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DOMINION OF CANADA

REPORT

OF THE

DEPARTMENT OF MINES

FOR THE

FISCAL YEAR ENDING MARCH 31, 1928

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DOMINION OF CANADA

REPORT

OF THE

DEPARTMENT OF MINES

FOR THE

FISCAL YEAR ENDING MARCH 31, 1928



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GOVERNMENT OF CANADA

REPORT

DEPARTMENT OF MINES

FISCAL YEAR ENDING MARCH 31, 1938

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DEPARTMENT OF MINES AND TECHNICAL SURVEYS

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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 report of the work of the Department of Mines, for the fiscal year ending March 31, 1928.

CHARLES STEWART,
Minister of Mines.

To General Sir Alexander Mackenzie, The Right Honourable Lieutenant Governor of Ontario,
O.C.M.D., O.C.A.E., G.B.E., Governor General and Commander in Chief
of the Dominion of Canada

Dear Sir: Please find enclosed:

The undersigned has the honour to lay before Your Excellency, in con-
junction with B-7 Report VII, chapter 30, section 18, the report of the work of
the Department of Mines for the fiscal year ending March 31, 1935.

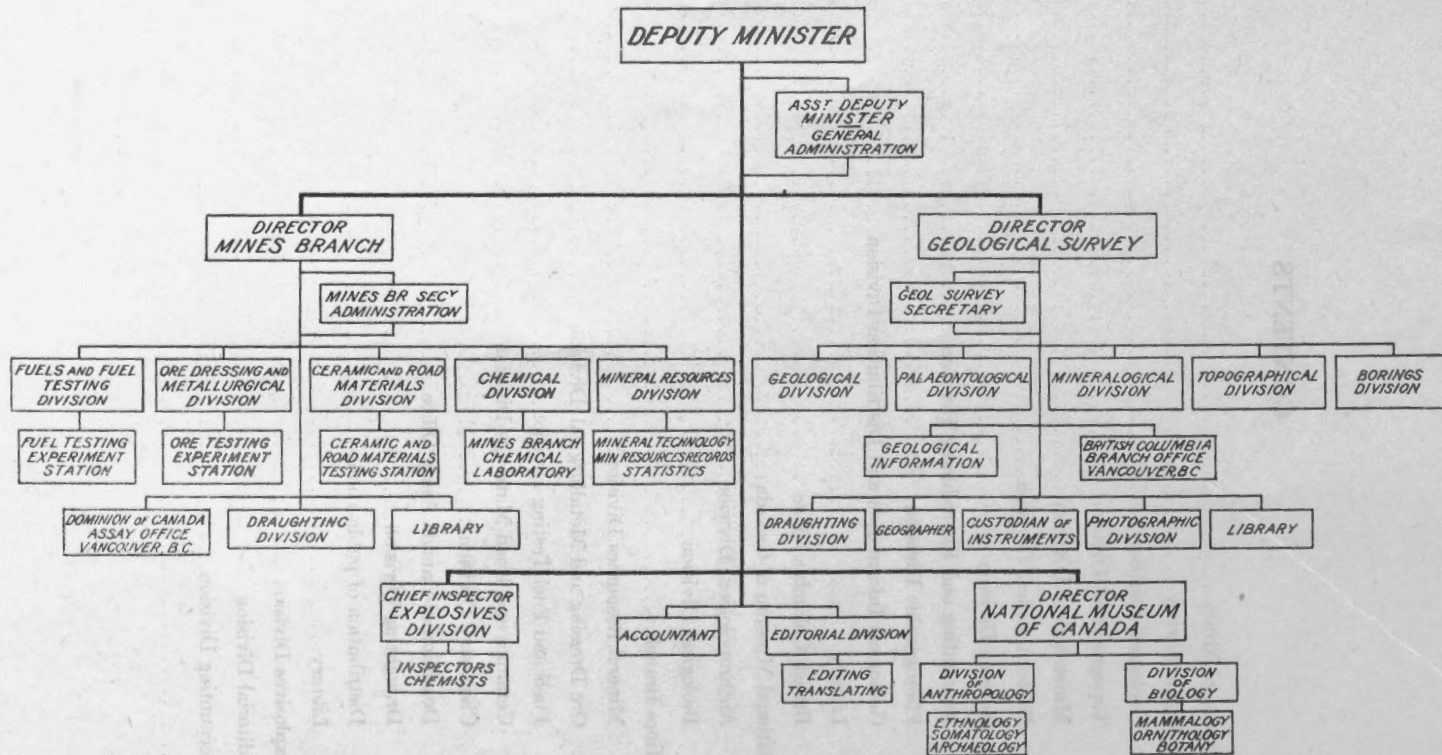
CHARLES STUART

Minister of Mines

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ORGANIZATION CHART
DEPARTMENT OF MINES



DEPARTMENT OF MINES

REPORT

OF THE

DEPARTMENT OF MINES

FOR THE FISCAL YEAR ENDING MARCH 31, 1928

To the Hon. CHARLES STEWART,
Minister of Mines,
Ottawa.

SIR,—I have the honour to submit, in accordance with the requirements of Parliament, the Annual Report of the Department of Mines for the year ending March 31, 1928.

The period covered by the present report has been one unequalled in activity and expansion in the history of the mining and metallurgical industries of Canada, and has been featured by a constantly increasing demand from all parts of the Dominion for the services of the Department. To meet this demand the investigations conducted both in field and laboratory by the scientific and technical branches of the Department have been extended to areas in every province of Canada. The list of these investigations, and the range and variety of the problems embraced, are in themselves sufficient to indicate the importance of the position that mining has already achieved in the industrial life of the nation, and the influence that it is likely to exercise on the course of our future economic development.

Statements of the functions and details of the operations of the several branches and divisions of the Department during the year, prepared by the heads of each branch or division, are to be found below. An examination of these statements will reveal that although much is being accomplished to further the economic development of our mineral resources, much still remains to be done, and that increased facilities for economic research along these lines, and consequently greater expenditure by both Dominion and provincial governments are very likely to be in the order of things for years to come. A growing recognition of the value of scientific and technical research in the solution of problems related to the utilization of our natural resources has manifested itself particularly in the mining and metallurgical industries. Metallurgical research has already resulted in a notable contribution to the wealth of the Dominion by rendering profitable many previously unprofitable deposits and by extending the lives of a number of the older mining camps. Equally valuable, if not quite such spectacular, progress is being made in other directions, notably in respect to the utilization of our low-grade fuel resources. Geological science is rendering invaluable assistance in locating and determining the oil-bearing formations of the west, and in the search for and exploitation of the metalliferous and other mineral deposits with which the Dominion is so richly endowed.

In the very diversified field of activity in which it operates, the Department of Mines is chiefly concerned with the various scientific and technical phases of

mining, milling, and metallurgical operations, and with delimiting, mapping, and directing attention to the mineralized areas of Canada, in assisting the mine operator and metallurgist in solving the problems continually arising in the business of extracting, milling, and smelting ores, and, through technological research, in the study of methods by means of which the product of the mine may be more efficiently utilized and the market for Canadian mineral products extended. This work, in its relation to national development, has a value far beyond that represented by the purely material results immediately secured. In the history of modern civilization mining has proved to be one of the greatest pioneering and colonizing influences, and the primitive mining camp of today is, in fact and often, the thriving and many-sided community of tomorrow.

During the year the Geological Survey had fifty field parties engaged in geological and topographical mapping and related work, operating in widely separated parts of the Dominion. This number was supplemented by various field investigations undertaken by the Mines Branch and the National Museum of Canada. Field work in geology, topography, mineral resources, palæontology, ethnology, and biology was continued from last year and new investigations were commenced; laboratory investigations embraced a wide range of subjects in the fields of mineralogy and petrography, ore dressing and metallurgy, fuel testing, ceramics, and road materials. To provide much-needed accommodation for the increasing work in fuel testing the construction of a new Fuel Research Laboratory at Ottawa was commenced, and it is expected that the new building will be ready before the end of the next fiscal year. Plans have also been made for a large-scale experiment in the manufacture of peat fuel and a very complete peat manufacturing plant, planned in accordance with the recommendations of the former Joint Peat Committee, has been built during the past year at Alfred, Ontario. This will be operated during the year on a basis approximating as closely as possible commercial conditions.

The Department has maintained during the year its general policy of co-operation with other departments of the Dominion and of provincial governments, and with the development branches of the railway companies, banks, chambers of commerce, and other Canadian organizations interested in the development of our natural resources. The general type of investigation undertaken by the Department differs distinctly from those conducted by other bodies, and the danger of overlapping is almost entirely eliminated. Where similar work is carried on—as is the case in some of the universities, provincial governments, and the National Research Council—every effort is made to co-ordinate the work of the Department with that of these various bodies. Close co-operation is also maintained with the Imperial Institute (London), the British Department of Scientific Research, the United States Department of Commerce at Washington, and with certain technical societies in the United States.

An outstanding event of the year was the meeting in Canada of the Second (Triennial) Empire Mining and Metallurgical Congress, which opened in Montreal on August 22, and closed in Quebec on September 28, following an extensive tour of the Dominion during which the principal mining and metallurgical centres were visited. The Congress was convened by the Canadian Institute of Mining and Metallurgy and was representative of every important phase of the mining and metallurgical industries in all parts of the Empire. Included in the total attendance, which exceeded twelve hundred, were delegates from mining and kindred associations established throughout the Empire and visitors from many foreign countries. The papers presented at the technical sessions of the Congress embraced a wide variety of topics related to recent progress, the present status and future prospects of the mining and metallurgical industries in almost every section of the Empire where these

industries are carried on. Specially prepared handbooks descriptive of Canada's mining and metallurgical industries were issued on this occasion by the Department, by several of the provincial governments, and by numerous private organizations. Every opportunity was given the visitors to secure an accurate idea of the extent and variety of our mineral resources and of their industrial possibilities, and the Congress was particularly impressed by the progress made in mining and metallurgy throughout the whole of the Dominion in the last few decades. The attendant publicity both at home and abroad, the technical discussions during the Congress, and the personal contacts made between outstanding mining men in different parts of the Empire, are factors that may mean much to the development of mining in Canada, and although it is impossible to estimate in terms of dollars the benefits which Canada will derive from this meeting on her own soil, it is not difficult to foresee that such benefits, both direct and indirect, will be of considerable importance.

The Deputy Minister, in addition to his administrative duties, devoted a considerable part of his time to other work devolving upon him as chairman or member of the following official bodies: Council of the Northwest Territories; Dominion Fuel Board; Canadian Committee of the World Power Conference, Advisory Committee on Mining Regulations, National Research Council; Niagara Board, Advisory Committee on Minerals of the Imperial Institute. Meetings of each of these bodies were held throughout the year. The work of the Lignite Utilization Board, of which the Deputy Minister has been a member since 1924, has now been brought to a close and a satisfactory disposition has been made of the leases and other rights, and of the equipment of the board.

In the autumn of 1927 the Deputy Minister accompanied the Minister of Mines on a visit to several European centres in which experimental work in the processing of fuels is in progress. The itinerary for this tour was planned in co-operation with the British Fuel Research Board and with official organizations in Germany, which permitted of a selection being made of the more advanced operations in both of these countries. Four low temperature retorts were inspected in Germany, and eight British plants, situated in South Wales, London, the Midlands, and in Scotland, were also examined. As a result of these investigations valuable information was gained which may have a bearing on the application of processing treatment to certain types of Canadian fuels should any of these developments prove applicable to Canadian conditions. Several processes designed to accomplish the liquefaction of coal or the conversion of coal into oil were examined. A small unit of the Bergius process installed in the British Fuel Research Station at Greenwich was inspected, and experiments in which the Fischer process is being essayed were witnessed at the Kaiser Wilhelm Institute of Coal Research at Mulheim on the Ruhr. Information was also secured in respect to a third process with which experiments are being made at Leuna in Germany. The possibilities involved in these different developments are of particular interest to Canadians because of our large reserves of low-grade coals. Although the liquefaction of coal is still in a comparatively early stage of advancement, important progress has already been made and it is highly desirable that further developments along these lines be carefully watched. While in Europe, the Deputy Minister participated in a meeting of the International Executive Council of the World Power Conference held at Cernobbio, near Como, Italy, September 5 to 10, and meetings in London of the Advisory Council on Minerals of the Imperial Institute.

The official mining newsletter series prepared by the Department and distributed from the High Commissioner's Office in London, has been maintained.

By means of this series, which was inaugurated in 1923, a rational and informed interest in Canadian mineral resources and mining operations is constantly sustained. This fortnightly service now reaches some four hundred selected newspapers, mining, banking, and investment houses in the United Kingdom and on the Continent. The titles of the twenty-eight articles dispatched during the year will be found following the list of papers and addresses appearing on pages 7 to 9.

As in preceding years, the results of all major investigations conducted by the Department in the field and in its laboratories have been published in the form of summary reports, special bulletins, maps, and memoirs. A great deal of information of scientific, technical, and current interest connected with the work of the Department is also disseminated through the public and technical press, and by means of addresses. In this phase of its activities the Department has continued to receive the valuable co-operation of the Natural Resources Intelligence Branch of the Interior Department. Requests received from a number of newspapers which proposed to issue special editions in honour of the Diamond Jubilee of Confederation led to the preparation by the Department of a series of thirteen special articles for release on this occasion. These articles were distributed to newspapers in many different parts of the Dominion and in the United Kingdom and included, in addition to reviews of progress made in the Canadian mining and metallurgical industries since Confederation, a number of articles prepared by members of the staff dealing with various other economic and cultural aspects of past and present phases of life in Canada. The annual series of educational lectures given during the winter months in the Lecture Hall of the Victoria Memorial Museum was again favourably received, and will be continued as heretofore.

Preliminary figures of mineral production recently published by the Dominion Bureau of Statistics show a new high record reached during the past year, when the value of the output rose to \$247,356,695, a gain of nearly \$7,000,000 over the record output in 1926, and of almost 200 per cent in the twenty-year period since 1907. Not only has 1927 been a record year for production; it has also witnessed the broadest and most important advance in development yet recorded in the history of Canadian mining, and has seen the field of operations extended and a more solid foundation laid for a still greater and more remarkable advance in the future. It can safely be said that never before has mining in the Dominion attracted and so consistently held the amount of interest that it does at the present time, and never has the effort to make the mineral-bearing regions of the Dominion yield up their wealth been so well organized and intensive, or so widespread.

An important feature of this record output, and one that has great industrial significance, is the diversity of fields over which it is spread. New output records have been established in a variety of metals and non-metallic minerals. Material advances have been made in the production of gold, copper, lead, and zinc, and in that of coal, cement, lime, and gypsum. An increase is also shown in the values of natural gas and petroleum, and an advance over production in 1926 is recorded for some twenty mineral products of varying industrial importance. Of the total production value recorded for 1927 over 99 per cent was contributed by nineteen different mineral products, each of which had an output of \$1,000,000 or more in value. On the whole a very healthy trend is visible to which greater emphasis is lent by the fact that, notwithstanding general declines during the past few years in the prices of mineral products, as revealed by the index numbers of the Bureau of Statistics, the total value of the annual mineral production steadily continues to increase.

The mining and metallurgical industries are yearly gaining in importance in the industrial life of the provinces. It has recently been said that mining may soon rank as the second of Canada's primary industries, and a study of the fields over which it is so rapidly expanding makes the realization of this prophecy appear not altogether impossible. Mining operations are now a matter of vital concern to three Canadian provinces, of prime importance to two others, and are becoming of increasing importance to the remaining three large provinces. In order of production in 1927 Ontario came first, British Columbia second, Nova Scotia and Alberta almost equal, Quebec fifth with a rapidly increasing production, and Manitoba, New Brunswick, Yukon, and Saskatchewan following in the order given. Developments in Quebec and more recently in western Manitoba and in Saskatchewan have thrown a new light on the mineral resources of these provinces, and the success of the pioneers in these fields has provided the incentive to greater activity and the more intensive examination of previously prospected areas. Vast areas hitherto entirely unexplored or which had been only hurriedly prospected have been made more readily accessible by airplane. The search for minerals is today contributing more than any other agency to the exploration of unmapped territory, and the map of the Dominion is being unrolled northward with remarkable rapidity. Enough is now known of the resources of the north to enable one to foresee the establishment, within a comparatively short space of time, of important mining and metallurgical centres throbbing with life and movement, and contributing materially to the greater economic development of the Dominion.

