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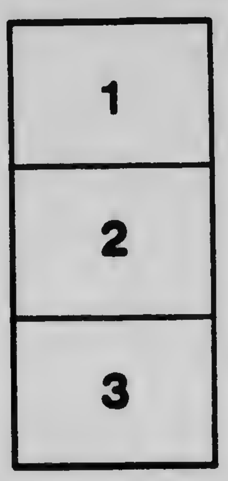
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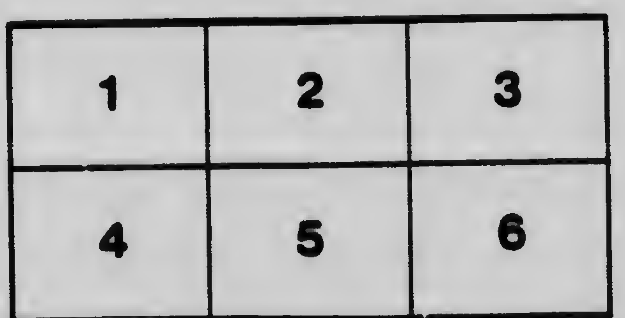
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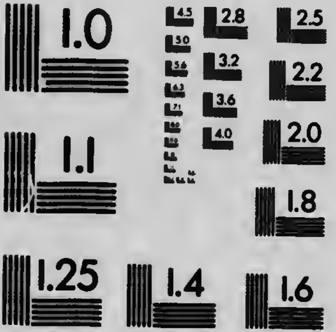

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Commission of Conservation
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The Utilization of Some of [illegible] Non-Metallic Mineral Resources Suggested by Present Conditions

BY

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Reprinted from the [illegible] Report of the
Commission of Conservation

OTTAWA—191[illegible]

Commission of Conservation
CANADA

COMMITTEE ON MINERALS

The Utilization of Some of Our Non-Metallic Mineral Resources, Suggested by Present Conditions

By
EUGENE HAANEL, Ph.D.
Director, Mines Branch, Department of Mines, Ottawa

Reprinted from the Sixth Annual Report of the Commission of Conservation

OTTAWA—1915

The Utilization of Some of Our Non-Metallic Mineral Resources, Suggested by Present Conditions

THE disturbed industrial conditions throughout the civilized world, which the present great war has created, have brought into prominence the fact that we have been, and are, dependent upon other countries for materials—raw or manufactured—which enter into our own manufactures, or which are necessary for our very existence.

The great question which, therefore, forces itself upon us is: Can we, in a measure, turn this calamitous dislocation of trade and commerce into what will ultimately lead to the expansion of our own industries, or, possibly, develop new ones, and render us, to a larger extent, independent of outside sources for the materials required for our needs? Necessity is a great stimulant, and there is no question but that this rugged, vigorous, northern nation, inhabiting this country of great resources and promise, will respond to the stimulus and emerge from this present condition of distress more vigorous, more self-reliant, and more prosperous than ever. This, however, can not be accomplished without some sacrifices. It will, if we desire to establish new industries, be necessary to be satisfied with modest profits, and we require to remember that some of the greatest industries of the world have been created and put upon a solid foundation only after many years of laborious efforts, after many discouragements, and much expenditure of money. Under present conditions we need captains of industry as much as captains for our soldiers, who bring into evidence their patriotism, the one, by tiding over the present distressful [illegible] the other, by defending the country against aggression.

I desire to confine myself in this paper to the discussion of those few non-metallic minerals which have hitherto been imported in large quantities, and represent an outgo of large sums of money, to point out to what extent it may be possible for us to substitute those of our own resources, and to give some hints regarding the lines into which we might direct our activities.

Consumption of Coal and Coke

The imports of coal for the year 1912 were :

Anthracite......................	4 million tons
Bituminous......................	10½ " "

The latter increased to 13½ million tons for the year 1913, and the total imports to 18 millions of tons in that year.

The imports of coke are represented for the years 1912 and 1913, respectively, by 628,000 and 723,000 tons.

Practically all of the anthracite coal is imported for domestic purposes.

I have, in a previous paper delivered before this Commission, outlined how we could, to a considerable extent, decrease this very large importation of fuel by utilizing the fuel of our extensive and excellent peat bogs.

