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W. Parsons

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THE MINES AND GEOLOGY BRANCH

DEPARTMENT OF MINES AND RESOURCES

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WAR WORK CONTRIBUTIONS

Services which the Mines and Geology Branch of the Department of Mines and Resources is staffed and equipped to render.

The war services which the predecessor of the present Mines and Geology Branch was able to render during the years 1914-1918 are briefly outlined in an appendix to this memorandum.

Some similar services are already in progress but a much more extended contribution can be made in the present emergency. Not only has the staff been almost doubled but laboratory facilities for investigation and research have been greatly extended and can also be used for production of special metals, alloys and mineral products. An efficient organization is functioning to supply the necessary information on the country's mineral resources and its productive capacity in minerals, metals and chemicals necessary for the normal maintenance of industry and the production of munitions.

These services may be briefly summarized under the following headings:

1. Mineral Resources and Mining, Metallurgical and Chemical Industry records and information. Details for individual properties and industries.
2. Geological service tributary to maintaining and extending Canada's production of gold and of petroleum.
3. Geological and Mining Engineering Services in the examination of and tributary to the development of mining properties for the production of critical war minerals (those in which Canada is deficient).
4. Physical and chemical testing of metals and materials entering into the production of munitions and war supplies.
5. Facilities for custom treatment of ores and commercial production of metals and alloys.

6. Investigational, testing and research work on the processing of metal and mineral ores of all kinds and of fuels to determine or improve methods of recovery of marketable products and the character or quality of the primary, intermediate and final products.
7. Control of the manufacture and inspection of explosives.
8. Fuel control.
9. Topographical Surveys.
10. Draughting and Map Reproduction.
11. Blue printing and photostatting.
12. The air photographic library.

The services listed above are more fully described on the following pages.

1. Mineral Resources and Mining, Metallurgical and Chemical Industry records and information. Details for individual properties and industries.

The Branch possesses in the Bureau of Geology and Topography and in the Bureau of Mines extensive records of mineral occurrences and of the mining and metallurgical industries and the allied chemical industries. Technical staff is available for collecting and analysing information relative to the occurrence of ores and minerals and the supplies of metals required for or in the production of munitions. These records have been gathered over a long period of years and are constantly being added to. They include all types of information having a bearing upon the economics of the mining industry.

2. Geological service tributary to maintaining and extending Canada's production of gold and of petroleum.

With United States' policy refusing loans and insisting on payment for purchases in "cash" an increasing production of gold may prove to be a very important factor in war finance. A long war may put a severe strain on the available production of petroleum for which Canada is dependent on outside sources of supply for 85 per cent of her own requirements.

The Geological Survey had in the field during the 1939 season 33 geological parties of which 6 were in areas where it was of primary importance to assist in the further development of gold mining, 15 in areas where geological studies were necessary for guidance in prospecting for either precious or base metals, and 7 parties in work designed to assist petroleum development.

War interests may require that the maximum amount of geological studies be made in order to increase Canada's production of gold and petroleum.

3. Geological and Mining Engineering Services in the examination of and tributary to the development of mining properties for the production of critical war minerals (those in which Canada is deficient).

There are a number of metals and minerals very necessary to the production of munitions and war supplies of which Canadian production is deficient. These include Chromium, Manganese, Molybdenum, Tungsten, Mercury,

Fluorspar, Graphite, refractory materials, etc. Geological and Mining Engineering staff and an administrative organization are available for investigating and reporting upon mining properties as was done to quite a considerable extent during the last war.

4. Physical and chemical testing of metals and materials entering into the production of munitions and war supplies. ...

Service of this character is already in progress for the Departments of National Defence and Transport and for the British Air Ministry.