Most of the enterprises now operating in the Canadian mining field are in the hands of reputable concerns interested in the honest development of their properties. The stock exchange frenzy of 1926 and 1927 and the ease with which funds could then be secured proved an irresistible inducement to operators of many promotions of the mushroom type, incorporated principally with the object of mining the public. This very undesirable element has since, fortunately, to a large extent disappeared, partly because of the greater caution now manifested by the investing public and partly because of repressive measures adopted by the governments concerned and by the banks. It cannot be too clearly understood that mining in the exploratory and pre-development stage is, in very many cases, risky, and all that the investor can possibly hope for is the honest expenditure of the funds of the company by an honest and competent management. The Canadian mining industries offer, on the other hand, a wide variety of opportunities of proven and undoubted value which, from the investment point of view, do not carry the risks inevitably associated with issues of the more speculative classes.

The Department wishes to express its appreciation of the recent tribute made to the memory of the late George Mercer Dawson, Director of the Geological Survey from 1895 to 1901, by Mr. Fenley Hunter, of New York city. Mr. Hunter's tribute is in the form of a memorial tablet which was erected in September, 1927, on the right bank of Liard river, Yukon territory, on the site of a boundary post placed there in 1887 by Dr. Dawson during his explorations in those regions. The erection of this memorial to a great Canadian geologist and explorer by a citizen of the United States of America is a fine tribute not only to Canadian science, but also to the interest and appreciation of the people of the United States. A more detailed description and a photograph of the monument have been included in the report of the Director of the Geological Survey in this volume.

Dominion Fuel Board

The Dominion Fuel Board, during the year, was engaged not only with the investigations previously initiated but also with inquiries in connexion with the better utilization of fuels, and the new uses to which coal is being put.

In co-operation with the Mines Branch, Department of Mines, a fuel power survey was planned with a view to learning how the fuels of the Dominion are being utilized in industry and promoting more economic methods in the use of fuels. The board is keeping in touch with experiments and methods for burning pulverized coal and arrangements have been made for the Mines Branch to investigate the present status of the project. If this method is found to be practicable, the use of certain Canadian coals, the markets for which are at present restricted owing to their high content of low fusibility ash, may be considerably extended.

The first of a series of pamphlets on house insulation and allied subjects was published in English and French by the board during the year. The object of this pamphlet is to direct public attention to the large wastage of heat resulting from improper house construction and to suggest methods whereby this loss may be overcome. Public reception of the 25,000 copies issued was such as to necessitate the printing of a second similar edition. Other pamphlets of the series are in course of preparation.

Information obtained by the board from an earlier investigation of the use of wood as an auxiliary fuel in Ontario was passed to the Forestry Branch, Department of the Interior. A synopsis of the investigation will be published in the general report of the Fuel Board now in course of preparation. The annual survey for the purpose of ascertaining the extent to which imported anthracite is being displaced in Ontario and Quebec was in the year under review conducted for the Fuel Board by the Mineral Resources Division of the Department of Mines. Data obtained in this way provide a broad knowledge of our domestic fuel situation. The report on the survey indicates a notable increase in the use of the so-called "substitute fuels." The board continued its program of distributing throughout Ontario and Quebec, printed cards and pamphlets showing proper methods of burning coke and other fuels displacing imported anthracite. At the board's direction a revised pamphlet on the use of these substitute fuels, printed in both English and French, was prepared and distributed by the Mines Branch, Department of Mines.

Administration of the Domestic Fuel Act, passed during the Session of Parliament of 1927, was assigned to the Fuel Board. The board dealt with an application for the benefits of the Act during the period under review, and submitted the necessary recommendations to the Minister. The application was accepted.

At the conference of the Provincial Premiers and Federal Cabinet held at Ottawa in November, the deliberations included the development of a Canadian fuel supply. For use at this convention special briefs dealing with the fuel situation were prepared by the board. The board also prepared and submitted information for ministerial use in connexion with the framing of policies which the Government adopted for test movements to extend the markets for the coals of both eastern and western Canada.

Articles for press and journalistic publicity and public addresses on the fuel situation were included in the year's activities. Information relative to fuel matters was supplied by the board to different branches of the Government service, and many requests from the public for such information were dealt with.

The Natural Resources Intelligence Service, the Mines Branch, Geological Survey, the Dominion Water Power and Reclamation Service, and the Dominion Bureau of Statistics freely co-operated with the board.

The board proposes to issue soon a general report covering its activities and progress since the Interim Report was published in 1923.

Changes in personnel and staff during the year included the resignation of Mr. C. P. Hotchkiss as a member and executive secretary of the board. Mr. F. G. Neate was appointed secretary in the place of Mr. Hotchkiss. Mr. M. D. McCloskey was transferred from the Department of the Interior to the staff of the Fuel Board.

Your obedient servant,

CHARLES CAMSELL,
Deputy Minister.

OTTAWA, November 7, 1928.

List of Papers and Addresses

(NOTE.—Lists of the papers prepared and addresses delivered during the year by members of the staff of the Divisions of Anthropology, Biology, and Mineralogy are to be found in the Annual Report of the Director, National Museum of Canada)

General

- The Status of the Canadian Mining Industry, by Hon. Charles Stewart. Empire Mining and Metallurgical Congress, August 22, 1927.
- Canada's Mineral Wealth, by Hon. Charles Stewart. Canadian Progress, 1927.
- Our Mining Industry, by Hon. Charles Stewart. Canadian Mining Manual, 1927.
- Dominant Developments in Canada, by Charles Camsell. Financial Times (Montreal), August 26, 1927.
- The Dominion's Minerals, by Charles Camsell. Financial Times (London), November 21, 1927.
- Range of Canada's Mineral Wealth, by Charles Camsell. "Canada" Mining and Financial Supplement, July 30, 1927.
- The New Position of Canadian Mining, by Charles Camsell. Stock Exchange Gazette, London.
- Canada's Mining and Metallurgical Industries, by Charles Camsell. Industrial Canada, January, 1928.
- Canada's Mineral Resources and Development, by Charles Camsell. Special Canada Number, Empire Mail (London), March, 1928.
- Mining, by Charles Camsell. Gyro Club, Ottawa, April 13, 1927.
- The Mining Industry, 1927, by Wyatt Malcolm. Annual Financial Review number of the Gazette, Montreal.
- The Mining Industry, 1927, by Wyatt Malcolm. Natural Resources, Canada, vol. 7, No. 1, p. 4, January, 1928.
- The Second Empire Mining and Metallurgical Congress, by Charles Camsell. Canadian Institute of Mining and Metallurgy, March 8, 1928.
- The Forthcoming Meeting of the Second (Triennial) Empire Mining and Metallurgical Congress in Canada, by J. McLeish. Address to Rotary Club, Ottawa, August, 1927.
- The Geological Survey of Canada, by Wyatt Malcolm. The Canada Year Book, 1926, pp. 34-36 (1927).
- The Work of the Mines Branch, Department of Mines, by John McLeish. Address to the Lion's Club, Ottawa, May, 1927.
- Field Work and Investigations To Be Undertaken by the Mines Branch During the Season of 1927, by John McLeish. Special List of Journals and Officials.
- Activities of the Dominion Fuel Board, by F. G. Neate. Canadian Review, 1927.

Geology, Mining, Mineralogy, and Mineral Resources

- Geology of Canada, by Wyatt Malcolm. The Canada Year Book, 1926, pp. 16-27 (1927).
- Geology of Canada, by Wyatt Malcolm. Empire Congress number of the Globe, Toronto.
- Economic Geology of Canada, 1926, by Wyatt Malcolm. The Canada Year Book, 1926, pp. 28-34 (1927).
- Outline of Carboniferous Stratigraphy and Geologic History of the Maritime Provinces of Canada, by W. A. Bell. Transactions, Royal Society of Canada, section IV, 1927.
- Stratigraphy of the Northern Subprovince of the Lake Superior Region, by T. L. Tanton. Geological Society of America Bulletin, vol. 38, pp. 731-748.
- The Eastern Contact Zone of the Coast Range Batholith on Stikine River, by F. A. Kerr. Canadian Mining and Metallurgical Bulletin No. 189, pp. 179-183, January, 1928.
- Review of "Our Mobile Earth," by R. A. Daly; F. J. Alcock. Canadian Field Naturalist, May, 1927.
- Zoning of Mineral Deposits, by George Hanson. Royal Society of Canada, Proceedings and Transactions, vol. 21.
- Emulsions of Silicates, by T. L. Tanton. American Journal Science, vol. 15, pp. 66-68.
- Chemistry in Mining, by C. S. Parsons. Toronto Branch, Canadian Chemical Association.
- Economic Minerals, by H. F. Fr chet te. Broadway Avenue Public School, Westboro.
- An X-Ray Study of the Garnet Group, by C. H. Stockwell. American Mineralogist, vol. 12, No. 9.

- Diamond Jubilee Celebration in the Gaspé Mineral Area, by F. J. Alcock. Canadian Mining Journal, July 22, 1927, p. 580.
- Recent Developments in Gaspé Peninsula, by F. J. Alcock. Canadian Mining and Metallurgical Bulletin, pp. 367-385, March, 1928.
- Industries of the Niagara Peninsula; Power and Transportation; Electro-Chemical Industries; Metallurgical Industries; Chemical Industries; by A. W. G. Wilson. Second (Triennial) Empire Mining Congress.
- Mining in Nova Scotia, by A. H. A. Robinson. Halifax Herald.
- Abrasives, by V. L. Eardley-Wilmot. Mineral Industry for 1926.
- Lead and Zinc in Canada, by T. W. Bingay and F. J. Alcock. Canadian Mining and Metallurgical Bulletin, pp. 920-943, August, 1927.
- Oil and Gas Developments in Canada, by G. S. Hume. Journal of the Institution of Petroleum Technologists, vol. 13, No. 63, August, 1927.
- Oil and Gas in the Maritime Provinces, by W. A. Bell. Second (Triennial) Empire Mining and Metallurgical Congress, Alberta.
- The Recent Zinc Discoveries near Sudbury, Ontario, by A. Buisson. Second (Triennial) Empire Mining Congress.

Fuels and Fuel Testing

- Low Temperature Carbonization and Coal Liquefaction in Europe, by Hon. Charles Stewart. Canadian Mining Journal, December 9, 1927.
- Recent Developments in Europe in the Treatment of Coal and Their Application to Canada, by Charles Camsell. Canadian Club of Ottawa, February 18, 1928.
- Low Temperature Carbonization and Liquefaction of Coal, by Charles Camsell. Canadian Mining Institute, Ottawa Branch, November, 1927.
- Research and Investigations of the Division of Fuels and Fuel Testing, by senior members of staff of the Division of Fuels and Fuel Testing. Canadian Chemistry and Metallurgy, August, 1927.
- Gasoline by Pressure Cracking of Canadian Shale Oil and Bitumen, by R. E. Gilmore. Canadian Chemistry and Metallurgy, November, 1927.
- Fuel Markets and Their Development, by F. G. Neate. Financial Times, London, England, December, 1927.
- Extended Use of Alternative Fuels, by F. G. Neate, January, 1928.
- Canada's Fuel Problem, by Charles Camsell. Address before Ottawa Canadian Club, February, 1928.
- Development of Welsh Coal Market in St. Lawrence District, by F. G. Neate. Financial Times, London, England, March, 1928.
- Improvement in Domestic Fuel Situation, by M. D. McCloskey. Toronto Saturday Night, April, 1927.
- Subsidy for Coke Plants, by M. D. McCloskey. Natural Resources Canada, April, 1927.
- Fuel Problem in Ontario, by F. G. Neate. Canadian Retail Coal Dealers' Association, Toronto, May, 1927.

Ore Dressing and Metallurgy

- The Ore Dressing and Metallurgical Laboratories, by W. B. Timm. Toronto Branch, Canadian Institute of Mining and Metallurgy.
- Improvements and Innovations in Canadian Flotation Practice, by W. B. Timm. Annual Meeting of British Columbia Branch, Canadian Institute of Mining and Metallurgy.
- Custom Concentrators, by C. S. Parsons and A. K. Anderson. Annual Meeting, C.I.M.M., Quebec, Que.
- Flotation Practice (2 papers), by C. S. Parsons. Mining Students, Queen's University, Kingston.
- The Flotation Process, by C. S. Parsons. Engineering Society, Queen's University, Kingston.
- The Flotation Process, by C. S. Parsons. Ottawa Branch, Society of Chemical Industry.
- The Concentration of Ores of Western Quebec, by G. S. Godard. Annual Meeting, C.I.M.M., Quebec.

Ceramics and Road Materials

- Address to Ceramic Students of Toronto University, by H. F. Fréchette. March, 1928.
- Clay Handling and Delivery Costs, by J. F. McMahon. American Ceramic Society, February, 1928.
- Enamelling on Metal, by J. F. McMahon. Victoria Memorial Museum.
- The Enamelled Saucepan, by J. F. McMahon. Victoria Memorial Museum.
- Roads and Road Materials, by H. F. Fréchette. Special List of Journals.

Physiography and Topography

- A New Method of Determining the Rate of Recession of Niagara Falls, by W. H. Boyd, Transactions Royal Society, Canada.
- Co-ordination of Topographical and Geological Mapping in Relation to Mining Development, by K. G. Chipman and W. F. James. Canadian Institute of Mining and Metallurgy, Annual Meeting, Quebec, March, 1928.
- Canada's Physical Features Promise Rich Future, by D. A. Nichols. Confederation Issue, Ottawa Journal, June, 1927. Reprinted in several papers.

Palæontology

- The Ancient Life of Canada, by E. M. Kindle. Mail and Empire and other Canadian papers.
- The Role of Thermal Stratification in Lacustrine Sedimentation, by E. M. Kindle. Trans. Royal Society of Canada, vol. 21, ser. 3, sec. 4, pp. 1-35 (1927).
- The Romance of Fossil Hunting, by E. M. Kindle (Review). Journal of Geology, vol. 35, pp. 95-96 (1927).
- Some Canadian Triassic Faunas, by F. H. McLearn. Trans. Royal Society of Canada, 3rd ser., vol. 21, sec. 4, pp. 61-73, Pl. 1, Fig. 7 (1927).
- Horned Dinosaur Group in National Museum of Canada, by C. M. Sternberg. Canadian Field Naturalist, April, 1927.
- Homologies of Certain Bones of the Ceratopsian Skull, by C. M. Sternberg. Royal Society of Canada, 3rd ser., vol. XXI, sec. IV, 1927.
- Hunting Dinosaurs in the Bad Lands, by C. M. Sternberg. Y.M.C.A., Ottawa, October 19, 1927.
- Dinosaurs, by C. M. Sternberg. Trinity Church; Ottawa Boys' Club, March 17, 1928.
- Hunting Dinosaurs in Alberta, by C. M. Sternberg. Kiwanis Boys' Club, Ottawa, February 3, 1928.
- The Age of Mammals, by C. M. Sternberg. National Museum of Canada Lecture Course, January 14 and 18, 1928.
- Evolution of the Horse, by C. M. Sternberg. Veterinarian Group, Professional Institute, Ottawa, March 7, 1928.