Peat, a Substitute for Coal

The improved plant for the manufacture of peat fuel, erected at Alfred, Ont., by a private company employing the process demonstrated by the Mines Branch is, perhaps, the most complete and effective yet constructed. The war has stopped its operation. I need here to state, that in the event of again starting operations at Alfred next spring, the operators must bear in mind that such an industry can only succeed under most careful business management, and can only expect to pay a small but reasonable profit. Three years ago, Russia produced two million metric tons of peat fuel, and, for the last two years, this amount was increased to a production of seven million tons per annum. The process employed is identical with that demonstrated by the Mines Branch and carried out with improved machinery at Alfred. Peat fuel is manufactured by thirty-seven firms in central Russia ; thirty-six of these firms are manufacturers of woollen and cotton goods and glass, and manufacture their own fuel, and only one firm manufactures peat for sale. This statement goes far to prove that, if properly managed, the peat fuel industry could be put on a sound financial basis in Canada.

The conversion of peat fuel into an industrial gas appears, however, to be the most feasible and attractive method for the conversion of the latent heat energy of our peat bogs into useful heat energy.

Certain of the peat bogs examined in the province of Ontario contain very large percentages of nitrogen—up to 2.6 per cent—and this can be recovered as ammonia or ammonium sulphate by means of by-product recovery producers. This ammonium sulphate is one of the most valuable fertilizers and the demand for it previous to the war exceeded the production. A ready market is, therefore, always available.

By-Products from Peat

So important did this subject appear to me that a Commission, consisting of the Chief Engineer of the Fuel Testing Division and his assistant, was sent to Europe to investigate there in detail the peat industry, with special reference to the utilization of this fuel in by-product recovery producers. The report embodying the results of this investigation is now in the press, and it is there shown that certain of the Canadian peat bogs can be profitably utilized for the production of industrial gas, at a cost far below that possible for town gas. In that report it is further pointed out that such a gas distributed to surrounding towns and villages would do much toward relieving the fuel situation in places favorably situated for the introduction of this method of obtaining power and heat for domestic purposes.

I have received the following letter of enquiry from R. B. Prickett & Co., Trafalgar Buildings, 1 Charing Cross, London, Eng., dated April 22nd, 1914 :

"We are writing to enquire whether the output of the Government plant at Alfred is now sufficient to enable you to make a contract to deliver at Alfred say 250 tons of peat per day or say a yearly quantity of 75,000 tons. If you cannot deliver this quantity, what is the largest tonnage of peat you can contract to sell and at what price per ton (state short or long) will you deliver it at Alfred, Ontario ? Can you sell absolutely dry peat or would you prefer to sell peat with 25 per cent of moisture, and when could you begin delivery on such a contract ?

"If we can arrange with you for the supply of peat from the Alfred bog, we intend to put up a plant at Alfred to treat this peat for the recovery of by-products."

This goes far to show that the treatment of peat for the recovery of by-products alone is considered a sound business enterprise.

Use of Lignites and Bituminous Coal

The large quantity of bituminous coal imported into Canada is due to the fact that our own supplies, though extensive and capable of supplying the needs of the country, are situated in the far east and west, and the extra cost entailed by the long haulages from producer to consumer renders its utilization in the central provinces at present impracticable.

It may, however, be possible, in the near future, to decrease the annual importation of bituminous coal, by utilizing the Western lignites for those purposes for which bituminous coal now appears indispensable. The principal, and perhaps the main purpose for which bituminous coal is used in the West is for railway locomotives and power plants.

Lignites as Gas Producers

A few years ago the Mines Branch erected and equipped a fuel testing station for the investigation, on a commercial scale, of the various fuels found in Canada. Up to the present time, several 25-ton samples of lignites —obtained principally from the province of Alberta—have been investigated to determine their value as fuels for the production of power-gas and for steam raising, and it has been found that, in almost every case, they have proved most excellent fuels for the production of power-gas in the gas producer.

Certain of the Western lignites, and this also applies to certain bituminous coals, contain a sufficiently high percentage of nitrogen to make their utilization in the by-product recovery producer a profitable venture. The gas could be used either for power, industrial or domestic purposes, and could be sold per 1,000 heat units at a price far below that possible with retort gas made from ordinary gas coal. This gas could be distributed from the plant, preferably placed at the lignite mine, to the homes, offices and factories, of such a city, for example, as Edmonton. That such a method of using fuel economically is feasible and profitable is evident from the fact that this method of distributing gas, generated as described, over an industrial area of large extent for power and other purposes is in actual operation in Staffordshire, England.

The further problem of adapting the Western lignites by some preliminary treatment and briquetting for use in locomotives and for domestic use is at present occupying the attention of our fuel-engineers.