A full and complete range of all the necessary mechanical testing machines is available for testing the strength of materials going into the manufacture of munitions, such as Vickers, Brinell and Rockwell hardness testing machines and a Shore scleroscope; an Amsler impact machine for izod and charpy tests; a 100-ton Amsler universal machine for tensile, compression and bend tests, including an extensometer for accurate determinations of elastic properties; an R. R. Moore rotating beam type fatigue testing machine, and a Foeppel-Pertz damping tester. All necessary equipment for the preparation of specimens and polishing metallographic sections is available, together with a Leeds and Northrup transformation point apparatus and a Rockwell dilatometer. The microscopic equipment for the study of metal structures is the most modern and includes a large inverted-type Zeiss machine with a full set of objectives and oculars, homals for observations and photomicrography of specimens up to 5,000 diameters.

In conjunction with the Ore Dressing Metallurgical Laboratories, there are maintained chemical laboratory facilities for the analysis of all inorganic materials, including metals and alloys. Two spectrographs are available, one for qualitative analyses of unknowns and a large, specially mounted grating spectrograph for quantitative analyses. An X-ray crystallographic spectrograph is also available for the determination of unknowns and the physical structure of metals, alloys, refractories, etc. These chemical laboratory facilities are in the hands of a staff of thirteen chemists and physical chemists, trained and specialized in chemical methods of analysis.

5. Facilities for custom treatment of ores and commercial production of metals and alloys.

The large-scale testing plant of the Bureau of Mines could be used for the sampling and concentration of the essential ores, such as those of molybdenum, tungsten, and manganese, on a production basis of about 30 tons daily. Any metal products purchased by a Munitions and Supply Board could be sampled. A similar service was rendered in the Great War.

The metallurgical laboratories are equipped with roasting, calcining, sintering, metallizing and smelting facilities for the treatment of ores and metallurgical products. The electric furnace melting equipment consists of a unit of Ajax high-frequency induction furnaces, one having a crucible of 500 pounds capacity, one of 50 pounds capacity, and one vacuum furnace of 20 pounds capacity. These furnaces are adaptable for making special steels and could be put on a production basis of 5,000 pounds of special steel, such as high grade tool steel, per day. A $1\frac{1}{2}$ ton, 700 K.W. Heroult electric steel furnace is also available. It could produce ten tons of special steel per day. This furnace should be used at its present location, moved or sold so that the fullest use could be made of it. Advantage should be taken of this furnace capacity of the laboratories to make special steels where the amounts required are small, too small for the capacity of industrial furnaces. Six small-sized electric furnaces are available for heat treatment, drawing and tempering of small special parts, with accessories such as quenching tanks, potentiometer, and furnaces for checking thermocouples.

6. Investigational, testing and research work on the processing of metals and mineral ores of all kinds and of fuels to determine or improve methods of recovery of marketable products and the character or quality of the primary, intermediate and final products.

The Bureau of Mines maintains ore dressing and metallurgical laboratories which probably contain the most complete facilities to be found anywhere in the world for developing methods of treatment for all classes and types of ores. These facilities have already been referred to in some detail under sections 4 and 5 of this memorandum.

Industrial Minerals Laboratories are maintained for investigation into the processing of non-metallic minerals other than fuels; ceramic laboratories for investigation and research on clays, shales and refractories, and road materials laboratories for testing of materials used in the construction of roads. Information is available regarding Canadian sources of supply of industrial minerals, developed and undeveloped; the plants for processing, with approximate capacity; and general information on the character of the products produced and the physical specification of the consuming industries.

It is foreseen that the group of industrial minerals of greatest war importance will be those used in the manufacture of refractories for furnace linings, etc., including the magnesia, chrome and alumina-silica refractories. Preparations are well in hand for the development of the recently discovered brucite deposits of Ontario and Quebec for the manufacture of magnesium refractories and, if necessary, metallic magnesium. The staff will be available to lend every assistance. Sources of supply of fireclays in Ontario and Quebec will be investigated. China clay is likely to be produced shortly by a mill in Quebec and assistance will be given in producing products suitable for the paper and ceramic industries. The Saskatchewan ball clays may have to be used to supply the market to a great extent, and the problem of their use will be studied. There is a possibility of a shortage in clay and graphite crucibles, which will involve a search for sources of supply of suitable clays and graphite and an investigation of the methods of manufacture. Laboratory investigational work may be required for the manufacture of chemical stoneware in Canada. At present, certain brine wells in Ontario and Quebec are being sampled to determine possible sources of bromine.

