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DEPARTMENT OF MINES, OTTAWA, CANADA.

Notes on the Work and Organization of the Mines Branch of the

Dominion Department of Mines

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It may, I think, be taken as axiomatic that to intelligently administer national business, the Government should possess through its departmental organizations the greatest possible amount of information respecting Natural Resources, their extent, character, production, trade, consumption, and the technology of their recovery, treatment and use. Moreover, there are many directions in which government can with national profit and advantage contribute an important and perhaps necessary measure of assistance toward the economical and most efficient exploitation of the National Mineral Wealth.

The duties or functions of the Mines Branch have been defined by statute in the Geology and Mines Act, 1907, and their general scope is to collect information and conduct investigations designed to promote in the national interest the efficient development and utilization of the Mineral Resources. This is a broad field of activity, extending from the commercial development of mineral deposits to the production and utilization of the marketable products. Indeed so broad is the field and so comparatively small the organization assigned to it that only a comparatively small number of the many problems that might be studied can be taken up.

The Administrative end includes a Secretarial division, with files, distribution of publications, library, draughting division, etc., at Ottawa, and the Dominion of Canada Assay Office (for the purchase of gold) at Vancouver, B.C.

The investigative function is carried out under the following organization:

- Mineral Resources Division,
- Ore Dressing and Metallurgical Division,
- Fuels and Fuel Testing Division,
- Ceramic and Road Materials Division,
- Chemical Division

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MINERAL RESOURCES AND TECHNOLOGY

There is great need of, and opportunity for securing exceedingly valuable results from, the study and investigation of mining and marketing conditions. The natural mineral resources of Canada require to be administered under laws and regulations that will best serve the public interest. Production should be made in a manner and under conditions that will give a maximum recovery of valuable constituents with a maximum protection of health and life, and of associated mineral resources not being immediately exploited. Such assistance, as is properly within the function of the Government to grant, should be given, to facilitate the development of and supplying of markets both at home and abroad for those mineral resources that are susceptible of economic and profitable exploitation.

At the present time Canada, notwithstanding apparent enormous mineral resources, is a very large importer of certain mineral products, and although economic conditions play a very important part in this international trade in products of the mine, nevertheless much of it is due to a lack of knowledge of our own resources, their accessibility, and of the methods and processes that must be employed to make them marketable and bring them to the favourable consideration of the manufacturers or consuming public. This applies with particular force to our great and varied resources in non-metallic products.

The plan of the work to which attention has so far been given has been to collect statistics of Mineral Production (a duty recently transferred to the Dominion Bureau of Statistics); and to study and collect information regarding the mining industry in all its phases.

These investigations of our mineral resources and of their technology provide the basis for a national inventory of our mineral wealth. The great value and importance of such an inventory was amply demonstrated when these resources had to be called upon for their maximum contribution to the national defence. A complete comprehensive card index and filing system is being built up for the accumulation of this inventory. In the immediate utilization of these resources, the reports on investigations conducted furnish the interested consumer, investor or prospector with a record of the localities where the occurrence of economic mineral resources has already been determined, and with the available data as to the extent both of their occurrence and of their exploitation. To the owner, discoverer or expectant operator are furnished the collected and accumulated data respecting the physical and chemical characteristics of mineral products;

81

descriptions of methods of mining and treatment commonly employed; the specifications as to the composition and character of the products required to meet market conditions; the uses to which the products are put; the industries in which they are employed, and the essential commercial data respecting markets, prices, marketing conditions, production, consumption and other related economic facts.

It is not alone through published reports that the work of this Division or indeed of any of the other activities of the Branch are made available to the public. Every effort is made in reply to correspondents or to personal enquiries, to furnish as full and complete information as is feasible. A very large amount of the time of the staff is taken up in giving assistance of this kind.