Tar, an Important By-Product

Tar obtained from the coking and retorting of bituminous coal is of special interest, since on this material —not many years ago regarded as a waste product —has been founded one of the largest and most profitable industries in Germany: the manufacture of aniline dyes. While it is conceded that it would be unwise, at the present time, to establish such an industry in all its ramifications on this continent, Canada requires for its own use and can produce certain distillation products of tar which we now require to import in large quantities, as the following figures will show :

Canada imported during the twelve months ending March, 1914 :

Crude coal and pine tar......	2,600,000 gallons
Coal and pine pitch..........	1,400,000 "
Carbolic or heavy oil.........	1,022,000 "
Asphalt....................	107,000,000 lbs.

The United States consumed in 1913, for timber preservation over 90,000,000 imperial gallons of creosote, and, *of this quantity*, 62 *per cent was imported from Europe*. Between 60 and 70 per cent of the total quantity consumed was used for the treatment of railway ties. The annual consumption of railway ties in Canada is 19 millions, and, of these, ten per cent are creosoted.

Approximately, 60 per cent, or 950,000, of these creosoted ties are imported from the United States, and the balance are creosoted in Canada. The quantity of creosote oil required to thoroughly creosote a railroad tie is said to be about three gallons. Approximately, 5,700,000 gallons of creosote oil would, therefore, be required to creosote these two million railroad ties alone. The total quantity of tar reported to be produced from by-product coke ovens and gas works in Canada is approximately eight million gallons from coke ovens, and four million gallons from gas works. This latter figure is merely an estimate, definite information not being available.

If all this tar, 12 million gallons, were distilled for the recovery of creosote oil alone, under the most favourable conditions, the yield would be 4,800,000 gallons. In practice, however, such conditions do not obtain, since the tar is distilled for other products, in addition to creosote oil. The yield of creosote oil would, therefore, be considerably less than 4,800,000 gallons. From the above figures it will be seen that, if all the tar produced in Canada were worked up into its various oils and other by-products, it would be insufficient to meet the demand of the home market, and, with an increased consumption of ties by railroad companies, which is almost certain to ensue, a greatly extended market for creosote oil will be provided.

It is, therefore, of the utmost importance that all retorting in coke ovens or in town gas retorts be conducted in by-product ovens for the recovery of tar, and that distilleries be established at strategic points for the distillation products of tar, for which a steady market would be assured.

Petroleum and its Derivatives

Petroleum in the crude state, and its refined derivatives, were imported into Canada in the following quantities for the twelve months ending March, 1914 :

Gasolene	27,451,379	gallons
Petroleum (crude fuel and gas oils, sp. gr., 0.8235)	177,879,835	"
Petroleum (crude gas oils other than naphtha, benzine, and gasolene lighter than the former, but not less than 0.775 sp. gr.)	45,853	"

Coal oil and kerosene (about)	19,300,000 gallons
Illuminating oils, derived wholly or in part from petroleum	168,290 "
Lubricating oils costing less than 25c. per gallon	5,157,804 "
Lubricating oils, N.O.P.	1,112,583 "
Petroleum products, N.O.P.	5,166,274 "

The large quantity of petroleum represented by these figures is almost wholly imported from the United States, Great Britain contributing but little toward our import trade of this important material.

The total domestic production of petroleum for the two years 1912 and 1913 was 8,516,762 and 7,982,798 gallons, respectively.

The oil-fields of Ontario practically supplied the whole of this quantity of petroleum, and while, in the past, this field has been an extensive producer, its output has been falling off during the last five years, instead of increasing as the requirements of the market would demand.

Discovering New Sources of Oil

The great need of discovering new sources of supply of petroleum to meet this ever-increasing demand led to the employment by the Mines Branch of Mr. Clapp, one of the ablest petroleum experts of the United States, to make an investigation of the oil and gas resources of the Dominion, with special reference to the geological indications of the existence of oil in the province of Alberta. The report of this investigation is now in the press and, according to the opinion of Dr. Day, petroleum expert of the United States Geological Survey, who read and aided in the assembling of the manuscript and extending certain portions of it, no such complete report on this subject has hitherto appeared on this continent.

While the indications of the existence of petroleum in Alberta are promising, no large producing oil wells have as yet been developed. We have, however, in the extensive and rich oil-shale deposits of New Brunswick a source of oil which, if exploited, would substitute large quantities of petroleum and its derivatives, now annually imported.

The distillation of oil-shales in Scotland has been for many years, and is to-day, a successful and flourishing industry. Our shales are, on the average, richer than the Scotch shales, and no argument can be presented against the establishment of a similar industry in Canada. So important are these deposits and so great the need of decreasing the large amount of petroleum imports, that the Government, to encourage the exploitation of these deposits, has amended the Petroleum Bounty Act, and has provided for a bounty of 1½ cents per gallon, or 52½ cents per barrel containing 35 imperial gallons, on oil recovered from oil-shales.