Mining Newsletter Series

- (Distributed from the Office of the High Commissioner for Canada in London)
- Great Possibilities of the Stikine River Area, by F. A. Kerr.
- Copper in Canada, by A. H. A. Robinson.
- Progress of Exploration in Beardmore Area, by T. L. Tanton.
- Recent Zinc Discoveries near Sudbury, by A. Buisson.
- Ore Deposits near Portland Canal, B.C., by G. Hanson.
- Alberta Bituminous Sand for Paving Purposes, by S. C. Ells.
- Turner Valley Oil Field, Alberta, by G. S. Hume.
- Field Work of the Geological Survey, by Wyatt Malcolm.
- Nova Scotia Salt for Use in the Fisheries, by L. H. Cole.
- The Empire Mining Congress, by C. Camsell.
- The Acid Industry in Canada, by D. M. Stewart.
- Lead and Zinc in Sudbury District, by W. H. Collins.
- Horne Smelter Soon to Commence Operations, by H. C. Cooke.
- Further Development in Rouyn Area, by H. C. Cooke.
- Alkali Industry in Canada, by D. M. Stewart.
- With the Eastern Tour of the Empire Mining Congress, by Wyatt Malcolm.
- Kirkland Lake Gold Area, by A. Buisson.
- Mining Developments in Manitoba, 1927, by J. F. Wright.
- Lead and Zinc in Canada, by A. H. A. Robinson.
- Mining Developments in British Columbia, 1927, by V. Dolmage.
- The Mining Outlook in British Columbia, by V. Dolmage.
- The Zinc-copper Deposits at Chelmsford, by A. Buisson.
- Mining Developments in Western Quebec during 1927, by W. F. James.
- Canadian Tale and Soapstone Industry Shows Progress, by H. S. Spence.
- Mining Development in Gaspé Peninsula, by F. J. Alcock.
- Progress of the Porcupine Gold Area, by A. Buisson.
- The Chibougamau District of Quebec, by J. B. Mawdaley.
- Antimony in Canada, by A. Buisson.

GEOLOGICAL SURVEY

W. H. Collins, Director

CHANGES IN STAFF

In the Geological Division, W. S. Dyer, assistant geologist, resigned on June 8, 1927, to take a position as geologist in the Ontario Department of Mines. C. H. Stockwell was appointed assistant geologist on June 4, 1927, and H. C. Gunning on January 1, 1928.

The Draughting Division was strengthened by the addition of two apprentice draughtsmen, G. S. Daughtry, on September 20, 1927, and W. C. Güssow, on September 21. To meet a need both in the Geological Survey and in the National Museum for relief models of geological, topographical, and other features, R. E. Ouimet, of the Topographical Surveys Branch, Department of the Interior, was appointed relief map maker on June 27, 1927. A. V. Waite was appointed process worker in the Photographic Division, on April 15, 1927, to replace L. Y. Clarke, who resigned in 1926.

Among the positions of a clerical nature, Miss V. I. Reid, stenographer in the Borings Division, resigned on October 16, 1927, and was succeeded on January 1, 1928, by Miss A. H. Campbell. P. J. Moran was appointed, on August 1, 1927, as principal clerk, to take over the duties of the late Alexander Young, deceased August 2, 1926.

On March 3, 1928, John James McGee, junior clerk, died. Mr. McGee had been in the Geological Survey for twenty-four years, and was held in esteem and affection by his associates.

PROGRESS OF WORK

A short explanation was made in last year's report of the need for classifying and making more accessible to users of Survey publications the information which is scattered through the great number of reports and maps that have been issued since 1842. This work of systematizing maps and reports is making satisfactory progress, though owing to the slowness of preparing and publishing such matter a few years must elapse before any marked results can be apparent.

The general geological map of Canada, on a scale of 1 inch to 100 miles, is now in its third edition, and, complementary to it on the same scale, is an index map to the mineral occurrences. Of thirty-four regional geological maps on a scale of 1 inch to 8 miles which are planned, four are published (Nos. 39A, 155A, 190A, and 204A), three are in course of publication, and work will shortly commence upon three others. A large number of 1 inch to 1 mile topographical and geological sheets, each covering 15 minutes of latitude and 30 minutes of longitude, are published or in various stages of preparation. This system, inaugurated about 1909 by R. W. Brock, Director at that time, is already well established, being also adopted by the topographical survey organizations in the Department of the Interior and the Department of National Defence.

The series of Economic Geology reports, which is designed to assemble into compact and convenient form the mass of information about mineral occurrences that is scattered through the reports of the Survey, the publications of the provincial Departments of Mines, and various periodicals, is also making good progress. Four reports—on talc, iron ores, arsenic, and a general report on the geology and economic minerals of Canada—are published; four others—

on oil and gas, lead and zinc, the rare-element minerals, and a handbook for prospectors—are in course of publication; and work has been commenced on four more.

These publications are largely supplementary to the usual activities of the Survey, the extent of which is increasing yearly.

NEEDS

Some growth in the Survey has been necessary to keep up with the growth of the mineral industry in Canada, the northward trend of railway communication, and prospecting and the consequent demand for geographical and geological information. In a distorted fashion this growth is reflected by the table given below—distorted, because the diminishing purchasing power of money cannot be taken into account, and also because the expenditures mentioned include those for the National Museum as well as the Geological Survey, the former being a rapidly growing institution requiring more and more financial support. Neither does column one express the fact that the effective scientific staff of both Survey and Museum is augmented every summer by teachers and students from almost every Canadian university to carry on field work. The cost of their services is included in column two, which covers all costs of both institutions with the exception of salaries of permanent employees (column one) and the maintenance, heating, and lighting of the buildings, which is borne by the Department of Public Works. Even about 10 per cent of the salaries of permanent employees is covered by column two.

The salary pay-roll has kept pace fairly closely with the growth of the mineral industry. Expenditures for field work and all related operation costs (column two), has not advanced as rapidly and since 1920 there has been a decrease, in spite of the fact that since 1920 the number of field parties has increased about one-third and a much larger number of scientists from universities have been employed temporarily. In large measure this decrease has been accomplished by strict economy. However, economy has its limitations, and in the present case they seem to have been nearly reached. If more work is required from the Geological Survey more funds for column two will be needed.

But further support in this direction is not requested, except in very small amount, for there is another direction in which the need appears to be greater—an enlargement of the Victoria Memorial Museum, the home of the Geological Survey and the National Museum, in order to provide more laboratory and office room for scientific and technical work and more storage and exhibition space for museum purposes. This need is explained at some length in an article entitled "The National Museum of Canada" in the Annual Report of the National Museum for 1926, and is also referred to in the section of the present annual report of the Department which deals with the museum.



IN MEMORY OF
GEORGE MERCER DAWSON
GEOLOGIST SCIENTIST EXPLORER

BORN AUG. 1. 1849
DIED MARCH 2. 1901

THIS MONUMENT MARKS THE SITE OF ORIGINAL
WOODEN POST ERECTED BY DAWSON IN 1887 AS A
REFERENCE MARK FOR THE B.C.—YUKON BOUNDRY
LATITUDE $60^{\circ} 1' 6''$

THIS MONUMENT ERECTED 1927 BY FENLEY HUNTER
TO REPLACE ORIGINAL POST REMOVED BY HIM IN 1923

Year	Salaries (about 90% of permanent employees, Geological Survey and National Museum)	All other costs, Geological Survey and National Museum	Total cost, Geological Survey and National Museum	Value of mineral production in Canada (for calendar years 1900-1927)
	\$ cts.	\$ cts.	\$ cts.	\$
1927-8.....	331,649 40	303,605 18	639,254 58	247,356,695
1926-7.....	274,605 59	312,448 88	587,154 47	240,437,123
1925-6.....	274,360 60	316,533 84	590,894 44	226,583,333
1924-5.....	280,593 19	302,088 44	582,681 63	209,583,000
1923-4.....	271,938 20	292,596 77	564,534 97	214,079,331
1922-3.....	259,509 40	289,155 89	548,665 29	184,297,242
1921-2.....	241,495 38	332,756 39	574,251 77	171,923,342
1920-1.....	228,507 19	336,245 90	564,753 09	227,859,665
1919-20.....	213,192 43	293,096 60	506,289 03	176,686,390
1918-19.....	202,008 05	206,292 33	408,300 38	211,301,897
1917-18.....	196,043 30	223,474 81	419,518 11	189,646,821
1916-17.....	195,448 30	224,703 29	420,151 59	177,210,534
1915-16.....	193,775 77	314,535 60	510,311 37	137,109,171
1914-15.....	179,490 93	302,792 29	482,283 22	128,863,075
1913-14.....	155,381 09	285,388 99	440,770 98	145,634,812
1910-11.....	103,502 94	167,791 25	271,294 19	106,823,623
1905-6.....	62,036 78	145,109 05	207,145 83	69,078,999
1900-01.....	51,436 14	71,479 30	122,915 44	64,420,877

MEMORIAL TO G. M. DAWSON

The diversified services rendered by the Geological Survey are especially well exemplified by the work of Dr. George M. Dawson, geologist and former Director, of whom the *Victoria Colonist* once said editorially: "In one sense he is the discoverer of Canada, for the Geological Survey, of which he has been the chief, has done more than all other agencies combined to make the potentialities of the Dominion known to the world." More recently another testimonial has been paid to Dawson by Mr. Fenley Hunter, of New York city.

Mr. Hunter has travelled extensively in northern British Columbia, Yukon, and the North West Territories, where the surveys made by Dawson and other early explorers are still, to a large extent, the best geographical information available. In the course of one of his trips he found a wooden post on the bank of Liard river, that had been placed there by Dawson in 1887, to indicate the position of the boundary between British Columbia and Yukon, which at that time was defined but not actually surveyed. The post was badly decayed, so Mr. Hunter had made and erected in its place in 1927 a metal monument in appreciation of the accuracy of Dawson's surveys and the far reaching extent of his explorations. These are all the more remarkable when it is remembered that, forty years ago, the main line of the Canadian Pacific railway was the only organized means of travel across western Canada, and also that most of Dawson's surveys were made with no better instrumental aid than a compass and a sextant.

Out of appreciation of this fine tribute by Mr. Hunter and also of Dawson's work, the Canadian Government had set aside a piece of land around the monument. The monument itself is of cast iron and bears an inscription as shown in the accompanying photograph. It is situated on the right bank of Liard river just north of the boundary line between British Columbia and Yukon.

An account of the expedition, in the course of which the original post was planted, is contained in the Annual Report of the Geological Survey, volume 3, 1887-88.

FIELD AND OFFICE WORK

Fifty field parties were sent to widely separated parts of Canada during the season of 1927. Thirty-six were engaged in geological work, thirteen in topographical surveying, and one in collecting minerals for the museum. Short accounts of the field work of these parties and of the laboratory and office work accomplished during the rest of the year are given in the following statements by the chiefs of divisions.

GEOLOGICAL DIVISION

G. A. Young, Chief Geologist, reports:

Yukon

W. E. Cockfield geologically and topographically explored an area of about 2,000 square miles in the vicinity of Dezadeash lake, southwestern Yukon. A main reason for undertaking this work was to outline a part of the western border of the Coast Range batholith, a body with which many important mineral deposits are associated in Yukon and British Columbia. Mr. Cockfield also examined ore deposits at Fifteenmile creek on Yukon river below Dawson; at Rude creek; and at Whitehorse. A report upon Dezadeash Lake area, accompanied by a map and short reports upon the ore deposits of the three localities mentioned, appears in Summary Report, 1927, Part A.

British Columbia

Victor Dolmage made a survey of the economic minerals in the part of northern British Columbia drained by Finlay river. Much interest has been displayed in this district following upon reports of the finding of important mineral deposits. A report and geological map of the area is published in Summary Report, 1927, Part A.

F. A. Kerr continued topographical and geological mapping of a strip of country along Stikine river from Telegraph Creek south to the International Boundary. During the last two seasons an area of about 1,000 square miles has been surveyed and studied. A part of the east margin of the Coast Range batholith lies within the area which, therefore, is of prospective importance as a mineral-bearing district.

George Hanson completed the geological study and mapping of an area of 200 square miles embracing part of the drainage basins of Bear and Marmot rivers in the vicinity of Stewart on Portland canal, where many mineral deposits, valuable chiefly for their lead, zinc, and silver contents, have been found. A memoir upon the work and two geological maps are in course of preparation.

J. R. Marshall commenced a geological and topographical survey of a hitherto unexplored and little prospected area stretching from the headwaters of North Thompson river west towards Clearwater lake. A brief, preliminary report upon the work so far as it has progressed is included in Summary Report, 1927, Part A.

C. E. Cairnes completed the study of the geology and ore deposits of Slocan mining area. During the past season geological field work was extended southward to include an adjoining map-area of 380 square miles, which includes New Denver, Silverton, Slocan City, and Sandon. Many mining properties and undeveloped mineral deposits lie within the two map-areas.

H. S. Bostock completed the detailed study of the gold-arsenic and other mineral occurrences at Hedley, and commenced geological mapping of an area

of about 400 square miles east from Similkameen river. Mr. Bostock also examined the Horne silver mine, 6 miles from Similkameen station. A report on this mine is published in Summary Report, 1927, Part A.

J. F. Walker, assisted by H. C. Gunning, completed the study of the geology and mineral resources of Lardeau area; a final report and geological map are being prepared. Messrs. Walker and Gunning also made a geological and geographical reconnaissance of Fry Creek basin and of several other areas along the east side of Kootenay Lake valley.

C. S. Evans continued detailed geological mapping of the territory bordering Columbia River valley. During 1927 he examined an area of more than 400 square miles immediately west of Golden. A memoir and maps representing the work of 1927 and preceding years are being prepared.

A. Anrep made a detailed examination of certain peat bogs near Vancouver and visited other peat bogs in the same general area and on Vancouver island. The investigation was made for the purpose of determining the suitability of the deposits for the manufacture of peat litter. A report presenting the results obtained appears in Summary Report, 1927, Part A.

Alberta

B. R. MacKay made a detailed geological survey of the Brûlé coal area on the Canadian National railway, 180 miles west of Edmonton. The results of this work, in the form of a report and map, will be presented in Summary Report, 1928, Part B.

G. S. Hume geologically mapped and studied an area of 150 square miles lying 20 miles west of Calgary and adjacent to Turner Valley oil and gas field. A preliminary report dealing with certain aspects of the 1927 field work is included in Summary Report, 1927, Part B.

Saskatchewan

F. H. McLearn commenced a systematic revision of the areal mapping, stratigraphy, and structure of southern Saskatchewan, similar to work in southern Alberta which has recently been completed and published (See Calgary sheet). He also investigated several localities where petroleum, gas, or other mineral occurrences were reported. A preliminary report is given in Summary Report, 1927, Part B.

Manitoba

W. A. Johnston continued the investigation of the surface geology, including the soils, of southern Manitoba and southeastern Saskatchewan. The geological mapping of the surface deposits of the areas covered by the Emerson, Virden, Turtle Mountain, and the greater part of the Winnipeg sectional maps was completed. The field work in Manitoba will, probably, be completed in 1928, after which it is proposed to prepare a report and map.

E. M. Burwash studied and mapped the geology of an area in the vicinity of Kississing (Cold) lake, 140 miles northwest of lake Winnipeg. The district is of importance because of mineral deposits already discovered. Mr. Burwash also examined a number of mineral occurrences along the route from Sturgeon Landing to Kississing lake.

J. F. Wright made a geological reconnaissance of about 1,000 square miles in Island Lake area, northeastern Manitoba. Considerable areas were outlined which, other conditions being favourable, may hold important mineral deposits. Summary Report, 1927, Part B, contains a report and map giving the results of the reconnaissance.

C. H. Stockwell concluded an investigation of the lithia-bearing pegmatites and associated rocks of southeastern Manitoba and adjacent parts of Ontario. The region explored has an area of 2,500 square miles.

Ontario

H. M. Bannerman completed the detailed examination of pyrite and iron-bearing formations in the vicinity of Nickel and Pipestone lakes, Rainy River district, and Staunton on the Canadian National railway, Thunder Bay district. Mr. Bannerman commenced a detailed study of the Timagami iron range, Nipissing district.

T. L. Tanton investigated many of the mineral deposits in the Port Arthur silver-bearing area, which borders lake Superior for 125 miles from Nipigon southwest to Arrow lake. The results of this work will be incorporated in a memoir now being prepared.