During the earlier years of the Mines Branch organization it was found expedient, in order to have monographs prepared on special subjects, to engage therefor the services of practising consulting engineers. This practice, while perhaps possessing some merit, had some serious disadvantages. On the completion of any special investigation so undertaken and the publication of the report, the Department immediately lost the advantages, that should have been retained, of the personal relationships built up between the investigating officer and the particular industry studied. It entirely lost the benefit of the experience gained by this temporary officer, the value of which is not, perhaps, sufficiently realized, and only a small portion of which can be given expression in a published report. Whereas when such studies are made by officers continuously employed, they are enabled to keep more or less fully informed and up to date on the subjects investigated, and their services and accumulated experience are always then available to the Department and, through the Department, to the public.

Over 60 separate reports, of which 26 are out of print, have been issued on 27 different mineral products or metals.

The staff at present assigned in this Division includes 8 Engineers, or Mineral Technologists as we prefer to designate them, and 8 technical and other clerks.

The work in progress during the present summer includes the following investigations:

The development of chemical and metallurgical industries in Canada:

- Molybdenum, its occurrence, production and use.
- Mineral Pigments in Eastern Canada.
- Sodium Sulphate deposits of Saskatchewan and Alberta.
- Bituminous Sands of Northern Alberta.
- The Possibilities of British or European markets for certain non-metallic minerals.
- A general review of the mining industry in Canada.

It is proposed to extend this latter work until the entire industry can be reviewed each year, or as frequently as may seem expedient. These reviews will summarize, supplement and bring up to date the information available in the more extended and detailed monographs.

There are many other types of investigations that might well be taken up in this Division of the Mines Branch, but which, with the present limited organization, can only be superficially dealt with. These include:

The accumulation and studies of mining laws, Provincial, Federal and Foreign, covering the disposal of mining lands, the control of mining operations, the imposition of tariffs and of royalties, or the offering of bonuses, or bounties, so that new regulations, or changes and revisions may be made with a view to simplification and unification of the present complex and diverse situation.

Studies having in view the most equitable disposition of mining land, or the withdrawal of mining land from public entry.

Studies having in view the protection of the health and lives of employees and the protection of the public interest in respect to the prevention of waste in the recovery of mineral products and in respect to the disposal of waste, or injurious products.

Laboratory Testing and Research

The laboratories or experiment stations of the Mines Branch are comprehensively equipped for testing and research investigations on ore treatment, on fuels and oils, with particular reference to their physical and chemical character and their recovery and utilization, on clays or ceramic and refractory materials, on rocks, sand and gravel used for road building purposes, etc.

The work is carried on in four Divisions, as described below, with a total technical staff, including Chiefs of Divisions, of twenty-two engineers and chemists, with laboratory and mechanical assistants.

Ore Dressing and Metallurgy

The purpose, tests and equipment of this experiment station have been described in a departmental bulletin.

The purpose is to determine methods and processes applicable to the treatment of ores submitted for test, and to carry on research on special problems connected with the milling, concentration, separation, and metallurgical treatment of Canadian ores. The test work itself frequently involves a considerable amount of research. The prospector who has a promising occurrence of valuable mineral may have simple test work performed to determine the most feasible methods of treatment. The small mine owner may have more extensive laboratory investigation and research conducted, to determine a commercial metallurgical process, from which he will obtain valuable information and data for the erection of a treatment plant. Large commercial enterprises and established concerns may have experimental test and research work conducted on problems connected with the metallurgical treatment of their ore.

Investigations of national importance, common to a certain phase or part of the mineral industry, or to a particular district may be carried on, the results of which will contribute materially to the advance of the industry.

The experimental tests may be divided into two main classes, namely:

- (a) Small scale and preliminary investigation tests;
- (b) Large scale, or tonnage check tests.

(a) Small scale tests are made on shipments of 100 pounds to 2,000 pounds; the ore is examined as to its physical characteristics. If it is found necessary, polished and thin sections are prepared, and a thorough examination made under the microscope. By a series of tests the ore is subjected to any or all the established processes that could be considered applicable. The more feasible methods having been determined, complete tests are conducted covering all phases of its treatment.