It is quite possible, also, that the lignite deposits of the West might, upon retorting, prove an additional source of oil. The lignites of Germany, it is reported, are at present being utilized in this manner. It should be borne in mind that the recovery of oil from the oil-shales and lignites is accompanied by the production of ammonia recovered as ammonium sulphate, for which there is always a ready market.

Progress of Ceramic Industries

In the great expansion and development of commercial activities, so apparent in the Dominion of Canada prior to the war, and which must, after its cessation, be even more vigorously prosecuted, the subject of ceramics is necessarily of great importance.

The commercial value of clay products in Canada may be estimated from the following figures, collected through the statistical division of the Mines Branch. The clay products mentioned were manufactured in Canada during the years 1912 and 1913:

	Production in 1912	Production in 1913
Brick, common	$ 7,010,375	$5,917,373
pressed	1,609,854	1,458,733
paving	85,989	75,669
ornamental	8,595	15,423
Fire-clay and fire-clay products	125,585	142,738
Fire-proofing	448,853	461,387
Pottery	43,955	53,533
Sewer pipe	884,641	1,035,906
Tiles	357,862	338,552
Kaolin	160	5,000
Total value	$10,575,869	$9,504,314

During the year 1905, the importation of clay products amounted in value to $2,501,206, and it has increased to $6,760,762 for the year 1913, equal to nearly 170 per cent. For the year 1912 we utilized clay products valued at $17,149,659, yet the returns show that we imported 38 per cent of these products. This simple statement shows that in 1913 we sent out of Canada for these products alone $6,760,000, which, if it had been held in our own country, would have meant the investment of a large amount of capital, and would have given employment to a large number of men.

Exploitation of Canadian Clays

It must not be concluded from this statement that this very large importation, which is constantly increasing, is due to lack of raw materials at home. Reports on the location and character of the clay deposits of Manitoba, Saskatchewan, Alberta, Quebec, and Nova Scotia have been issued by the Geological Survey. New deposits are constantly being discovered and specimens are being sent to our laboratories, with the request that we state what use can be made of the deposit. To merely send the owner of the deposit a chemical analysis of his clay does not answer his query, since chemical analysis is only a preliminary, though necessary, step in ascertaining the fitness or unfitness of a clay for any special clay product. Before a sound opinion can be arrived at, as to whether a specimen of clay is the proper material for the manufacture of tiles, bricks, terra cotta, sewer pipe, or other clay products, the specimen requires to be submitted to a physical examination regarding the character of the product as it comes from the muffle. It is during this investigation that the problem, in many cases, admits of solution, of how a clay otherwise unfit may, by special treatment, be rendered suitable for the manufacture of a commercial product. To enable the Mines Branch to furnish this complete information regarding clays submitted by prospective operators of clay deposits, provision has been made for the establishment of a ceramic division in the Mines Branch, with a properly trained and experienced ceramic engineer in charge. The completion and equipment of the ceramic laboratory begun last year, is under way. Through the activities of this division, intelligent assistance will be given to the manufacturers of clay products, and it is expected that this course will lead materially to decrease the large imports of clay products into Canada.

Bituminous Sands of Alberta

The existence of deposits of bituminous sands in the McMurray district of Northern Alberta has been known for many years. The absence of transportation facilities has, however, prevented the utilization and even the prospecting of these deposits.

Anticipating the building of the Alberta and Great Waterways railway into Northern Alberta, a preliminary examination of the deposits was undertaken by the Mines Branch in 1913 and continued in 1914. Meanwhile, the construction of the railway, which will open up and render available these deposits, is being rushed, and its completion is expected in 1916.

The investigation made revealed the fact that the tonnage of bituminous sands in the McMurray area is very large, and, although much of the material is low grade and, in some cases, the overburden so heavy that mining by open-cut is impracticable, it is found that some 20 per cent of the material, representing many millions of tons, may be considered as of commercial value.

Bituminous sands have for a number of years been used in the construction of various classes of pavements in the United States. The principal sources of supply, at the present time, are in Kentucky, Oklahoma, and California. The extent to which the material has been used appears to have been largely determined by the fixing of freight rates. The greater part of the bituminous sand used at the present time in California for paving purposes comes from the Santa Cruz quarries, and is, in many respects, similar to the Alberta material. The bitumen contained in the McMurray rock is, however, much softer. It is believed that, with proper manipulation, such as heating, and the addition of a hardening flux, the penetration of the bitumen can be reduced to meet the requirements of standard specifications for its successful employment in the laying of pavements in substitution for imported asphalt.