R. C. Emmons concluded the geological survey of the Woman River and Ridout quadrangles. Promising lead-zinc deposits, as well as other types of mineral deposits, occur within the district. The two maps and accompanying memoir are being prepared for publication.

T. T. Quirke completed a geological survey of the Key Harbour quadrangle, which borders the northeast corner of Georgian bay. The area holds deposits of non-metallic minerals of probable economic value. The geological map and report are being prepared.

W. H. Collins, assisted by R. Thomson, completed the geographical and geological mapping of Espanola quadrangle, which lies immediately west of the Sudbury nickel basin. The geological map of the area is being prepared for publication. Field work was extended to the adjoining map-area to the east, which includes part of the Sudbury nickel basin. Mr. Thomson began a special study of the nickel-bearing irruptive and various associated igneous formations.

C. Tolman, under the supervision of W. H. Collins, continued the mapping and studying of the Birch Lake granite, a body that extends an unknown distance northward from Espanola map-area.

G. M. Brownell, under the supervision of M. E. Wilson, geologically mapped the district in Leeds county represented by the southeast part of the Westport sheet of the Department of National Defence. Deposits of mica, iron ore, and galena occur within the area studied.

Quebec

H. C. Cooke made detailed geological examinations of various mineral deposits in Rouyn district, western Quebec. The results obtained will be incorporated in a memoir on the geology and mineral deposits of the entire Rouyn district.

W. F. James reinvestigated the geology and examined the principal mineral discoveries within Duparquet quadrangle, Rouyn district. A revised edition of the geological map is being prepared. An account of the mineral occurrences will be included in the memoir on Rouyn district above mentioned.

J. B. Mawdsley geographically and geologically explored the Kaopitina-Father Lakes area, about 1,700 square miles in extent and situated southwest of Chibougamau lake. West of Chibougamau lake, an area of 70 square miles, in which mineral deposits occur, was investigated in some detail. Routes leading from Monet station, Canadian National railway, to the main field of work were geologically surveyed. An account of this work appears in Summary Report, 1927, Part C.

T. H. Clark commenced studying and mapping the area in southeast Quebec, represented by the Sutton sheet, Department of National Defence.

F. J. Alcock made a detailed study and geological map of an area of 20 square miles surrounding the Federal mine, central Gaspe. The results of this work are presented in Summary Report, 1927, Part C.

New Brunswick

W. V. Smitheringale examined various manganese occurrences in Nova Scotia and New Brunswick. Mr. Smitheringale also visited Michipicoten district, Ontario, for the purpose of investigating the manganese-bearing iron formations of that district. The information relating to manganese is to be incorporated in a report on the manganese deposits of Canada. Several lead-zinc occurrences in Ontario were examined by Mr. Smitheringale.

F. J. Alcock examined a number of mineral deposits in New Brunswick and Nova Scotia. The information obtained concerning various lead-zinc deposits will appear in a report on the lead-zinc deposits of Canada.

Nova Scotia

E. R. Faribault continued the systematic geological survey of Nova Scotia. The area surveyed in 1927 completes the Digby quadrangle.

G. W. H. Norman, under the supervision of W. H. Bell, commenced the geological study and mapping of Ainslie quadrangle, Cape Breton. A main purpose of the work is a re-study of the Port Hood, Mabou, and Inverness coal fields.

Northwest Territories

L. J. Weeks returned from the Arctic in the autumn of 1927 after spending two summers and a winter geographically and geologically exploring the territory bordering and extending west from Cumberland sound, southeastern Baffin island. A report on the several seasons' work appears in Summary Report, 1927, Part C.

TOPOGRAPHICAL DIVISION

W. H. Boyd, Chief Topographical Engineer, reports:

During the year topographical and geographical surveys were carried out in British Columbia, Alberta, Ontario, Quebec, New Brunswick, and Nova Scotia.

British Columbia

A. C. T. Sheppard revised the Vancouver sheet, one inch to one mile. This area was mapped in 1920 and a comparison of the two maps furnishes striking evidence of the growth and expansion of the city since that time. Illness unfortunately forced Mr. Sheppard to give up field work the first of August. He was unable to undertake the detailed mapping of the Corbin coal areas.

Mr. Sheppard visited in the field the parties of J. W. Spence and J. A. Macdonald in order to advise on any matters relating to the field work.

J. A. Macdonald carried out the topographical mapping of a portion of the Topley quadrangle, latitude $54^{\circ} 30'$ to $54^{\circ} 45'$ north, longitude $126^{\circ} 00'$ to $126^{\circ} 30'$ north. This map is for publication at one inch to one mile with contour interval 100 feet.

Alberta

D. A. Nichols completed the east half of Jumpingpound quadrangle, latitude $51^{\circ} 00'$ to $51^{\circ} 15'$ north, longitude $114^{\circ} 30'$ to $114^{\circ} 45'$ west, and extended this mapping in a northwesterly direction. This work is part of a series of sheets on one inch to one mile covering the potential oil areas southwest of Calgary.

On his way to the field Mr. Nichols visited a landslide and change in the channel of Blanche river at Wawbewawa, Ontario. This was interesting from a physiographic standpoint and also from the economic side in showing the possibility of other slides under similar conditions. Both aspects are being considered in a special paper by Mr. Nichols.

J. W. Spence completed a topographical survey of Turner Valley quadrangle, latitude $50^{\circ} 30'$ to $50^{\circ} 45'$ north, longitude $114^{\circ} 00'$ to $114^{\circ} 30'$ west, and mapped portions of the Bragg Creek quadrangle, east half, latitude $50^{\circ} 45'$ to $51^{\circ} 00'$ north, longitude $114^{\circ} 30'$ to $114^{\circ} 45'$ west. The Bragg Creek sheet has a contour interval of 100 feet and the Turner Valley sheet an interval of 50 feet; both are for publication at one inch to one mile.

Ontario

A. G. Haultain carried out surveys in Rutter quadrangle, latitude $46^{\circ} 00'$ to $46^{\circ} 15'$ north, longitude $80^{\circ} 30'$ to $81^{\circ} 00'$ west, and Key Harbour quadrangle, latitude $45^{\circ} 45'$ to $46^{\circ} 00'$ north, longitude $80^{\circ} 30'$ to $81^{\circ} 00'$ west. These are geographical sheets for publication on a scale of one inch to one mile. He also extended the control, carried out the previous year, for the Espanola sheet, and carried out a number of surveys in Sudbury district for the control of mapping from aerial surveys.

Quebec

R. C. McDonald completed control surveys for the Taschereau sheet, Quebec, latitude $48^{\circ} 30'$ to $48^{\circ} 45'$ north, longitude $78^{\circ} 30'$ to $79^{\circ} 00'$ west. He also completed the primary traverse of the Canadian National Railways branch line to Rouyn and established a base to be used in the detailed mapping of the vicinity of Rouyn. The Taschereau sheet is for publication at one inch to one mile. Drainage and minor details on the Taschereau sheet will be put in from air photography.

K. G. Chipman commenced a detailed map, on a scale of 1 inch to 400 feet with 5-foot contours, to include the area in the vicinity of Noranda and Rouyn. This work is so arranged as to be easily extended as the development of the area may warrant.

New Brunswick

H. N. Spence completed the Carleton sheet, Quebec and New Brunswick, latitude $48^{\circ} 00'$ to $48^{\circ} 15'$ north, longitude $66^{\circ} 00'$ to $66^{\circ} 31'$ west. This work, commenced in 1926 and completed in 1927, is for publication at one inch to one mile.

R. Bartlett completed the surveys for the west half of the Loch Lamond sheet, latitude $45^{\circ} 15'$ to $45^{\circ} 30'$ north, longitude $65^{\circ} 30'$ to $66^{\circ} 00'$ west; and the Cape Spencer sheet, latitude $45^{\circ} 00'$ to $45^{\circ} 15'$ north, longitude $65^{\circ} 30'$ to $66^{\circ} 00'$ west. This sheet is for publication at one inch to one mile, and the drainage, with some minor detail of roads and culture, will be put in from vertical aerial photography.

K. G. Chipman mapped topographically on 1 inch to 1,000 feet the drainage basin of the Chamcook lakes near St. Andrews. This work was at the request of the Biological Board of Canada, who are conducting experiments in fish culture in these lakes and require a detailed map on which to plan their work and to show their information.

Mr. Chipman visited in the field the parties of R. C. McDonald, J. V. Butterworth, and H. N. Spence, in order to advise on any matters relating to the field work.

Nova Scotia

J. V. Butterworth started a geographical survey of Ainslie quadrangle, Nova Scotia, latitude $46^{\circ} 00'$ to $46^{\circ} 15'$ north, longitude $61^{\circ} 00'$ to $61^{\circ} 30'$ west. This area includes the coal fields at Inverness and Port Hood.

S. C. McLean, assisted by S. M. Steeves, junior topographical engineer, carried out the triangulation and traverse control of the Ainslie sheet; the triangulation control of the east half of the Oxford sheet; and the primary control traverse of the Port Mouton sheet in southwestern Nova Scotia. The work in southwestern Nova Scotia is now consolidated, the work of 1927 being tied in with the work of 1924, and also connected with the work of the Geodetic, the Topographical, and Hydrographic Surveys.

W. H. Miller completed surveys for the Oxford sheet, latitude $45^{\circ} 30'$ to $45^{\circ} 45'$ north, longitude $63^{\circ} 30'$ to $64^{\circ} 00'$ west. This sheet is for publication at one inch to one mile.

The following maps were completed for publication during the year:

Province	Map-sheet	Latitude and longitude	Scale
British Columbia.....	Topley.....	$54^{\circ} 30'$ to $54^{\circ} 45'$ $126^{\circ} 00'$ to $126^{\circ} 30'$	1 inch to 1 mile
Alberta.....	Bragg Creek—east half.....	$50^{\circ} 45'$ to $51^{\circ} 00'$ $114^{\circ} 30'$ to $114^{\circ} 45'$	1 inch to 1 mile
	Jumpingpound—east half.....	$51^{\circ} 00'$ to $51^{\circ} 15'$ $114^{\circ} 30'$ to $114^{\circ} 45'$	1 inch to 1 mile
Ontario.....	Key Harbour.....	$45^{\circ} 45'$ to $46^{\circ} 00'$ $80^{\circ} 30'$ to $81^{\circ} 00'$	1 inch to 1 mile
	Rutter.....	$46^{\circ} 00'$ to $46^{\circ} 15'$ $80^{\circ} 30'$ to $81^{\circ} 00'$	1 inch to 1 mile
	Ridout.....	$47^{\circ} 30'$ to $47^{\circ} 45'$ $82^{\circ} 30'$ to $83^{\circ} 00'$	1 inch to 1 mile
Quebec-New Brunswick.....	Escumiac.....	$48^{\circ} 00'$ to $48^{\circ} 15'$ $66^{\circ} 00'$ to $66^{\circ} 30'$	1 inch to 1 mile
New Brunswick.....	Chamcook Lake drainage basin.....		1 inch to 1,000 feet
Nova Scotia.....	Digby.....	$44^{\circ} 30'$ to $44^{\circ} 45'$ $65^{\circ} 30'$ to $66^{\circ} 00'$	1 inch to 1 mile
	Granville Ferry.....	$44^{\circ} 45'$ to $45^{\circ} 00'$ $65^{\circ} 30'$ to $66^{\circ} 00'$	1 inch to 1 mile
	Oxford—west half.....	$45^{\circ} 30'$ to $45^{\circ} 45'$ $63^{\circ} 45'$ to $64^{\circ} 00'$	1 inch to 1 mile

In connexion with the work of the enlarged Niagara Board, and at the request of Mr. Charles Camsell, one of the Canadian representatives, the chief topographical engineer undertook a precise survey of the crest lines of the Horseshoe and American falls. This work was successfully completed early in April, 1927, with the assistance of A. C. T. Sheppard and K. G. Chipman. An account of this survey is to be published by the Geological Survey.

Continuing his work in physiography, D. A. Nichols has selected and described slides and views illustrating Canadian physiography. Some of these have been added to our own series, some have been sent to universities and to Geneva, and many others have been supplied for illustrating lectures and scientific text books. Relief models of the Fort William-Port Arthur and Kokanee Park map-sheets have been prepared and are now on exhibition in Ottawa and elsewhere.

Reference to Mr. Nichols' visit to the Wawbewawa landslide is made in the report on field work.

Computations of the geographical positions of the permanent marks established in northern Manitoba along, and east of, Nelson river, including Hayes river, Fox river, Oxford lake, Gods lake, and Island lake, have been completed and supplied to the Topographical Surveys Branch, Department of the Interior, for use in their maps. Computation of the geographical positions of the permanent marks established in southwestern Nova Scotia, and along the Canadian National railways, Rouyn branch, have been completed. These positions are available on request to the Director.

MINERALOGICAL DIVISION

Eugene Poitevin, Chief of the Division, reports:

Owing to the steadily increasing interest shown by the public in the mining industry of Canada, the volume of work performed this year by this division was almost double that of any previous year.

FIELD WORK

A. T. McKinnon spent two months in Ontario and Quebec collecting minerals required for the preparation of our educational collections.

LABORATORY WORK

About 2,000 rock and mineral specimens for examination were received from geologists, mining engineers, prospectors, educational institutions, etc., over half of these being sent by prospectors. Prospectors are showing greater knowledge of geology and mineralogy and a greater capacity for appreciating the results of scientific investigation of the samples submitted. A great part of this progress is due to special instruction. Ontario, with its School of Mines at Haileybury and its travelling prospectors' classes, and British Columbia with its excellent work carried on by the Chamber of Mines at Vancouver and the associated Boards of Trade of that province, contribute effectively to the welfare of the mining industry. More recently Alberta, Quebec, New Brunswick, and the other provinces have taken similar praiseworthy action.

During the fiscal year just ended, Eugene Poitevin and H. V. Ellsworth have furnished, in addition to numerous verbal reports, more than 2,000 reports dealing with mineralogical problems. Mr. Poitevin completed studies on the various minerals described in the recently published Bulletin No. 46. H. V. Ellsworth also has continued his studies of the Canadian rare elements, and the preparation of the forthcoming report dealing with this subject. Seven papers were published by H. V. Ellsworth in the *American Mineralogist* and the *Mineralogical Magazine*. The titles of these papers are given in the deputy minister's statement in this report.

R. J. C. Fabry has carried out the analyses of three granites from Killarney, Ontario, for W. H. Collins and T. T. Quirke; one garnet-sillimanite rock from Ceylon for Dr. Frank D. Adams; one chlorite schist for C. E. Cairnes; one chromium-bearing, dolomitized rock for H. C. Gunning; and three specimens of

diamond-drill core. He has also made complete chemical analyses, for C. H. Stockwell, of the following minerals, which were obtained from the Silver Leaf Mining Syndicate, lot 17, range 16, township 16, southeastern Manitoba: spodumene, lepidolite, montebrazite, pink muscovite, lithiophyllite, margarodite, lithium-bearing muscovite, beryl. He has also analysed one specimen of hydro-talcite from Vimy Ridge, Megantic county, Quebec. The results of these analyses will be published in reports by the geologists above named.

MUSEUM WORK

The work of rearranging and cataloguing the systematic collections of Canadian and foreign minerals is being continued, but owing to the bad condition these collections were in, it will be some time before the work can be completed. The services of Dr. W. F. Ferrier were obtained again this year from January 3, 1928.

Cases of economic minerals which were formerly displayed at 227 Sparks street have been moved to the Museum. Altogether 34 cases of temporary exhibits have been put in the National Museum, more than 20 of which were put in during the fiscal year just ended.

Several fine specimens were added to the collections by purchase and by donations, an itemized list of which is given in the annual report of the National Museum.

EDUCATIONAL COLLECTIONS

The demand for collections Nos. 1, 2, 3, prospectors' sets, etc., has been very heavy this year, as shown by the following table. The magnitude of this work is indicated by the fact that 12,406 specimens were used in the collections and 22 tons of rocks and minerals required. These collections are sold to universities, high schools, and other educational institutions, in foreign countries as well as in Canada. Descriptive circulars are obtainable on request from the Director of the Geological Survey.