When the test shows the ore not readily amenable to standard methods of treatment, more detailed research is undertaken, and a study is made of all information and data relative to the problems which would have a bearing on the solution. Exhaustive small scale experimental tests are conducted, procedure being from any and all angles which have the slightest possibility of giving a clue to the solution of the problem presented.

(b) Large scale or tonnage check tests are conducted after the small scale tests have determined the processes most applicable to the ore or product under investigation. They are made to establish the physical behaviour of the ore or product, under conditions more nearly approaching to practice, and to verify the results of the preliminary tests on a larger scale, under such conditions. Lots of one ton to a carload are used for these tests.

Operating tests are sometimes conducted in cooperation with the mining companies, who make provision for the use of an operating mill, which is run over a period of time. These tests are conclusive as to the practicability of any process.

During 1921, tests were made on the treatment of gold ores from Manitoba; on the concentration of garnet from its rock; on the concentration and separation of the minerals in the lead-zinc-silver ores of Kimberley, B.C.; on the concentration of the low grade copper ores of Hidden Creek, B.C.; the Flin-Flon ores of Manitoba, and the zinc-lead-copper-silver ores of Cape Breton, N.S.; on the concentration of the lower grade nickel-copper ores of Ontario. The majority of these are complex in character and are being continued. In addition tests are being made during the current year on the concentration and separation of fluorite, on the possible recovery of metals of the platinum group from placer concentrates and from certain copper-nickel ores; on the concentration and separation of amber from Western coals.

Extended research is being undertaken or planned in respect to the milling of asbestos rock, the use of Canadian made flotation reagents; the production of electrolytic iron from pyrite and pyrrhotite; the removal of impurities from coal by washing and flotation.

FUELS AND FUEL TESTING

The first systematic investigation of Canadian coals was begun by the Geological Survey just prior to the organization of the Mines Branch in cooperation with the Mining Department of McGill University. On the organization of the Mines Department, this work was continued and completed under the auspices of the Mines Branch. At the same time a fuel testing station was established at Ottawa for the large scale testing of peats, lignites and coal in gas producer plants and under steam boilers, etc.

Apart from the very necessary function of making complete chemical and physical examinations of our extremely varied types of fuels, with a view to determining for each type, area or mine, the character and usefulness of the fuel, Canada has two great problems more or less related in respect to fuel production and fuel supply. One of these problems is to investigate our low grade fuels such as peat and lignite, with a view to developing a method of production on the one hand and a process of treatment on the other, that will permit of the production from these of a high grade and desirable domestic fuel. The other problem is to study the entire fuel situation in Central Canada, Provinces of Ontario and Quebec, with a view to finding a substitute fuel to replace American anthracite as a house fuel in these Provinces.

Oils, oil shales and gases are included with peat, lignite and coal, as products to be investigated. The function of the Fuel Testing Division may be defined broadly: to investigate the fuels of Canada, solid, liquid and gaseous, in order to gain a comprehensive knowledge of their value for varied uses in the Arts and Industries, with particular reference to their character, heating values, coking and retorting and gas and oil producing possibilities, methods of utilizing fuels under boilers and in furnaces; investigation of oil shales and of processes for their treatment.

Investigations are now in progress on carbonization of lignite coals. Small scale experiments originally applied to the lignites of the Souris valley, Saskatchewan, are being applied to the various grades of Alberta lignites. Investigations are designed to be undertaken in respect to the alterations of lignites which are effected by heat and other treatments, with particular reference to: (1) the character of the carbonized residue, yield of gas, tar oils and ammonia; (2) thermal re-actions covering a wide temperature range to determine exothermic and endothermic points; (3) physical and chemical examination of residue with regard to briquetting qualities; (4) the effect of varying pressure and atmosphere in retort on the quality of the residue; (5) the determination of physicochemical properties of raw lignites and other products.

Oil Shales. An investigation is in progress respecting the destructive distillation of oil shales, with particular reference to the changes which take place when oil shale is digested in a bath of oil according to the Ryan process. It is proposed also to carry on other investigations in respect to the distillation of oil shale and on the retorting of oil shales on a large experimental scale for the purpose of recovering sufficient oils to investigate their value for refining into motor spirits, lubricating oils, etc., The problem of standardization of a medium scale laboratory method for the examination of oil shale samples is also under investigation.