Use of Tar Sands in United States

Before the Mines Branch felt justified in making any recommendation regarding the utilization of the tar sands of Alberta for road construction, it was important to ascertain the success or failure which attended attempts in this direction in the United States. Enquiries were, therefore, sent to a number of municipal engineers, who have had actual experience with this class of rock in California. The following are the answers received :

Mr. Walter M. Frickstad, Assistant Superintendent of Streets, Oakland, Cal., wrote, in part, as follows :

"The sandstone used in Oakland is all from the Santa Cruz quarry......Since 1911, we have used this material in the construction of about one and one-half miles of street with uniformly satisfactory results......The first street constructed with this material in Oakland was built about twenty-two years ago, and is in excellent condition to-day. This street has had a steady stream of light traffic, but is not a portion of a thoroughfare. Another street laid in 1898 has carried a reasonably heavy traffic from the time of its construction, and is now one of our main business streets. The pavement of this street had no repairs until last year, when about 2½ per cent of the surface was renewed. Additional repairs are now being made to about the same amount......"

Mr. Eld[illegible] A. Garland, City Engineer of Santa Barbara, Cal., wrote as fc[illegible] :

"In answer to your communication relative to the bituminous deposits in the vicinity of Santa Barbara, would say that in my opinion an excellent pavement can be made from this material if it is properly treated......In short, I would say that, from my observation and experience, I believe, with proper treatment, as good a pavement can be made with the material from natural deposits of bituminous lime rock or sandstone as can be laid with the use of refined asphalt."

Mr. M. M. O'Shaughnessy, City Engineer, San Francisco, Cal., wrote as follows :

"In reply to your letter of Jan. 4, 1914, regarding bituminous rock pavements laid in San Francisco, will say that I find them very satisfactory. We have some streets of this material that have been down many years which are still in an excellent condition......"

Bitumen for Building Roads

In view of the fact that the bitumen contained in the tar sands of Alberta is softer than the bitumen of the California material, arrangements have been made by the Mines Branch for the laying of an experimental pavement in the city of Edmonton with the Alberta material, the city government having agreed to construct the concrete foundation. Upward of 60 tons of suitable material has been assembled in the McMurray district for transportation to Edmonton, and it is expected that work will be begun in the laying of the pavement early this summer.

The City Commissioner stated in his letter to the Department offering the co-operation of the city,

"that if this work is successfully carried out it will be of greater value to the city of Edmonton and Alberta generally than the bringing in of half a dozen industries. At the present time," he goes on to say, "we are absolutely suffering from the lack of cheap pavement and from the lack of good road-material, whereby the farmers may haul their products to the city on well built roads. The solution of this problem will be worth millions of dollars...."

At the present time, all asphaltic paving materials used in Canada are imported from foreign countries. In 1913-14 the value of these imports reached a total of nearly $900,000, and the consumption is rapidly increasing. The value of a cheap and satisfactory paving material in Western Canada would be very great.

Uses for Tar Sands

The bituminous sands may also serve as a source of pure bitumen, which may be extracted either by disulphide of carbon, the lighter petroleum distillates, or by the use of hot water and steam. Among the many uses to which this extracted bitumen may be applied may be mentioned : floorings for many classes of buildings, such as mills, hospitals, schools, skating rinks ; for foundations which require to absorb vibrations and jars, as in electric power plants ; for lining and damp courses for cellars, reservoirs, etc. ; for insulation of pipes ; and as a source of asphaltic oils.

Attempts in this direction have been made for the past twenty years in the United States. No industry, however, has been established and no extracting plant is now in operation. The cause for the failures is not far to seek. In California extracted bitumen, at $12.00 per ton, can not compete with petroleum residuum at $6.50 to $9.00 per ton. In Alberta, however, bitumen extracted at $12.00 could compete with imported refined asphalt, costing $27.00 to $34.00 per ton, delivered.

Before such an industry, however, is attempted, all available information of the results of many years' serious and often costly experimentation in the United States should be consulted.

Feldspar as a Possible Source of Potash

The extensive potash deposits near Stassfurt and Magdeburg have enabled Germany to control the world's market of this important material, which enters into the composition of fertilizers, soap, glass, matches, colours, and is extensively employed in the photographic and chemical industries. In 1913, the United States imported some fifteen million dollars' worth of potash salts, 85 per cent of which was used in the fertilizer industry. Canada imported, in 1910, potash salts to the value of $267,214, besides cyanide of potassium and of sodium for metallurgical purposes, valued at $62,410. The importation of potash salts during the fiscal year ending March 31, [illegible] amounted to $524,514, and of cyanide of potassium and of sodium [illegible]7, showing a very large increase in the consumption of these salts.