Province	Standard	Grade II	Grade III	Grade IV	Miscellaneous	Prospectors	Mineral chips	Keg
British Columbia.....	2	0	0	0	2	18	1	0
Alberta.....	0	0	1	0	7	5	1	1
Saskatchewan.....	0	1	1	0	1	3	0	0
Manitoba.....	1	0	0	0	1	4	0	0
Ontario.....	4	1	35	0	17	80	1	0
Quebec.....	10	0	2	50	9	49	2	0
New Brunswick.....	1	1	0	0	6	1	1	0
Nova Scotia.....	2	0	1	0	1	1	0	0
Foreign.....	3	0	1	0	11	2	0	0
Total.....	23	3	41	50	55	163	6	1

Total collections distributed = 342.

PALÆONTOLOGICAL DIVISION

E. M. Kindle, Chief of the Division, reports:

FIELD WORK

W. A. Bell was in Nova Scotia from June 5 to July 8 on a geological reconnaissance of the area comprising Port Hood, Mabou, and Inverness coal districts.

E. M. Kindle examined in June parts of the Welland Canal section, in the interest of the Department of Railways and Canals. The remainder of the field season was spent in Jasper park, Alberta.

F. H. McLearn was engaged in mapping and studying the structure of the eastern end of the Cypress hills in southwestern Saskatchewan. More than four months were spent in the field.

Miss A. E. Wilson was occupied during the larger part of a month in field work in the Cornwall quadrangle.

OFFICE WORK

The office work of W. A. Bell comprised preparation of a geological map of Pictou coal fields, additions to a memoir upon the geology of the Horton-Windsor formations of Nova Scotia and New Brunswick, and reports on the following collections of fossil plants:

- (a) From Brûlé coal-field, Alberta, for B. R. MacKay.
- (b) From Brazeau formation, Stirco and Coal valley, Alberta, for B. R. MacKay.
- (c) From Ravenscrag formation, Sask., for F. H. McLearn.
- (d) From Jasper park, Alberta, for E. M. Kindle.
- (e) From Sextant rapids, Abitibi river, Ont., for W. S. Dyer.
- (f) From the Milk River, St. Mary River, and Willow Creek formations, Alberta, for W. S. Dyer and M. Y. Williams.
- (g) Tertiary plants gathered by H. S. Bostock from White Lake district, B.C.

E. M. Kindle prepared a report on the geology of Jasper National park for the Commissioner of Canadian National parks. Articles were also prepared on certain sections in Jasper park, and on the character of the bottom deposits of lake Cavell, a glacial lake. Correlation reports based on fossils were prepared for members of the staff.

F. H. McLearn was, during a considerable part of the winter, occupied with the preparation of map, sections, and report on the eastern end of Cypress hills, published in the Summary Report, 1927, Part B. A report was prepared on collections of Mesozoic fossils received from the Hudson's Bay-Marland Oil Company, and collections made by G. S. Hume and other members of the geological staff. A short paper entitled "Some Canadian Jurassic Faunas" was published in the Transactions of the Royal Society of Canada. A first contribution to the Jurassic Ammonoidea of Skidegate inlet was completed, and is published in Museum Bulletin No. 54. A short paper on some new Jurassic ammonoids from the Fernie formation of western Alberta was handed in for publication. The study of Jurassic ammonoids from Skidegate inlet was continued. Some progress was made in the study of Upper Triassic ammonoids from the Schooler Creek formation, upper Peace river, B.C.

Miss A. E. Wilson was absent doing university post-graduate work during the first three months of the year. The remainder of the office work was devoted to carrying on the type catalogue re-identification.

C. M. Sternberg has prepared descriptions of two new armoured dinosaurs and has identified collections of vertebrate fossils sent in for determination.

Miss M. A. Fritz was engaged during July and August in grading, identifying, and labelling fossils in the old collections.

MUSEUM WORK

A considerable number of collections of fossils were sent out for the use of high schools. Two colleges were also supplied with study collections. An account of the specimens received and prepared for museum display is given in the annual report of the National Museum.

BORINGS DIVISION

E. D. Ingall, Chief of the Division, reports:

The Borings Division of the Geological Survey exists for the specific purpose of securing records of borings made throughout Canada in search for water, petroleum, natural gas, etc. It is now recognized universally that the

collecting of reliable data illustrative of the nature and structure of the strata passed through in boring is of the utmost importance for the intelligent direction of the efforts to locate gas, oil, water, etc. This work is carried on in co-operation with operators, and in some provinces with the assistance of the provincial and federal government organizations, and results in the building up of extensive reference files of well records sent in by drillers, geologists, and others.

Whenever possible, complete sets of samples are obtained from the operators. These samples are taken at intervals of 10 feet or less, with a view to acquiring an intimate knowledge of the characteristics of the various strata by means of microscopic, mechanical, and chemical examination of the cuttings, and the interpretation of any fossil evidence. Light is thus thrown on the conditions, favourable or unfavourable to the existence of gas, oil, or water in commercial quantities, such as the existence or absence of porosity, favourable structures, etc. Careful search of the cuttings is made for fossil forms, which often constitute the only evidence distinguishing strata of different geological ages, and, therefore, of different position in the succession of the strata. The small microscopic forms have to be thus relied upon, the larger fossils being destroyed by the process of drilling, except in the rare cases where a core drill has been used.

In many parts of Canada the obtaining of supplies of water pure enough for domestic use and free enough from mineral contents to be suitable for irrigation is limited to that held in the surface deposits overlying the bedrock strata, and efforts to obtain records from local drillers have been constantly made and the resulting logs incorporated in the reference files of the division. To obtain and retain the co-operation of thousands of local shallow well-drillers is a difficult task, and much remains to be done in this direction. This problem might be solved in the future by endeavouring to enlist the interest of the local drillers in the formation of drillers' organizations such as those recently started in the United States. The annual conventions held by these bodies have a great educational effect and could be used as a means of interesting their membership in the utilization of the Borings Division as a clearing house for the results of all the scattered borings, to the advantage of both drillers and their clients.

During the first fifteen years of existence of the Borings Division—it was created in 1908—the collecting of records and samples occupied a large part of the time of the small staff. In response to requests from drillers for interpretative advice, the determination of geological horizons and other geological conditions encountered in the various borings through the study of the samples received was necessarily confined to such preliminary chemical and microscopic examinations as could be made with the limited means at disposal. However, a large mass of borings data was accumulated and systematically filed, and a great quantity of sample material was collected and systematically arranged in sets representing some hundreds of borings and illustrative of the geology in depth of various parts of Canada. The number of samples of cuttings now on hand is about 70,000, besides sets of cores from various wells put down with the core drill. Though only a part of this accumulation has so far received preliminary study, it represents material which could only be obtained during the progress of the borings and will doubtless yield valuable detailed knowledge of the strata penetrated when more intensive research methods, now available, can be applied to it. In future years new questions will probably arise upon which light can be thrown by applying to this material improved research methods which will doubtless be developed, so that the sample material accumulated has not only a present but also a future value. A very good example of such unforeseen

needs lies in the utilization, in recent years, of the foraminifera and other small fossil forms in determining geological horizons as encountered in borings in the Cretaceous and younger formations of the western parts of the continent. -

The falling off in late years of activity in the Ontario gas and oil districts, owing to near exhaustion of the pools at present known, has been offset by the very large increase in the operations in the Prairie Provinces. As a result of the increasing activities in western Canada, the staff of the division was increased in 1923 by the appointment of Mr. D. C. Maddox, who was entrusted with the work of sample examination, and this phase of the work has been gradually expanded and laboratory equipment developed. In the Prairie Provinces the preliminary determination of samples has been taken over by officials of the North West Territories and Yukon Branch of the Department of the Interior, in whom is vested the power to regulate all boring operations for gas and oil, but they supply samples to the Borings Division for more intensive geological, mineralogical, and chemical study.

The work of the Borings Division falls into two groups.

(1) The carrying out of the general policy of keeping in touch with boring activities throughout Canada and maintaining co-operative relationships with operators so as to secure logs, sets of samples, and all possible boring data. It includes also the systematic filing of all the information acquired and its utilization in aiding operators to solve the geological problems encountered, using also all information available in the geological literature dealing with Canada and the United States.

(2) Examination in the laboratory of samples collected and the preparation of well logs based on the results thus obtained. Reports descriptive of the methods adopted and of results attained, will be found in Parts B and C of the Summary Report of the Geological Survey, 1927.

During the past year important additions have been made to the equipment of the laboratory, and the staff was strengthened by the addition of F. J. Fraser, a graduate of Birmingham University, who is assisted by M. Mahoney. For the first time in the history of the division two men were able to give their undivided attention to the work of sample examination. As a result of this arrangement, and of Mr. Fraser's experience in laboratory methods as applied to sedimentary materials, it has been possible to greatly enlarge the scope of the laboratory work.

Apart from the routine examination of sets of samples, resulting in the geologically descriptive logs of the wells examined, special attention has been directed to the investigation of the possibly diagnostic value of the heavy mineral constituents of the samples of borings. These were separated by panning, microscopic slides were prepared, and their mineralogical characters determined under the microscope. These slides were prepared and filed for reference. Speaking of this work Mr. Fraser reports on the results of examination of material from the Prairie Provinces: "Few of the slides have been described in detail, but from the results of examination now being carried out many interesting points are evolving. With especial reference to the Turner Valley material, the slides already made represent mainly the Benton shale residues, characterized by apatite, tourmaline, and zircon with perhaps a limited range of spherical and octahedral pyrite. Blairmore residues, so far examined, also show garnet, and work in the near future should confirm and limit the range of this mineral in pre-Benton strata. A few post-Benton residues have been separated and examined and these invariably contain a much greater variety of minerals than the older beds. Epidote, garnet, and perhaps andalusite have been noted."

In addition to the above, tests for oil are made in many instances, using the distillation method and treatment with carbon tetrachloride. In the deter-

mination of limestone and dolomite horizons tests are made with cold and hot acid. Where called for, chemical tests for sulphates have been made. The proportions of material of different fineness have in some cases been determined by mechanical separation by sieves.

Of the work of investigating the minute fossil forms contained in the drill cuttings, with a view to determining their value as horizon markers, Mr. Maddox reports as follows: "During 1927 the work of collecting foraminifera from cuttings from borings in the Cretaceous shales of the western provinces was chiefly done by Mr. R. T. D. Wickenden, a student assistant attached for the summer months to the Borings Division. Mr. Wickenden is specializing in work of this nature and on his return to Harvard University undertook the study of these forms under Dr. J. A. Cushman. It is hoped that the work will be further extended during 1928 and will ultimately prove of great assistance in the task of working out the stratigraphy of the western Plains. Foraminifera have proved to be of the utmost value in the correlation of the Cretaceous formations in Texas by providing a basis for the location of stratigraphic horizons in a long series of shales which cannot be lithologically differentiated.

"In the western Plains of Canada the great thickness of the marine Cretaceous formation, largely shales, such as the Niobrara and Benton formations of the Colorado group, is in many cases inaccessible except by the use of the drill, and in the absence of surface exposures the stratigraphic position of samples within these formations is, in general, impossible to determine until the next underlying formation is reached. At present it is impossible in well samples to differentiate the marine Colorado shale from the overlying Lea Park marine shale of Montana age unless the two are separated by a lithological break as in the case of the Milk River sandstone. In the absence of surface geological information, this means that there will be a long succession, probably 2,000 feet or more, of shales indistinguishable lithologically from each other, and that the drill will have to penetrate to the underlying known marine formation before the stratigraphic position of the well is definitely known.

"The establishment of definite stratigraphic horizons within the marine shales at fairly shallow depths would be of inestimable value to the operator and would in many cases preclude the necessity of proceeding to the underlying known marine formations or would enable him to know the approximate depth at which he might expect to reach this latter. To the field geologist, the method might prove to be of great value, as enabling him to locate his stratigraphic position by the use of foraminifera when no other fossils were available."

Besides the laboratory work directly connected with the examination of well cuttings it has been possible to use the laboratory methods in assisting some of the field geologists, such as in the examination of a sample of volcanic ash from Cypress hills in Saskatchewan and of calcareous clay from the same province. Work has also commenced on samples of rocks, chiefly sandstones, collected by F. H. McLearn in southern Saskatchewan. Mr. Maddox reports: "The isolation and identification of the heavy minerals contained in these rocks formed the principal part of the work. Some mechanical analyses were also made. This work is likely to prove of much value as providing possible criteria for the identification of stratigraphic units in cases where fossils are absent."

Apart from the work done in examination of well cuttings from borings put down by either the churn drill or rotary methods, a certain amount of cores from wells put down by core drills have been available. Cores give, of course, much more definite results, being free from the uncertainties inherent in the fragmentary material produced by the ordinary drilling methods.

During the year samples have also been available for examination from a certain number of shallow wells bored to obtain local water supplies.

WORK DONE IN THE LABORATORY DURING THE YEAR¹

	<i>Samples examined</i>
<i>Wells of the Northern Foothills Group (including Turner Valley)</i>	
Big Chief, British Dominion, Bow R. No. 1, Calmont No. 1, Dalhousie No. 5, Foothills No. 1, Home No. 1, Illinois Alberta No. 1, McLeod No. 2, McLeod No. 3, McDougall-Segur No. 1, Ranchman's No. 1, Regent No. 2, Royalite No. 5, Royalite No. 7, Seneca No. 1, Sentinel, Spooner No. 1, Stockmen's No. 1, Vulcan No. 1.	4,965
<i>Wells of the Southern Foothills Group</i>	
Mount Royal No. 1.	31
<i>Wells of the Northern Alberta Group</i>	
International Oils, Black Rock Petroleum No. 2, International Bitumen No. 1A.	392
<i>Wells of the Southern Plains of Alberta Group</i>	
Devenish No. 1, Imperial Burdett, United Oils, Roth No. 2.	1,205
<i>Wells of the East Central Alberta Group</i>	
Imperial Ribstone, Ribstone Oils No. 1.	357
<i>Wells of the Saskatchewan Group</i>	
Simpson Oil Co.	45
<i>Wells of the Manitoba Group</i>	
Northern Manitoba Oil Co., W. J. Holmes Well No. 1.	124
<i>Wells of the Canadian National Railways Group</i>	
19 shallow wells drilled for water supplies.	285
<i>Wells of St. Hyacinthe District, Quebec, Group</i>	
Samples from 8 old wells for re-examination, Canadian Natural Gas Co. wells Nos. 1-5, National Gas Co. wells Nos. 1 and 2, St. Madeline.	1,473
<i>New Brunswick</i>	
D'Arcy Exploration Co. Gautreau No. 2 (old well for re-examination).	360
<i>Prince Edward Island</i>	
Doherty Interests well No. 2 (Governor island, Charlottetown).	189
<i>Sundry Other Examinations</i>	
Volcanic ash, Cypress hills, Sask.; calcareous clay for W. A. Johnston; sandstone, etc., for F. H. McLearn, southern Saskatchewan; kaolin, northern Ontario; igneous rocks, various sandstones, Sydney Mines, N.S., etc.	

In regard to boring activities throughout Canada during the present year a condensed résumé follows:

In British Columbia and the Yukon deep boring activities were very limited and no samples and records were sent to the Borings Division. As in the past, no cognizance was taken of the doubtless very large amount of core drilling prosecuted in testing individual mineral deposits, as these would be of interest to the owners only and would add nothing to the understanding of the general geological problems of the region.

Boring activities of a nature coming within the scope of the Borings Division researches were mostly connected with the deep wells being put down in the Prairie Provinces in continuing the search for gas and oil, the chief operations centring in Turner Valley district in Alberta. Thanks to the co-operation of Mr. C. C. Ross, supervisory engineer of the North West Territories and Yukon Branch, Department of the Interior, the division has received sets of samples from most of the important wells put down in the Prairie Provinces in search for gas and oil. This material has been submitted to intensive study in the laboratory of the division, and the results of this research have been placed at the disposal of the field geologists of the Survey and of the officials of the Interior Department office in Calgary for advisory use in the service of the operators. A total of 12,657 samples were received from the Prairie Provinces from 101 borings, which included some from 18 shallow water wells. Records of 39 shallow wells were received.