Peat. Research work is being continued on the heat or other treatment to which peat should be submitted for producing the largest quantity of motor spirits, lubricating and other oils, and for determining the value of peat for the manufacture of alcohol, and the treatment that may be necessary to make it suitable for briquetting.

Pulverized Fuel. Large scale tests are being undertaken on the generation of steam by the use of pulverized peat, lignite and other coals.

Domestic Heaters. Investigations are in progress with a view to determining factors and suggesting alterations in design of heaters to permit the more efficient utilization of fuels other than anthracite.

It will be observed that the major portion of the activities of the Fuel Testing Division is devoted to the interests of the public at large, and that little direct assistance is given the coal mine operator. It is hoped that as the Branch expands, it will be possible to undertake investigations that will have a more direct bearing upon improving efficiency in all matters relating to the mining of coal.

87

CERAMIC AND ROAD MATERIALS DIVISION

Resignations and lack of experienced staff have delayed the development of these Divisions, and they have for the present been united for administrative purposes.

Ceramic Laboratories.

These laboratories are equipped to investigate clays and other materials used in the clay industries to determine their physical and chemical characteristics, their behaviour when subjected to firing, and the purposes for which they may be used. Reports are made on any clays submitted for examination.

Canada is a heavy importer of clay products, and the Canadian clay working industry, particularly in respect to the higher class of products, has been slow in development because of a serious lack of knowledge of the character and possibilities of our domestic resources.

Those interested in the development of the manufacture of clay products are thus afforded the facilities of having complete tests of their clays made in Canada, and the Department is enabled to carry on its clay investigations without the necessity of recourse to United States Laboratories of similar type.

When provided with staff, this Division will undertake laboratory investigations on feldspar, quartz, sand, or other materials used in pottery bodies, or as glaze and enamel materials, also special investigations on problems arising in the utilization of the above materials.

Road Materials Laboratory.

The function of this laboratory is to conduct the testing by standard methods of samples of road materials collected by field parties. The laboratory tests are necessary for the scientific determination of the physical values of road making materials such as the various types of gravel, rock, etc. The laboratory also provides opportunity for the investigation of special problems connected with the use of road materials, such as methods of improving the binding qualities of gravel and macadam roads, and methods for making more serviceable road surfaces prepared from natural soils.

Work has been carried on in cooperation with Provincial Highway Departments. The two engineers assigned to the work have been engaged during the past two years in examining the road materials along highways being built in the Rocky Mountains Park, Alberta, and in Nova Scotia, a large amount of work having previously been done in Ontario.

CHEMICAL DIVISION

The main Mines Branch Chemical Laboratory is very completely equipped for the chemical analysis of rocks, ores, minerals, mineral water, oils gases, mine air, etc. Samples collected by field officers of the Geological Survey and of the Mines Branch requiring to be analysed or assayed are submitted to this Laboratory. Much work in the way of chemical and physical examinations is done for other Government departments. In addition to the work required for departmental investigations, an endeavour is made to meet as far as possible the public demand for mineral identifications and for assays and analyses. Analytical and assay work for the public is subject to appropriate fees.

Through this Division the Department is doing a large amount of work in the analyses of mine air and gases.

During the past year two members of the staff have been engaged in important research investigations - one on bentonite, a colloidal clay found in British Columbia and Alberta, to determine the physical and chemical characteristics and possible uses of this material, and the other on natural gas for the production therefrom of methanol (methyl alcohol) and formaldehyde.

DOMINION OF CANADA ASSAY OFFICE, VANCOUVER, B.C.

The Assay Office acts as an agent for the purchase and assay of gold bullion in western Canada. Customs assays on minerals or ores are not undertaken.

The number of deposits in 1921 was 1,460; total weight after melting: 160,826 ounces, valued at \$2,834,499.61. All gold, with the exception of small amounts sold for manufacturing purposes, is shipped to the Royal Mint, Ottawa.

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