Many attempts have been made to break this monopoly by devising a process for the economic extraction of the potash contained in feldspar—a mineral of wide distribution. As applications have frequently been made to the Mines Branch for information regarding the feasibility of utilizing our extensive feldspar deposits for the extraction of the contained potash, I take this opportunity to describe the most recent and, in my opinion, the simplest process which has, so far, been devised. The inventors, Alerton S. Cushman and Geo. W. Coggeshall, at the recent meeting of the American Institute of Chemical Engineers delivered a paper in which they considered in detail the cost of production of potash from feldspar by their process. The costs are based upon the results of practical mill-runs made on a large scale by the authors. The process employed may be briefly described as follows :

Extraction of Potash from Feldspar

A mixture of finely-ground feldspar, containing about 10 per cent of potash and burned limestone, is formed into rounded aggregates, termed "clumps," about ¼ inch in diameter, by being sprayed with an 80 per cent solution of calcium chloride. The clumps so produced are transferred directly into a rotary kiln, heated either by oil or powdered coal flame. During the passage of the clumps through the furnace, the reaction takes place which converts the insoluble potassium silicate into the soluble potassium chloride. The red hot clumps, as they come from the furnace, fall directly into water, contained in leaching vats, which dissolves the chloride of potash formed. The remainder of the process consists in recovering the solid chloride of potash from the concentrated solution.

The authors recommend a plant large enough to handle 300 tons of feldspar per day of 24 hours, producing 47·54 tons of 80 per cent potassium chloride.

The cost of this product comes to $31.32 per ton. The price quoted before the war in the United States for the same article, of German origin, was $37.50 per ton. This is over $6.00 higher than the calculated cost of the article manufactured by the Cushman-Coggeshall process. According to their cost sheet, this $6.00 represents a profit of 20 per cent on the manufacturing costs of potash from feldspar. For the figures in detail on which this cost of manufacture is based, I must refer you to the inventors' paper.

Assuming that cost of plant, overhead and operating charges would be the same in Canada as stated in their paper, the cost of the raw materials would be determined by the cost at which they can be assembled at the locality selected for the proposed plant in Canada. The prices quoted per ton of the raw materials entering into the calculation of costs of product given by the authors are : Coal, $2.50 ; feldspar, $1.00 ; burnt lime, $2.33, and calcium chloride, $7.33. The latter is a by-product of the ammonia-soda-alkali process, and would require to be imported from the United States at a considerably higher figure than that given.

Prices of Potash in America

During the last week of November, 1914, chloride of potash was quoted at $100.00 per ton in the United States, an advance of 266 per cent on the price before the war. How long such, or even higher, prices will prevail depends upon the length of the war and how soon the potash deposits of Germany can again be drawn upon to supply the market. It is stated that the cost of mining the potash deposits permits the product to be sold profitably at one-third the cost charged to customers in the United States before the war. It is evident, therefore, that, when commercial relations are once more adjusted, the proprietors of the potash deposits, whoever they may then be, could undersell any manufacturer of potash from feldspar, and this would mean the scrapping of the plants which had been erected, if they could not then be used for other purposes.

SOURCES OF SULPHUR USED IN CANADA

The only domestic sources of sulphur are its ores, pyrites and pyrrhotite. The sulphur in our native ores does not occur in a form which makes it available for many purposes. We require, therefore, to import elemental sulphur to satisfy our needs. These imports reached, in 1913, 36,300 tons, which, for customs purposes, were valued at $20.00 per ton. I have pointed out, in a previous address to this Commission, that, hitherto, we have not been able to conserve the truly enormous quantities of sulphur which, in the form of sulphur dioxide, result from the roasting of our sulphurous ores. The discovery of a process, therefore, which would permit the economic recovery of the sulphur from the waste sulphurous gases of roasting furnaces would be of immense value. Such a process has recently been invented by William Hall of New York. It was primarily designed for the purpose of preventing noxious fumes of sulphur from smelting operations contaminating the atmosphere. The commercial development of this process is under way. In experiments on a commercial scale that have already been made, the principal difficulty appears to have been the collecting of the elemental sulphur produced, because it was produced in such quantities that the washer provided was unable to remove it, and the pipes became clogged. This is a mechanical difficulty, which proper design will overcome.

It is estimated that elemental crude sulphur can be produced by this process for about $5.00 per ton. For certain purposes it may require refining, which would increase the cost of the final product to about $9.00 per ton. Contrast this with $20.00 per ton, which we require to pay for imported sulphur.