¹In the case of many wells the work done was in continuation of that commenced in 1926.

In eastern Canada little was reported in the way of deep borings. In Ontario the receipts of samples and logs were much less than formerly, boring activities being naturally much lessened as a result of the near exhaustion of the pools of gas and oil at present known, whose exploitation for nearly seventy years has been such an important economic factor in the peninsula of Ontario.

In the Palæozoic region of eastern Ontario and central Quebec, sporadic efforts to locate oil and gas pools have been described in previous reports and there was a slight revival of interest, but no borings were undertaken. In view of this re-awakened interest, the 1,473 samples on file, obtained from deep borings put down in 1914 to 1916 near St. Hyacinthe, which, from lack of time, had received only preliminary examination, were further studied in the laboratory. The possibilities of this large area underlain by undisturbed sedimentary strata can hardly be regarded as determined by the few and scattered deep borings already made.

In the Maritime Provinces little new information was available regarding the long established Moncton gas and oil field. In view of the very considerable amount of information (logs and samples) already accumulated by the Borings Division through the courtesy of Dr. J. A. L. Henderson, who is in control of the operations of the New Brunswick Gas and Oil Fields Company at Moncton, it was agreed that samples should be sent only from important new wells which did not duplicate those samples already received.

In Nova Scotia no particular deep boring operations were reported, although some efforts were made by the International Petroleum Company and the Eastern Gulf Company bored a number of shallow holes to demonstrate structure at a number of points. Nothing conclusive was reported, however. In a province such as this where mining is active, a considerable amount of core drilling is always being prosecuted with the drills of the local Government Mines Department. The policy of the Borings Division being to confine itself to borings which throw light upon district geological problems, no records are sought of such borings as are of interest only to private owners of mineral deposits.

The outstanding interest in the Maritime Provinces centred in the deep boring put down by the Henry L. Doherty Company to test for oil on Governor island near Charlottetown, P.E.I. Samples were received last year from this company's No. 2 well to a depth of 4,127 feet, at which depth boring was suspended for the winter. On the resumption of work in the spring of 1927 the well was continued to a depth of 5,965 feet when operations were finished without encountering any definite change of formation. Samples to a depth of 5,870 feet were received and examined in the laboratory and the results communicated to the company.

DRAUGHTING AND REPRODUCING DIVISION

C.-Omer Senécal, Geographer, and A. Dickison, Chief, Draughting and Reproducing Division, jointly report:

Maps Published April 1, 1927, to March 31, 1928

Series A	Publication number	Title	Remarks
		YUKON	
192A	2124	Aishihik Lake area; scale, 1 inch to 4 miles.....	Geology. In report by W. E. Cockfield, Summary Report, part A, 1926
		ONTARIO	
✓ 194A	2134	Wakomata Lake area, Algoma district; scale, 1 inch to 1 mile.....	Geology. In report by R. C. Emmons, Summary Report, part C, 1926
		NOVA SCOTIA	
39A	1185	Nova Scotia sheet; scale, 1 inch to 8 miles.....	Geology. Second edition

Maps in Hands of King's Printer, March 31, 1928

Series A	Publication number	Title	Date of requisition	Remarks
—	1726	Athapapuskow Lake region, Manitoba and Saskatchewan; scale, 1 inch to 3 miles..	Mar. 16, 1928	Geology. Reprint
—	1801	Reed and Wekusko Lakes region, Manitoba; scale, 1 inch to 2 miles.....	Mar. 16, 1928	Geology. Reprint
193A	2130	Stewart sheet (west half), Cassiar district, British Columbia; scale, 1 inch to 1 mile..	Mar. 19, 1928	Topography
✓ 195A	2137	Beresford and Rice Lakes area, Manitoba; scale, 1 inch to 1 mile.....	Dec. 22, 1928	Geology. For memoir by J. F. Wright
✓ 196A	2138	Vancouver sheet, British Columbia; scale, 1 inch to 8 miles.....	Jan. 10, 1928	Geology
197A	✓ 1939	Fort William and Port Arthur sheet, Thunder Bay district, Ontario; scale, 1 inch to 1 mile.....	Mar. 23, 1928	Geology (surface deposits). For memoir by T. L. Tanton
198A	✓ 2141	Fort William and Port Arthur sheet, Thunder Bay district, Ontario; scale, 1 inch to 1 mile.....	Mar. 23, 1928	Geology (bedrock geology). For memoir by T. L. Tanton
✓ 200A	✓ 2144	Slocan sheet, Kootenay district, British Columbia; scale, 1 inch to 1 mile.....	Mar. 26, 1928	Topography
203A	2149	Thunder Cape sheet, Thunder Bay district, Ontario; scale, 1 inch to 1 mile....	Mar. 23, 1928	Geology. For memoir by T. L. Tanton
✓ 204A	2150	Calgary sheet, Alberta; scale, 1 inch to 8 miles.....	Mar. 3, 1928	Geology
✓ —	2151	Sections supplementing Map 204A, Calgary sheet, Alberta.....	Mar. 2, 1928	Geology

Other Map-Work in Varying Stages of Progress

—	Title	Remarks
YUKON		
J 1	Dezadeash Lake area; scale, 1 inch to 4 miles.....	Geology. For report by W. E. Cockfield, Summary Report, part A, 1927
YUKON AND BRITISH COLUMBIA		
1	Atlin sheet, latitudes 58° to 61°, longitudes 131° to 139°; scale, 1 inch to 8 miles.....	Geology
BRITISH COLUMBIA		
✓ 1	Finlay River area, Cassiar district; scale, 1 inch to 8 miles..	Geology. For report by V. Dolmage, Summary Report, part A, 1927
2	Britannia Beach sheet, New Westminster district; scale, 1 inch to 1 mile.....	Geology. For memoir by H. T. James
3	Copper Mountain mining area, Similkameen district; scale, 1 inch to 1,000 feet.....	Geology. For memoir by V. Dolmage
✓ 4	Stewart sheet (west half), Cassiar district; scale, 1 inch to 1 mile.....	Geology. For memoir by G. Hanson
5	Bear River sheet (west half), Cassiar district; scale, 1 inch to 1 mile.....	Topography and geology. For memoir by G. Hanson
ALBERTA		
✓ 1	Cadomin sheet (west of fifth meridian); scale, 1 inch to 1 mile.	Topography
2	Cadomin sheet (west of fifth meridian); scale, 1 inch to 1 mile.	Geology. For memoir by B. R. MacKay
✓ 3	Mountain Park sheet (west of fifth meridian); scale, 1 inch to 1 mile.....	Topography
4	Mountain Park sheet (west of fifth meridian); scale, 1 inch to 1 mile.....	Geology. For memoir by B. R. MacKay
5	Cadomin-Luscar coal basin; scale, 1 inch to 2,000 feet.....	Geology. For memoir by B. R. MacKay
6	Brûlé Mines area; scale, 1 inch to 1,000 feet.....	Geology. For report by B. R. MacKay, Summary Report, part B, 1927
SASKATCHEWAN		
A 1	Cypress Hills area, southwest Saskatchewan; scale, 1 inch to 1 mile.....	Geology. For report by F. H. McLearn, Summary Report, part B, 1927
ONTARIO		
1	Lake Huron sheet; scale, 1 inch to 8 miles.....	Geology. Revision and re-issue of Map 155A
QUEBEC		
✓ 1	Fiedmont sheet, Abitibi county; scale, 1 inch to 1 mile.....	Geology
2	Dubuisson sheet, Abitibi county; scale, 1 inch to 1 mile.....	Geology
3	Mineralized belt, Lemieux township, Gaspé county; scale, 1 inch to ½ mile.....	Geology. For report by F. J. Alcock, Summary Report, part C, 1927
NOVA SCOTIA		
1	Mahone Bay sheet, No. 88, Lunenburg county; scale, 1 inch to 1 mile.....	Geology
2	Bridgewater sheet, No. 89, Lunenburg county; scale, 1 inch to 1 mile.....	Geology

In addition to the foregoing, eighty map and related figure illustrations were prepared for reproduction by zinc-cut process; draughting and other work necessary for the use of the geological staff was also executed.

The duties of the Geographer in connexion with the Geographic Board of Canada have, as usual, been attended to. The Geographer has in progress the preparation of a report and the computations for a "Transverse Polyconic Projection for General Maps of Canada".

PHOTOGRAPHIC DIVISION

G. G. Clarke, Chief of the Division, reports that the following work was accomplished during the year. A steadily increasing share of this output during recent years has been for other branches of the Department and for the public, to whom photographs for lectures, articles, and many other purposes are sold at cost.

	Inches	Inches	Number
Contact prints.....	4 by 5 to 36	by 48.....	14,904
Bromide enlargements.....	4 by 5 to 40	by 72.....	289
Exposures developed.....	3½ by 4½ to 6½	by 8½.....	4,309
Dry plate negatives.....	4 by 5 to 11	by 14.....	623
Wet plate negatives.....	8 by 10 to 24	by 30.....	125
Zinc plates.....	11 by 14 to 24	by 36.....	21
Photostat copies.....	7 by 11 to 11	by 14.....	95
Lantern slides.....	3½ by 4		587
Photos and titles mounted.....			2,203
Total.....			23,156

GEOLOGICAL INFORMATION AND DISTRIBUTION DIVISION

Wyatt Malcolm, Chief of the Division, reports:

The work of the division consists in answering inquiries for information regarding the geology and mineral resources of Canada. This information is imparted verbally to those making application in person, and is given in the form of correspondence, memoranda, and published reports and maps. A considerable part of the technical correspondence of the Geological Survey is dealt with.

Articles were prepared during the year for publication in the *Gazette*, the *Globe*, the British press, and the Canada Year Book. These articles dealt with such subjects as the importance of the mineral industry of Canada, the status of the industry, and the progress made. Numerous short articles were prepared for the use of the press, and were well received. In this way the readers of the newspapers and mining and scientific journals were kept informed of the nature of the publications issued from time to time by the Survey.

The publications of the Geological Survey and of the National Museum of Canada are distributed by this division. During the year 58,775 publications, exclusive of the French editions, were distributed. Of these, 7,247 were sent to addresses on the regular mailing lists, and 51,528 were distributed in compliance with written and personal requests for named publications, or requests for general or specific information.

LIBRARY

Mrs. F. E. Forsey, Librarian, reports:

Additions to the Library during the year include:

Books purchased.....	485
Volumes received as gifts or exchanges.....	826
Pamphlets.....	631
Maps.....	394
Periodicals subscribed for.....	203
Periodicals received as exchanges.....	423

Seven hundred and ten volumes were bound, and 154 maps mounted on cotton. The catalogue was increased by 3,119 cards, not including those added to the map and lantern slide catalogues.

The work of keeping the files complete by requests, claims, and acknowledgments amounted to 701 pieces of correspondence. The regular correspondence, having to do largely with reference work, loans, and bibliography, involved the usual amount of translating from foreign languages. Translating of articles and letters for members of the staff of the Museum and Survey has also been done in the library.

In the operation of the library loan system, the library supplied reference material to the following institutions, as well as to individuals: Universities of British Columbia, Manitoba, Toronto, Queen's, Chicago; to the Agricultural Colleges in Winnipeg, Guelph, and Ste. Anne; the Normal School, London; Royal Ontario Museum, Toronto; laboratories in eight provinces; and to twenty Government departments in Ottawa. Books and periodicals have been borrowed from the following: Library of Parliament, Mines Branch, Forestry Service, Carnegie Library of Ottawa, McGill and Toronto Universities, the Library of Congress, United States Geological Survey Library, New York State Library, and the Library of the Gray Herbarium at Harvard.

The current year shows a marked increase also in the loaning of maps, lantern slides, and photographs from the library collections. To administer these collections adequately in accordance with modern museum methods, an enlarged library staff is urgently required. Additions to the staff have been recommended in recent years on account of the rapid development and expansion of the library proper. It would seem that the time has come to provide for these insistent needs.

A constant effort to complete series of important periodicals has resulted this year in securing several notable acquisitions, among them being thirteen volumes of the "Matériaux pour la carte géologique Suisse", and volumes 54-79 of Popular Science Monthly, filling the gap between the years 1899-1911, and completing the series. Our set of the Transactions of the Wisconsin Academy of Sciences, Arts, and Letters has been brought up to date by the Academy's gift of volumes 17-22, 1914-1926; and the four volumes necessary to complete our series of Handlingar of the Scandinavian Naturalists' Congresses have been presented by Mr. F. Johansen. Among the many institutions whose gifts are gratefully acknowledged, special mention should be made of the Carnegie Institution of Washington, which generously presents to us all of its publications pertinent to the activities of the Survey and Museum.

The library will shortly add to its equipment for scientific research the comprehensive "Card Index of New Genera, Species, and Varieties of American Plants", which is compiled and published by the Gray Herbarium of Harvard University. This unique and important index is regarded as the most valuable aid to botanical research on the continent, and henceforth it may be consulted by botanists throughout Canada, either in person or by correspondence, in the library of the Geological Survey.

BRITISH COLUMBIA OFFICE

V. Dolmage, Geologist in charge, reports:

During the year the office was moved from the Pacific building to rooms 509-513 Winch building, Vancouver. It was visited by 4,200 people interested in mining and metallurgical matters; 629 inquiries were answered by letter and a very large number by telephone; there were distributed by hand and by mail 2,000 memoirs and summaries and 2,075 maps; a large number of rock specimens were examined and reported on and seventeen lectures on subjects related to mining and geology were given by the staff, composed of V. Dolmage, F. A. Kerr, and A. J. C. Nettell.

A short account of the origin and purpose of this branch of the Survey was given in the annual report for last year.

NATIONAL MUSEUM OF CANADA

W. H. Collins, Acting Director

A brief outline of the history of the Museum was given in this report for last year, and a more extended account appears in the first annual report of the Museum, for 1926. These articles show how the Museum has originated from the Geological Survey of Canada and what are its present relations to the Survey, a knowledge of which is necessary for a proper understanding of the activities and needs of both institutions, but particularly of the Museum.

COLLECTIONS AND EXHIBITS

The collections of natural history specimens are large and rather good, owing to the fact that they have been accumulating since 1843 and that during most of this period of eighty-five years good material was more abundant than now. The display of these collections for the benefit of the public is not so well forward, because the Museum has been compelled to move three times since 1910, first from the old Survey quarters on Sussex street to the new Victoria Memorial Museum in 1910, then to various temporary quarters in 1915 when the Parliament buildings were burned, and again back to the Victoria Memorial Museum in 1920. Consequently, an abnormally large share of effort is now needed for the development of exhibits.

During the past year two rooms were constructed at the sides of the entrance hall for the benefit of visitors. That on the east side is used as an information bureau and for the display and distribution of books, picture post-cards, and other Museum and Survey publications. The other houses a departmental telephone exchange, a telephone booth for public use, and a room for the Royal Canadian Mounted Police officers stationed in the building.

The staff of cabinetmakers and carpenters have continued construction of exhibition cases for display of minerals and ten of these were complete at the end of the year. A contract was let in January, 1928, to the Steel Equipment Company, of Ottawa, to build sixteen metal cases and it is expected that these will be in place before the end of 1928. Some additional cases have also been provided for special exhibits or for the enlargement of exhibition halls already organized.

