3,777,328	$3,709,063
Wages paid	956,080	1,274,638
Men employed	1,786	3,029

The average price per barrel at the works in 1908 was $1.39, as compared with $1.55 in 1907.

The imports of Portland cement into Canada during the 12 months ending November 1908 were 1,600,934 cwt. valued at $530,209.

This is equivalent to 457,408 barrels of 350 pounds at an average price per barrel of $1.16. The imports in 1907 were equivalent to 672,630 barrels valued at $837,520 or an average price per barrel of $1.24½. The duty is 12½ cents per hundred pounds.

There is very little cement exported from Canada; the consumption is, therefore, practically represented by the Canadian sales together with the imports.

Following is an estimate of the Canadian consumption of Portland cement for the past five years:—

Year.	Canadian.	Imported.	Total.
	Barrels.	Barrels.	Barrels.
1904	910,358	784,630	1,694,988
1905	1,346,548	917,558	2,264,106
1906	2,119,764	694,503	2,814,267
1907	2,436,093	672,630	3,108,720
1908	2,665,289	457,408	3,122,697

(Continued.)

Exports of the Products of the Mine, Year 1908.

(Compiled from Trade and Navigation Monthly Statements.)

Products.		Quantity.	Value.
			$
Arsenic	Lbs.	1,913,732	43,493
Asbestos	Tons.	61,210	1,842,763
Barytes	Cwt.	3,509	13,690
Chromite	Tons.	4,571	56,864
Coal	"	1,729,833	4,661,377
Feldspar	"	9,524	34,045
Gold			7,740,918
Gypsum	Tons.	280,091	324,574
Copper, fine in ore, etc	Lbs.	51,136,371	5,934,559
Lead, in ore, etc	"	4,511,931	153,394
" pig, etc	"	13,942,663	469,06)
Nickel, in ore, etc	"	19,419,893	1,866,624
Silver, in ore, etc	Ozs.	20,884,451	12,403.482
Platinum, in ore concentrates, etc	"	43	937
Mica	Lbs.	580,195	198,839
Mineral pigments	"	249,635	4,850
Mineral water	Gals.	8,953	3,659
Oil, refined	"	25	296
Ores—			
Antimony	Tons.	149	5,647
Iron	"	4,334	72,260
Other ores	"	13,910	509,779
Phosphate	"	1	30
Plumbago	Cwt.	7,706	10,159
Pyrites	Tons.	17,283	96,600
Salt	Lbs.	527,229	3,840
Sand and gravel	Tons.	298,954	161,387
Slate	"	10,709	2,539
Stone, ornamental	"	1,314	28,777
" building	"	4,009	14,034
" for manufacture of grindstones	"	661	5,991
Other products of the mine			176,007
Manufactures—			
Bricks	M.	2,334	9,047
Aluminium, in bars, etc	Cwt.	194,546	399,785
" manufactured			1,727
Cement			34,591
Clay, manufactures of			92
Coke	Tons.	58,708	248,759
Grindstones, manufactured			13,730
Gypsum, ground			9,765
Iron and steel—			
Stoves	No.	651	8,258
Castings, N.E.S.			28,062
Pig iron	Tons.	290	10,614
Machinery (linotype machines)			126,590
" N.E.S.			285,257
Sewing machines	No.	9,697	109,002
Typewriters	"	3,720	169,939
Scrap iron and steel	Cwt.	92,566	73,807
Hardware (tools, etc.)			57,631
" (N.E.S.)			59,304
Steel and manufactures of			1,169,673
Lime			43,316
Metals, N.O.P.			65,360
Plumbago, manufactures of			876
Stone, ornamental			13,748
" building			1,446

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MINES BRANCH

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EUGENE HAANEL, Ph.D.,
Director of Mines,
Ottawa.