Fuel Research Laboratories are carrying out investigations and researches that will contribute to the more efficient use of the solid, liquid and gaseous fuels produced in Canada and the extension of the markets for these resources. The staff and laboratory facilities are available for carrying out analyses and tests on coals and other solid fuels such as peat, wood, cokes, chars, carbonized residues, briquettes, etc., and for tests on coal tar and petroleum oils, such as benzol,

toluene, phenol and other coal tar fractions; crude petroleum oils, lubricating oils, fuel oils and gasoline motor fuels; facilities are available for testing the octane rating of motor and aviation gasolines. The gas analysis laboratory is equipped for analytical and other tests on manufactured and natural gas, including the determination of helium, and also the testing of mine air for inflammability and noxious gases. The hydrogenation laboratory is presently used for investigating coal liquefaction, but the equipment could be employed for investigations on the processing of petroleum or other hydro-carbons for the production of aircraft fuel, naval fuel, or toluene for explosives. It has already been used as a cracking unit for a test on Turner Valley crude as a source of naval fuel. In the carbonization laboratory there is now in progress an investigation into the production of activated carbon for gas masks from coconut shells, peach and cherry stones. Its production from a special type of coal will also be investigated. The facilities of the solid fuels laboratory are available for testing the absorptive and other properties of peat moss for use in surgical bandages. A fairly complete study has been made of Canadian coals, of the coals imported into Canada, and the coals used for manufacturing coke and gas and other by-products in the Fuel Research Laboratories. The experience and advice of the staff are available for the problems in industrial plants and domestic use which are bound to arise from a disturbed coal supply.

7. Control of the manufacture and inspection of explosives.

This Branch, through the Explosives Division of the Bureau of Mines, administers the Explosives Act and maintains laboratory facilities for conducting chemical and physical tests on explosives such as gunpowder, gun cotton, trinitrotoluene (T.N.T.), cordite, nitroglycerine, and all kinds of dynamites and fireworks. The staff is available for all matters dealing with explosives, their manufacture, importation and storage. Their duties consist of assisting prospective manufacturers in establishing factories; inspecting sites; passing on allocation of buildings, manufacturing processes; authorizing new explosives; controlling storage, sales, licensing, importation, transportation other than rail, methods of packing, and imposing such restrictions as are deemed

advisable; performing laboratory tests and research on new explosives and on substitutes for recognized constituents; taking check-tests on run of work from factories, and maintaining good standards; investigating all accidents with explosives, especially in manufacture, and advising on their prevention.

8. Fuel Control.

The Dominion Fuel Board which followed up the work of the Fuel Controller during the last war and made extensive studies of Canada's fuel problems and which now administers the payment of Coal Subventions possesses a vast accumulation of information on the economic aspects of the coal industry and on coal trade. This organization has already been called upon to assist the Price Control Board and the Foreign Exchange Control Board in formulating and giving effect to fuel control regulations.

9. Topographical Surveys.

In the Topographical Survey there is a staff of topographers and engineers highly trained in surveying and map-making by both ground and aerial methods, together with a most up to date office, and field instruments and plotting machines.

This staff and equipment could be employed most usefully in carrying out the mapping of the areas along the east coast of Canada that, as yet, have not been accurately mapped. This work, if necessary, could be extended to include Newfoundland. The Survey could be used, also, for carrying out any mapping, reconnaissance or other surveys which may be required from time to time for any particular purpose.

10. Draughting and Map Reproduction.

In this Division, maps, charts and drafting of all kinds might be prepared for reproduction or for special reports and other purposes. Here is to be found a most highly trained map drafting staff in a well equipped drafting office.