NEED FOR ENLARGED QUARTERS

When the additional furnishings above mentioned are installed the exhibition halls will be practically full, but provision will have been made for less than half of the branches of natural history to which the Museum gives attention. This lack of space was discussed at some length in the first annual report of the Museum, for 1926. It was pointed out that the Victoria Memorial Museum building, originally intended as a home for the Geological Survey and Museum, is occupied also by the administrative part of the Department of Mines, the Dominion Fuel Board, and the National Art Gallery. In consequence, out of a total of twelve large exhibition halls and two smaller ones only four large halls and the two small ones are now available for Museum exhibits. Only in the case of anthropology and birds is it possible to develop permanent and comprehensive exhibits. Display of ores, minerals, mammals, plants, fossils, and other important features are being crowded into hallways and odd corners. Difficulty is also being experienced in finding office room for

the growing staff of the Survey. If the entire building were available for the Survey and Museum their staff and exhibition requirements would be nearly met, but there would not be sufficient room for storage of study collections and for work shops and laboratories. Wholly inadequate provision for these essentials to a scientific institution was made in planning the present building, and the only satisfactory solution appears to be an addition to the building.

Tentative consideration of this matter indicates that somewhat less than \$1,000,000 would be required to enlarge the museum building to meet requirements for the next twenty years or so. This is a formidable sum of money, but against it are to be offset certain considerable annual economies which would result. The Division of Mineralogy, which now occupies separate quarters about a mile away, would be housed in the Victoria Memorial Museum and there would be a yearly saving of \$10,000 to \$12,000 for rent, heating, and other services. Also, there should be a saving of \$3,000 to \$5,000 a year in temporary construction in the Victoria Memorial Museum itself, necessitated by the present cramped conditions. Averaging this annual saving at \$15,000, it represents the interest at 5 per cent on a capital investment of \$300,000. Moreover, it must be remembered that a much larger investment has already been made towards a national museum and that the additional amount wanted would probably make just the difference between a well-equipped, efficient institution and one that can not make an adequate return for what has been invested in it. The Victoria Memorial Museum must also be considered an important feature in any scheme for the improvement and beautification of the capital city and be supported with a liberality in correspondence with that accorded to other improvements. A national museum is an expression of the interest of its country towards the cultural aspects of civilization and should hardly be, therefore, an object of close economy. Compared with such sister institutions as the United States National Museum, the American Museum of Natural History, Field Museum, or even the Royal Ontario Museum at Toronto, the expenditure upon the National Museum so far has been small. The building of the American Museum of Natural History has already cost \$10,786,306.48 and extensions are planned which will enlarge it to about three times its present size.

There is only one thing of importance needed now in order to develop a national museum illustrative of the natural history, natural resources, and industrial products of the country that Canadians may regard with satisfaction—an addition of about 60 per cent to the present Victoria Memorial Museum building. It is a large requirement, but an essential one. It is quite apparent that the Government intended to support a national museum generously twenty years ago when the present building was built at the foot of Metcalfe street facing the Parliament buildings and it is to be hoped that this spacious policy will be continued. It will take two years or more to build an addition such as is needed, so it is hoped there will not be much delay.

DONATIONS

Interest in the Museum is shown frequently and in substantial manner by gifts of valuable material. This year a particularly valuable series of specimens of gold, platinum, palladium, and other rare metals obtained from the nickel-copper ore deposits of Sudbury district was presented by the Mond Nickel Company, and other fine material for the exhibit of nickel and its products was donated by the International Nickel Corporation and by Henry Wiggin and Company, of Birmingham, England. The section of the museum devoted to economic geology has been particularly favoured in recent years by gifts from the National Aniline and Chemical Company of Buffalo, the Imperial Oil Company, Mining Corporation of Canada, and other companies.

MUSEUM LECTURES

The Museum Lecture Committee, composed of H. I. Smith, M. E. Wilson, and C. L. Patch, reports that the course this year consisted of sixteen lectures, given by lecturers from twelve different technical institutions in the Government service. The course lasted from November 12, 1927, until March 14, 1928. Each lecture was delivered on a Saturday morning to children and on the following Wednesday evening to adults. The total attendance of children was 9,550 and of adults 2,312. Further details are given in the annual report of the Museum.

FIELD WORK

An account is given in the report of the Geological Survey, preceding, of investigations in geology, mineralogy, and palæontology. In addition, five field parties were engaged in anthropological work and four in biological work, short descriptions of which follow.

ANTHROPOLOGICAL DIVISION

D. Jenness, Chief of the Division, reports:

FIELD WORK

Five parties went out on field work during the summer.

D. Jenness visited Newfoundland to discover whether any traces remained of the extinct Beothuk Indians, and to investigate their relationship to the Indian and Eskimo tribes of Canada. Ever since their discovery by John Cabot, in 1497, mystery has attached to the Beothuk Indians of Newfoundland, who became extinct a century ago; they have stood by themselves, an isolated tribe that could not be definitely connected with any other Indian tribe in North America. Mr. Jenness' researches last summer seem to indicate that they formerly occupied a portion of Labrador peninsula contiguous to some early Eskimo tribes, and that they migrated to Newfoundland only a few centuries before Cabot's time.

C. M. Barbeau spent the summer on Nass and Skeena rivers, British Columbia, studying the northern branch of the Tsimshian group of Indians. In addition to his ethnological researches he made a special study of the native music in co-operation with Dr. Ernest Macmillan, of the Toronto Conservatory of Music.

H. I. Smith, archæologist, resumed his supervision of the work of preserving the totem-poles in Skeena River basin, British Columbia. He successfully restored eight totem-poles during the summer at Kitselas canyon, then moved to the vicinity of Prince Rupert to cast two petroglyphs and to supervise the partial excavation of a shell-heap.

W. J. Wintemberg conducted archæological researches first at Tadoussac, then westward along the north shore of St. Lawrence river as far as Three Rivers. His excavations at Tadoussac revealed evidence, not of an early Eskimo settlement, as had been reported previously, but of a somewhat peculiar Algonkian culture, either archaic or else a local variation.

J. C. Boileau Grant, Professor of Anatomy in the University of Manitoba, made an anthropometric study for the division of the Cree and Ojibwa Indians living on Island and Gods lakes, in northern Manitoba. Dr. Grant's field work was the first attempt to make a detailed anthropometric study of a Canadian Indian tribe. He examined over three hundred Indians at the two lakes he visited, and is now working up his notes and measurements into a full report.

OFFICE WORK

Scientific reports completed by the staff and handed in for publication during the past year were: "A Comparative Vocabulary of the Western Eskimo Dialects," by D. Jenness; "Materia Medica of the Bella Coola," by H. I. Smith; and "The Uren Village Site in Southeastern Ontario," by W. J. Wintenberg. Furthermore, two reports by former field workers were edited and submitted for publication: "Cree Tales," by Professor Leonard Bloomfield, and "The Bella Coola Indians of British Columbia," by Professor T. F. McIlwraith. Mr. Barbeau is completing his account of the totem-poles of Skeena river, British Columbia, and Mr. Wintenberg is preparing a report on the Roebuck village site in southeastern Ontario. Mr. Smith, having completed his "Materia Medica of the Bella Coola," is now arranging and titling a series of motion pictures that he has taken to illustrate the manners and customs of some Indian tribes in British Columbia.

The Division of Anthropology participated in several interesting events during the past year. It lent the services of Mr. Barbeau, and contributed French Canadian specimens, to the Canadian Folk Song and Handicraft Festival at Quebec, organized in May by the Canadian Pacific railway; in August it contributed a large collection of specimens to a festival at Joliette, Quebec, arranged by the Fathers of the Oblate Mission; it arranged a small exhibit for the meeting at Ottawa of the International Mining Congress in August; and it contributed most of the ethnological specimens for the Canadian West Coast Indian art exhibit shown at the National Gallery of Canada, Ottawa, in December, at the Art Gallery, Toronto, in January and February, and at the Art Association, Montreal, in February and March. It may be mentioned here, as indicating the standing which the division has attained in foreign countries, that Mr. Jenness was asked to lead a scientific expedition to Alaska during the summer on behalf of the National Geographic Society and the United States National Museum; the project was finally abandoned, however, through a disagreement between the two organizations concerning certain details in its arrangement.

MUSEUM WORK

The two exhibition halls assigned to the Division of Anthropology are undergoing extensive changes. The west hall, which is already filled with permanent cases, is being slowly reorganized; five of its cases were rearranged during the past year. The east hall, hitherto a medley of storage cabinets and small table cases, is to be equipped with large, glass-sided cases similar to those in the west hall, but with hinged doors that will make the specimens exhibited more accessible. These new cases are now undergoing assembly in the hall itself and will be installed and arranged during the coming year.

Accessions to Museum

The ethnological and archæological catalogues of the division show that its collections were augmented by about 800 specimens, but this total does not include a much larger number that are not yet catalogued. The majority of these specimens were obtained by members of the staff in the course of field work, but a certain number were donated, the North West Territories and Yukon Branch of the Department of the Interior being, as in former years, the chief contributor. The Canadian Pacific railway, through Mr. J. M. Gibbon, donated a motion picture reel depicting scenes among the Indians of the Pacific coast, and three other reels, illustrating the Nass River Indians, were presented by Dr. J. S. Watson, of Rochester, New York.

The division made two important exchanges of specimens during the course of the year. It exchanged a large collection of specimens from the Tsimshian Indians, B.C., with the National Museum of Denmark, Copenhagen, for a collection of Greenland specimens; and it exchanged with Lieut. G. T. Emmons, Princeton, New Jersey, some Vancouver Island wood-carvings for a collection of Tlinkit basket-making material. In addition, it made two donations: to the Royal Ontario Museum of Archaeology, a collection of Eskimo specimens; and to Loyola College, Montreal, which is establishing a natural history museum, a collection from the British Columbia and Plains' Indians to serve as the nucleus of a Canadian ethnographical section in that college.

BIOLOGICAL DIVISION

R. M. Anderson, Chief of the Division, reports:

FIELD WORK

R. M. Anderson left Ottawa August 26 and was joined at Saskatoon by Dr. Seymour Hadwen, Chief of the Department of Veterinary Science in the University of Saskatchewan. They made an expedition through parts of the Wood Buffalo park near the boundary of Alberta and the North West Territories. With the assistance of the warden service of the Wood Buffalo park, they collected skins and complete skeletons of two large adult wood buffalo bulls, as well as black bear, beaver, and other smaller animals. Careful post-mortem examinations were made for external and internal parasites and signs of disease in all species, large and small, and blood slides were taken for future examination. Such co-operation by a distinguished parasitologist and expert in health of mammals, in field work with wild mammals, opens up great possibilities in a field comparatively unworked in this country, and if continued may lead to important discoveries in regard to the periodicity in numbers of various species of our fur-bearing and other wild mammals.

P. A. Taverner spent most of his time in office work, but did some local work in bird photography.

C. H. Young, and H. M. Laing, of Comox, began collecting small mammals in an intensive way about May 5 at Huntingdon, B.C., near the border of the state of Washington. They continued work at Sumas, Cultus lake, Lihumpton park, Hope, Hope-Princeton summit pass, Stevenson creek, and Princeton. The primary object of the expedition was to make a complete collection of the mammals found in southern British Columbia near the International Boundary line. The southern part of British Columbia is much cut up by alternating mountain ranges and valleys, which show different climatic conditions and consequent varied fauna and flora, due to variations in humidity and altitude. A number of North American species reach their northern limits near this region, and there are probably several species and subspecies occurring in this region which have never been taken in Canada. Near Huntingdon they took a fine series of the large Townsend mole, or Oregon mole, which had never been recorded from Canada previously, as well as specimens of the spotted owl and California cuckoo, both of which have been taken very rarely within our limits. Fine series of other species not previously represented in our collections were also taken, mammals totalling 915, and birds 78. Mr. Young returned to Ottawa about the middle of September; Mr. Laing remained in the field until October 10.

J. D. Soper started from Ottawa May 23 and proceeded to Munson, Alberta. Beginning work at this place he proceeded southwest to Coleman, Alberta, and

worked eastward, keeping most of the time within 30 or 40 miles of the International Boundary line where roads would permit, in southern Alberta, Saskatchewan, and Manitoba as far east as Turtle mountains, Manitoba. He collected in the vicinity of Coleman, Burmis, Milk river north of Sweet Grass hills, Deer creek, Eagle Butte, and Lodge creek on the western edge of Cypress hills in southeastern Alberta; south and east of Cypress hills in Saskatchewan, collecting near Battle Creek, Fort Walsh, Eastend, Val Marie, Lonesome Butte, Big Muddy lake, McDonald lake, and Glen Ewen, Saskatchewan; junction of Antler and Souris rivers, and Max lake, Turtle mountains, Manitoba. He left Max lake on November 3 and proceeded to Prince Albert, Sask., going north from there about 60 miles to Harper lake and Birch Bark lake, where he collected a pair each of prairie elk, moose, and mule deer, as well as a number of smaller mammals, finishing this work December 15.

Joseph Rochon left Ottawa August 15, and collected at Ste. Veronique, Labelle county, Quebec, until September 15. He collected 118 small mammals, including a specimen of the least weasel, a species not previously recorded from the province of Quebec.

C. L. Patch, D. Blakely, and C. E. Johnson did some field work in Ottawa district, principally collecting local material to fill out the collections and obtaining accessories for habitat group work.

M. O. Malte early in the spring visited the New York Botanic Garden and the American Museum of Natural History, New York; the United States National Herbarium, Washington, D.C., and the Gray Herbarium, Harvard University, Cambridge, Mass., for studies of critical plant genera and methods of arranging botanical museum exhibits. On June 21, he left, with W. R. Watson, student assistant, for northwestern New Brunswick, making his headquarters at St. Leonard. On July 12 he left there for North Sydney, N.S., to join the Canadian Arctic Expedition of 1927, under direction of Mr. George P. Mackenzie, North West Territories and Yukon Branch, Department of the Interior, which sailed on July 16 on S.S. *Beothic* for Greenland and the principal islands in the eastern part of the Canadian Arctic archipelago. Botanical collections were made at twelve ports of call on Ellesmere island, Devon island, Somerset island, Baffin island, and the south shore of Hudson strait, yielding about 4,000 herbarium specimens of flowering plants and ferns. The expedition returned to North Sydney, N.S., September 5. During the absence of the chief botanist in the Arctic, Mr. Watson continued botanical explorations in northwestern New Brunswick until the last week of August. The collections from New Brunswick totalled about 3,000 herbarium specimens, containing about 550 species.

OFFICE WORK

The only official publication issued by the Biological Division during the year was "A Study of *Buteo borealis*, the Red-tailed Hawk, and its Varieties in Canada," by P. A. Taverner, Museum Bulletin No. 48.

A report on Marine Algæ, being Part B, Report of the Canadian Arctic Expedition, 1913-18, was issued November 24, 1927, by the Department, under the supervision of R. M. Anderson, general editor of reports of this expedition. It comprised sections on "Bering Sea and Arctic Ocean Algæ," by the late Frank Shipley Collins; "Calcareous Algæ," by Mme. Paul Lemoine; and "Hudson Bay Algæ," by Marshall A. Howe.

Completed manuscripts prepared for publication by officers of the division include: "A Faunal Investigation of Southern Baffin Island," by J. D. Soper, covering his work of 1923-26; "Commercial Bent Grasses of the Genus *Arctogrostis*," by M. O. Malte; "Birds of the Belvedere Region, Northern Alberta," by P. A. Taverner; "Birds and Mammals of the Mount Logan Expedition," by H. M. Laing.

R. M. Anderson made an extended study of the natural history literature of the eastern Arctic region and found that considerable valuable and interesting material had been generally overlooked and was unavailable to most students on account of not being printed in English. He prepared a paper for the Washington meeting of the American Ornithologists' Union, November 16, 1927, on "The Work of Bernhard Hantzsch in Arctic Ornithology," which was accepted for publication in *The Auk* in 1928. In connexion with the Baffin Island work, he prepared a translation of Hantzsch's "Beobachtungen über die Säugetiere von Baffinsland" ("Observations on the Mammals of Baffin Island"), *Sitzungsberichte der Gesellschaft naturforschender Freunde zu Berlin*, 1913, pages 141-160. With the assistance of Mrs. R. M. Anderson, there was also prepared for the library a translation of Dr. Erich Hesse's "Bernhard Hantzsch's ornithologische Ausbeute in Baffinland" ("Bernhard Hantzsch's Ornithological Results in Baffin Island"), *Journal für Ornithologie*, vol. 63, No. 2, 1915, pages 137-228; also "Beiträge zur Kenntnis der Vogelwelt des nordöstlichen Labradors" ("Contribution to the Knowledge of the Avifauna of Northeastern Labrador"), by Bernhard Hantzsch, *ibid.*, vol. 56, pages 177-202 and 307-393. The first part of the last-mentioned paper was published in *The Canadian Field-Naturalist*, Ottawa, vol. 42, Nos. 1 and 2, January and February, 1928, and the second, more technical part, will follow.