As Mr. Wierum, who conducted on a commercial scale the experiments made with the Hall process, is to read a paper on this subject at the ensuing meeting of the Canadian Mining Institute, I refer you for details of the process and probable cost of production to his paper.

Sulphur from Nickel Ores

Experiments are at present under way by the Mond Nickel Co., Ltd., at their Coniston, Ontario, plant, in trying out the Fink smelting furnace for the treatment of their copper-nickel ores, with which an 80 per cent matte is expected to be produced from raw ore fed to the furnace, thus eliminating heap-roasting, sintering, and separate converter operations hitherto required.

It was suggested by the President of the Fink Smelter Company that the Department of Mines send a representative to Coniston to witness the run. To a telegram addressed to Mr. Corless, Manager, asking for permission to witness and report upon the test-runs made with the furnace, we received reply that, at present, Mr. Corless was not in a position to grant our request. It is hoped that opportunity may be afforded to the Department at a later date to witness and report upon a test-run made with this furnace. If successful in treating raw ore for the production of an 80 per cent matte, by a single operation, and the Hall process can be applied to the recovery of sulphur from the gases issuing from the furnace, an immense step forward in the treatment of the Sudbury ores will have been made, and the sulphur dioxide troubles will not alone have been effectively overcome, but elemental sulphur will be produced as a by-product, which will find a ready market, and Canada, instead of importing this material, will probably be in a position to export it.

General Aspects of Work of Mines Branch

Permit me now to make some general statements regarding the efforts which have been made by the Mines Branch to render effective service to the mining industry.

Reports for Manufacturers

Shortly after the organization of the Department of Mines, it was found desirable, and in the interests of the mining industry, to make an investigation into the requirements of Canadian manufacturers for such minerals as they employ as raw materials, or indirectly, as a means of producing the finished articles of their factories.

To obtain this information, the manufacturers throughout the Dominion were called upon, and as full details as possible were obtained from them regarding the minerals used by them, the quantity of each consumed per annum, the source of supply, and the price, delivered at their factories. Special attention, in this enquiry, was directed to the physical and chemical properties which should be specified in purchasing the various minerals for each of their uses.

The report on this investigation, entitled "Non-Metallic Minerals Used in the Canadian Manufacturing Industries," is now in press, and will be ready for distribution early this year. It contains not only tables giving the yearly consumption of each mineral by each class of industry, and the source of supply, but includes descriptive articles on each mineral, its uses, the methods of preparation for the market, and notes on the physical and chemical properties which fit, or unfit, it for the several uses. There are two appendices, the first giving a list of Canadian manufacturing firms which are consumers of minerals, classified according to industries; and the second, a list of producers of the non-metallic minerals.

The figures obtained during the investigation reveal the fact that an unduly large proportion of the minerals used is of foreign origin. In a number of cases the importation is necessary or advisable, since some minerals and particular grades of others are not obtainable at present in Canada, or the material may be procured from abroad for less than the cost of production and delivery of the Canadian. In some other cases, however, it is due to the fact that the domestic products are not always prepared in the form most suitable for the purposes for which they are required. Thus, for example, the want of proper grading of the mica by the small [illegible] of this material in Canada, has done much to replace the Canadian mica by the properly graded mica of India, every consignment [illegible] which is uniform in quality.

In some instances, certain minerals were imported, which [illegible] produced in the country, of excellent quality, and often quite [illegible] at hand. Binoxide of manganese, for example, exists in Nova Scotia, and has been mined to some extent, yet varnish manufacturers, who use this material as an oxidizer, have gone abroad for their supply.

While the report points out to the producers the market and opportunities for extending it as well as the quality of mineral required for the various uses, the investigation has furnished us with information which is of great service for office use. It not only aids materially in determining the lines along which the departmental investigations are most urgently required, but furnishes us with data with which to reply to numerous letters of enquiry from owners of mineral lands and producers of minerals seeking a market, as well as from those in search of a supply of mineral for some special purpose.

Since the beginning of the war these letters of enquiry have been coming to the Mines Branch in increased volume. Our Department is now in a position to give not only a prompt reply regarding the requirements of the market, but can frequently put the enquirer into direct touch with the consumer or producer, as the case may be, of the mineral in question.