11. Blue Printing and Photostatting.

The Bureau of Geology and Topography has the most up to date blue print, photostat and Océ (special dry process for making true to scale reproductions from tracings) equipment in the city. This service is already being used extensively for war requirements by the Department of National Defence and by the National Research Council.

12. The Air Photographic Library.

The Bureau of Geology and Topography maintains an Aerial Photographic Library, an offshoot from aerial surveying, in which with the addition of this year's photographs there will be nearly 800,000 prints. These prints are continually being referred to by Government departments and by the mining, forestry, water power and other industries. Careful study and expert interpretation of these photographs and the preparation of maps and plans therefrom make a most important contribution toward the solution of many industrial problems.

In this summary of the facilities of the Mines and Geology Branch, it is shown that there exists in the Government Service an organization that can render valuable service and make a great contribution to Canada's war effort in the present emergency if the fullest use is made of the staff and facilities.

Ottawa, October 2, 1939.

A P P E N D I X

WAR WORK CONTRIBUTIONS BY THE DEPARTMENT OF MINES, 1914-18.

Mines Branch

Staff were loaned as follows:

- (1) The Chief of the Metalliferous Mines Division was loaned to the Shell Committee in connection with the procurement of supplies of copper, lead, and zinc. He served on a special investigating committee which reported on the possibility of refining zinc in Canada. He developed a special type of shrapnel ball and the process of its manufacture and was loaned to the operating company to get the plants into production. He was associated with the organization of the Fuel Control Board and was Canadian representative on an International Committee on sulphur and pyrites supply. He commenced in 1917 the first comprehensive survey of the development of the chemical industry in Canada (comprehensive report subsequently published).
- (2) The Chief of the Ore Dressing and Metallurgical Division was loaned as Secretary to the Munition Resources Commission. Orders in Council of November 27 and November 30, 1915 (See Report of the Commission's operations). This Commission made extensive use of the staff and laboratory facilities of the Department of Mines.
- (3) A member of the Chemical Division was loaned as Technical Assistant to the Chief Inspector of shell steel.

Laboratory facilities and other services were utilized as follows:

- (1) The collection of special statistics and information pertaining to war minerals, metals, and chemicals.
- (2) The translation from foreign languages of technical reports and patents pertaining to manufacturing processes.
- (3) Field examination and report on mining properties containing minerals necessary for the manufacture of munitions.
- (4) Laboratory investigations of processes to produce the much needed war minerals, metals, alloys, chemicals, etc.

- (5) The actual commercial concentration of ores of molybdenum and the production of over 70 tons of concentrates. The experimental concentration of manganese and tungsten ores.
- (6) The sampling and chemical analysis of ores concentrates ferro alloys and metals purchased by the Government.
- (7) Special chemical work for the militia and other Government Departments tributary to war requirements.
- (8) Finding a supply of suitable refractories in Canada for furnace linings, etc. The production of crucibles used in the preparation of alloys. The metallographic examination of shell blanks, cartridge cases, etc., for defects and determination of cause.
- (9) The mechanical and physical testing of special steels and alloys for munition purposes.
- (10) The investigation of the use of wood oils for flotation concentration of ores due to the difficulty of obtaining a supply of pine oil from the United States.
- (11) Investigations of fuels due to acute fuel shortage.
- (12) Investigations with respect to the supply of toluene and benzol.

Geological Surveys

A number of geologists were either loaned to the Munitions Resources Commission or were otherwise engaged in geological work required in Canada. War effort such as examining and reporting upon sources of supply of special war minerals.

National Resources Intelligence Service

Services to various government departments, war committees, commissions, etc., such as -

Blue print and photostat work on a large scale.

Drafting and sometimes compilation of special maps, charts, diagrams, etc.

National Resources Intelligence Service

Preparation of lantern slides for recruiting and victory bond sale purposes.

Investigations and reports relating to employment in industries and on farms.

Ottawa, September 28, 1939.

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