Field Work of Mines Branch

As a direct result of the information obtained from this investigation, it has been possible to arrange the programme of field work for the present year and for the coming year with a view to obtaining such information as is now most required by the country. Our resources of barytes, fluor-spar, pyrolusite, talc, tripolite, limestones and sands are now under investigation. Large quantities of these are being imported, while our resources are being drawn upon only to a slight extent. In the case of limestones and sands, the immediate need of devoting our attention to their investigation is not apparent until one realizes the immense quantities consumed, and the multitude of varieties and grades which the consumers require. Our objective is to discover sources of supply of such varieties as are not at present obtainable in Canada, and to secure data which will enable us to point out to the consumers the localities from which they may obtain such grades of material as are best suited to their needs. The work on barytes and pyrolusite is indeed timely, since the war has cut off the principal sources of supply.

Monographs on Minerals

The activity of the Mines Branch in aid of the mineral industry has, however, gone further than simply to furnish information as to what minerals the manufacturers may obtain from domestic sources, and where the miner may find a market for his product. Monographs on the different Canadian minerals have been published, which, in addition to this information, deal with the methods of mining to be employed for the different minerals, and describes the class of machinery required to prepare the mineral for the market or the smelter.

In many cases the mineral as it comes from the mine is not marketable, either because it is too low in grade to stand the transportation charges, or it contains deleterious ingredients, which require removal before the product becomes acceptable to the consumer. In other cases, an ore contains two or more valuable minerals. It becomes necessary then to separate the minerals for further successful treatment. In many cases this can be effected by mechanical means.

The processes of solving these various problems require to be suited to each case, and necessitate the use of special machinery.

Ore Dressing Laboratory

To aid the miner in solving the problem of how to prepare his ore for the buyer most effectively and economically, and give him the necessary information of what machinery to install and what costs are involved, the Mines Branch has installed in Ottawa, the Dominion of Canada Ore Dressing and Metallurgical Laboratory. This laboratory is fully equipped with ore dressing machinery of the most modern design, and is furnished with a complete assay department for the making of all necessary chemical determinations.

Apart from the Universities, there are no laboratories in Canada in which ore dressing may be carried out on a commercial scale, such as is required for the proper elucidation of ore dressing problems. The Universities maintain their laboratories primarily for educational purposes, and cannot be expected to offer facilities and an expert staff free of charge to the miner when he presents his numerous, and often difficult, problems in mineral separation.

The testing work in the Mines Branch laboratory is carried out free of charge when the mineral is of Canadian origin. The miner is required to pay all ore transportation charges, and is required to furnish not less than two hundred pounds of ore for a small scale test, and not less than five tons for a large scale test.

The reports of all tests are incorporated in the publications of the Mines Branch, but single copies are given to the owners of the samples when the tests are completed, to enable him to make use of the information immediately.

The laboratories are, of necessity, under the control and direction of officials of the Mines Branch. However, arrangements may be made for engineers or other competent persons to supervise such experiments as they are interested in. With the assistance of our laboratory and staff, mine owners can determine the possibilities of milling their ores and select the most advantageous methods of concentration. They will be enabled to make close approximations of the value of the concentrated products which, with a determination of their mining and milling costs, will put them in possession of facts concerning the actual value of their ores in the ground.

Problems Awaiting Solution

In the non-metallic division of minerals there are many problems that might be studied with advantage to existing conditions. The concentration of barite, fluor-spar, and chromite ; the washing, classification and sizing of sands for various purposes, and the crushing and cleaning of quartz for the manufacture of glass, are but a few examples of the work that the laboratory is equipped to carry out.

All problems in the concentration and purification of minerals bear a certain direct definite relation to the value of mineral deposits and, indirectly, a definite relation to the wealth of the community in which the deposit is situated. Ore deposits are valued according to the amount of merchantable mineral they will yield from approved methods of extraction. If existing methods of extraction can be improved to yield a higher percentage of recovery, at less cost than the value of such additional output, then existing methods should be discarded, and better methods substituted.

It is not expected that these laboratories of the Department will effect any radical change in existing methods of ore dressing. But if the miner will make intelligent use of this opportunity for the scientific investigation of his ore dressing problems we predict a steadily increasing effort to increase the efficiency of present methods, and the general betterment of conditions affecting the exploitation of mining prospects.

As it is the aim of the Mines Branch to co-operate with and assist the miner in the same manner as the Department of Agriculture assists the farmer, I have thought it appropriate to show briefly in the foregoing the preparation made in the organization of the Mines Branch and equipment of its laboratories to enable the Department to render efficient aid to the mineral industry, and to such manufacturers as depend upon it.

May I, in conclusion, state it as my opinion that the efforts being made to know more of our resources and to know them more in detail should not, at present, be relaxed, but very greatly increased, so as to render us, as far as possible, independent of outside sources.