P. A. Taverner contributed an important paper to *The Auk*, vol. 44, No. 2, April, 1927, pages 217-228, entitled "Some Recent Canadian Records." In this paper he recorded a number of Canadian bird occurrences which have not been formerly recorded, as well as a few others which have been published in media that are not generally available for reference, the whole being to some extent supplementary to his "Birds of Eastern Canada," and "Birds of Western Canada." Other members of the staff have contributed brief notes and reviews to periodicals but no formal articles have been listed.

MUSEUM WORK

Some progress has been made in installing biological exhibits in the Museum halls. A few small bird habitat groups with accessories have been prepared, and a considerable number of individual bird specimens have been freshly mounted or remounted from old material to fill out the gaps in the systematic exhibit collection of birds. In some of the families and genera of birds, specimens of each species known to occur in Canada are exhibited in some form. It is intended ultimately to have all the more commonly observed or important species represented in the different adult and juvenile plumages of both sexes in the different seasons. A number of small mammals have been mounted singly, and a habitat group of black-tailed prairie-dogs, taken at Val Marie, in southwestern Saskatchewan, the first authentic Canadian specimens of this species, were installed. Extensive increase in the number of mounted specimens of large species can not be made with the space at our disposal.

As a result of field work by members of the staff, considerable additions have been made to the reserve study collections of both mammals and birds, and many specimens suitable for mounting have been acquired. A few particularly desirable specimens have been purchased. Many valuable specimens have been obtained by gift or transfer from other departments, notably from the Canadian National Parks Branch and the North West Territories and Yukon Branch, Department of the Interior, and from the Royal Canadian Mounted Police.

The Canadian National Parks Branch, through the Commissioner of Parks, Mr. J. B. Harkin, has kindly sent in many specimens of large game and pre-

datory and fur-bearing mammals which have died from natural causes, or have been killed by park wardens, as well as confiscated for illegal trapping in the various national parks, Waterton Lakes, Yoho, and Jasper. The North West Territories and Yukon Branch have sent in several skulls of timber wolves and Arctic wolves from the northern districts, principally from the Wood Buffalo park. The Commissioner of the Royal Canadian Mounted Police, Colonel Cortlandt Starnes, has showed continued interest in our work and has encouraged the police detachments in the north to send in material to the Museum. The most notable accession secured last year from the police was a series of three skins and skulls of the small white Arctic caribou, or Peary caribou, taken by Staff-Sergeant (now Inspector) A. H. Joy on Axel Heiberg island in the spring of 1927. We are also indebted to Dr. Morten P. Porsild, Director of the Danish Arctic Station, Disko, Greenland, for the gift of three fine heads of the Greenland caribou, brought down by the Canadian Arctic Expedition of 1927. Both of these species have long been desiderata in our mammal collections.

Considerable progress has been made in identifying and arranging the systematic collections, particularly in botany, mammalogy, ornithology, and herpetology, and a large amount of data has been assembled along these lines for use in reports and memoirs now in preparation, or necessary as a foundation for future publications. The determination of the large amount of new material coming in from new districts has involved considerable study on the part of the technical officers of the Biological Division.

Accessions to Museum

Plants received outside of collections made by staff:

Mr. H. Groh, Ottawa, Ontario.....	53
Gray Herbarium, Cambridge, Mass.....	229
National Museum, Stockholm, Sweden.....	10
Dr. Morten P. Porsild, Disko, Greenland.....	132
Dr. B. Lynge, Oslo, Norway.....	87
Mr. E. A. Moxley, Owen Sound, Ontario.....	47
Mr. E. M. Kindle, Ottawa, Ontario.....	69
Fr. Marie-Victorin, Montreal, Quebec.....	191
Mrs. George Black, Dawson, Yukon.....	31
Dr. E. H. Moss, Edmonton, Alberta.....	60
Miss E. S. Dowding, Edmonton, Alberta.....	2
Mr. Wm. Herriott, Galt, Ontario.....	5
Mr. H. Mousley, Montreal, Quebec.....	8
Total.....	924

Plants distributed:

Gray Herbarium, Cambridge, Mass.....	283
National Museum, Stockholm, Sweden.....	36
Fr. Marie-Victorin, Universite de Montreal.....	104
Dr. B. Lynge, Oslo, Norway.....	65
Scholasticate of the Oblates of Mary, Ottawa.....	224
Dr. Selim Birger, Stockholm, Sweden.....	100
Total.....	812

Accessions to the zoological collections:

Mammals received and catalogued.....	2,097
Birds received and catalogued.....	307
Reptiles and amphibians received and catalogued.....	287
Birds' eggs in sets, and nests.....	6
Birds' stomachs (in formalin), for investigation of contents, received and catalogued.....	25
Insects collected (mostly Microlepidoptera).....	500

MINES BRANCH

John McLeish, Director

The organization of the Mines Branch continues substantially as revised in 1922, although the activities and amount of work undertaken in the major investigative divisions have been greatly extended. The expansion which the mining industry in Canada is now experiencing is reflected in the demand upon the Mines Branch for information concerning the industry, for test work on ore treatment, and for assistance in solving the many problems that continually arise in respect to the treatment of metallic ores, non-metalliferous minerals, and the manufacture of clay products. The public demands for information on the varied matters relating to fuels become more and more insistent, and the scientific study of fuels has become an industrial necessity. This is especially so in the matter of selecting, preparing, and cleaning coals for the market; of burning coal in its powdered form; of high- and low-temperature carbonization, and of the latest developments in coal liquefaction.

To meet these demands the activities of the Mines Branch are being extended as rapidly as appropriations permit, but insufficient housing accommodation for both laboratories and staff is proving a severe handicap.

Although no additional duties have been assigned to the Branch during the past year, several developments indicate important and interesting new lines of procedure. One of these is an agreement entered into with Base Metal Extraction Company, a British organization, under which the company built and equipped a laboratory in Ottawa on the departmental property for the experimental test and demonstration of a metallurgical process for treating complex zinc ores. An agreement was also made with the Cassel Cyanide Company under which the company is to maintain for two years a research fellowship in selective flotation, the appointee carrying on his investigations in the departmental laboratory under the direction of the Chief of the Ore Dressing Division.

A private attempt to develop a peat industry having failed apparently through lack of funds, the Government followed the recommendation of the Peat Committee, made in 1924, for the construction and operation of a small commercial plant according to plans recommended by the committee. An agreement was entered into with Peat Fuels, Limited, for the taking over of the old plant, its reconstruction, and operation. A complete plant has been built during the past year at Alfred, Ont. This plant will be operated on a commercial basis during the season of 1928.

Progress was made on the construction of a Fuel Research Laboratory in Ottawa. The new building will house the present staff of the Division of Fuels and Fuel Testing; provide better accommodation for the small-scale chemical work in solid fuels, oils, and gases; and new accommodation for large-scale investigations in respect to the cleaning, burning, and carbonizing of coal.

Many members of the staff contributed to the success of the Second Empire Mining and Metallurgical Congress which met in Canada during August and September. A large amount of literature on the mining and metallurgical industries of Canada was published for the Congress and representatives accompanied both main excursions, the one to northern and western Canada, and the other to northern and eastern Canada and Newfoundland.

CHANGES IN STAFF

Six permanent positions were vacated during the year by resignation: two of these were chemists; three, clerks; and one, laboratory helper; a seventh permanent position was made vacant by the death of Michael Bones, labourer.

Eleven vacant permanent positions were filled during the year by appointment under competition: of these four were engineers or chemists; four, laboratory assistants or helpers; and three, clerks or stenographers.

Thirty temporary appointments were made in Ottawa during the year, in addition to field assistants and labour at Alfred in connexion with the construction of the peat plant. These included two engineers, nine student assistants and laboratory helpers, ten clerks and stenographers, one mechanic, and eight labourers. The services of nine temporary employees, including four clerks, four student assistants, and one labourer, were discontinued during the year.

The positions of seven technical officers and one laboratory assistant were improved during the year by promotion or reclassification.

The construction of the peat plant at Alfred required the services of 25 men for varying periods of time.

On the organization of the Mines Branch in 1907, the staff comprised 21 persons, of whom 13 were technical officers including administrative officers, engineers, chemists, and assayers.

In 1920 the staff had increased to 98, of whom 35 were technologists including engineers, chemists, and assayers; 22 clerks, and 41 mechanics, labourers, laboratory assistants, messengers, etc.

In 1928 at the end of March, the number employed was 151, including: 56 administrative officers, engineers, chemists, and assayers; 12 technical clerks and draughtsmen; 22 clerks and stenographers; 18 laboratory assistants, in several grades; and 43 mechanics, labourers, messengers, etc.

MINERAL RESOURCES DIVISION

The Chief of the Mineral Resources Division, A. W. G. Wilson, spent about three months on field service in various parts of Canada during the season of 1927. Short trips were made to points in southern Ontario, where new work was in progress on old prospects, in continuation of the search for sources of rare minerals containing rare chemical elements, especially zirconium, caesium, and rare earths. A reconnaissance trip was made in company with M. F. Goudge, departmental specialist on limestones, to Prince Edward Island, and afterwards to cap d'Or, N.S. At the latter point a quantity of zeolites were collected for use in some experimental work in the absorption of rare gases required in the manufacture of vacuum tubes and special lights and beacons. Part of August and all of September were devoted to attendance at the Second Empire Mining and Metallurgical Congress, including the western excursion, for the purpose of imparting information concerning Canada's mineral resources, their development and utilization. Towards the end of the year a week was spent in visiting the plants of the Aluminum Company of Canada at Arvida, Shawinigan Falls, and Toronto; a number of other plants in the vicinity of Toronto and Hamilton, where aluminium products are fabricated, were also visited in prosecution of a general study of the development of this industry in Canada. The services of this officer were, on several occasions, requisitioned by the Advisory Board on Tariff and Taxation in connexion with technical matters relating to several of the reference hearings.

H. S. Spence was engaged during the season in resurveying the feldspar and mica industries, and industries utilizing these products. The data assembled will be embodied in reports shortly to be issued, designed to show the present

status of these industries, and to supplement the information contained in monographs on these minerals published some years ago.¹ During the course of field work Mr. Spence secured a special consignment of graphite ore for the purpose of initiating an investigation into the possibilities of producing a flake graphite suitable for the manufacture of graphite crucibles. Mr. Spence attended the Second Empire Mining and Metallurgical Congress as a departmental representative, and he accompanied the Congress on its western tour to British Columbia and return to Quebec and Thetford Mines.

L. H. Cole was engaged during the field season in resurveying the gypsum and salt industries of Canada. The latter part of July and the first part of August were spent in examining and sampling gypsum deposits in Nova Scotia and New Brunswick. A visit was paid to the salt mine at Malagash. Again, during the month of October and the first half of November additional gypsum deposits in Cape Breton, in the vicinity of Antigonish, and in Hants county, Nova Scotia, were examined and sampled. The samples obtained are large commercial samples and are to be used in laboratory research work. Mr. Cole also secured samples from a number of salt springs not previously examined. The most important result of the field work is the discovery of the occurrence of potash salts in well borings from an exploratory well at Gautreau, in the valley of Petitcodiac river, New Brunswick. These borings were placed at the disposal of the Department for examination through the courtesy of Dr. J. A. L. Henderson, Managing Director of the Maritime Oil and Gas Company, Limited. Mr. Cole attended the Second Empire Mining and Metallurgical Congress as a departmental representative, and he accompanied the Congress on its western trip to British Columbia and return via Quebec and Thetford Mines.

S. C. Ells continued his work on the bituminous sands of northern Alberta, leaving Ottawa on May 8, and returning on October 15. The work of the season constitutes a logical sequence in the program planned some years ago when the first study of the bituminous sands was initiated by the Mines Branch, and included drilling and demonstration paving. In a preliminary report on the bituminous sands, issued by the Mines Branch in 1914, it was indicated that only after detailed exploration by means of adequate equipment can the true value of any portion of the bituminous sand area be determined. Subsequent investigation has amply confirmed this contention. It has, therefore, appeared desirable to attempt to develop efficient drilling equipment which will not only pass through heavy overburden but will also recover accurate core samples of the bituminous sand itself. During 1927, three wells were commenced and carried to the desired depth. As a result, it is realized that the most efficient type of drilling equipment has not yet been developed. It is, however, considered that results already achieved will prove of practical value to any who may contemplate extensive core sampling of these sands. For many years, natural rock asphalts, including bituminous sand, bituminous sandstone, and bituminous limestone, have been used in the United States for paving purposes. The record of early development of rock asphalt paving was, however, marred by many failures. Such failures not only entailed the loss of large sums of money, but, for a time, seriously prejudiced the public against the use of the natural material. Failure was due to various causes which are now well recognized. Among these were lack of uniformity in the materials quarried and shipped, and carelessness or lack of skill in subsequent manipulation. It appeared desirable, therefore, to undertake a limited amount of demonstration paving. During parts of 1926 and 1927, upwards of 35,000 square yards of wearing surface were laid at Jasper, Alberta. This work involved selection of an area from

¹ Spence, H. S.: "Feldspar."

Spence, H. S.: "Mica."

which suitable bituminous sand could be secured; opening up of a quarry with mining and shipping of the required tonnage of bituminous sand; designing and operating a commercial mixing plant suitable for the manipulation of bituminous sand; and laying the mixture in place. The first three divisions of this work were undertaken by the Mines Branch; the last was done by the Parks Branch. Wearing surfaces laid at Jasper included approximately 12,100 linear feet of motor highway, 3,200 square yards of garage drives and parking space, and 2,100 square yards of walks within Jasper Lodge grounds.¹

M. F. Goudge continued the systematic survey of the limestone resources of Canada, which has now been in progress for three years. Six months were spent on field work, chiefly in eastern Canada, where practically all the field work in this investigation has now been completed. Early in the season a number of modern lime plants in the eastern United States were visited to study the latest developments in the lime industry in that country. Mr. Goudge's services were loaned to the executive of the Second Empire Mining and Metallurgical Congress as assistant to the train secretary in charge of the eastern excursion to the Maritime Provinces and Newfoundland.

A. H. A. Robinson is engaged primarily in the compilation of a report on "Lode Mining for Gold Ores in Canada." About three months were spent in the field during the past season; during July and part of August mining camps in British Columbia, including Anyox, Stewart, Britannia, Allenby, Trail, Nelson, and Kimberley were visited and current activities and outlook noted; short visits were paid to other localities in western Canada to discuss with local government and university officials current developments in the mineral industries in the western provinces. Mr. Robinson joined the eastern excursion of the Second Empire Mining and Metallurgical Congress on August 24, and accompanied the party to Newfoundland. Leaving the party on its return to North Sydney, on September 17, the following two weeks were spent in visiting localities in Nova Scotia where gold mining or prospecting were in progress.

V. L. Eardley-Wilmot has been engaged in compiling a report on "Artificial Abrasives," which constitutes one of the parts of his monograph on "Abrasives and Their Uses."² His next assignment is the preparation of a monograph on "Silver Mining in Canada." About two months were spent on field work in preliminary studies incidental to the compilation of this report, visits being paid to Cobalt, South Lorrain, and Gowganda. Mr. Wilmot was also assigned as a departmental representative on the eastern trip of the Second Empire Mining and Metallurgical Congress. While on this trip he examined additional diatomite deposits in Nova Scotia and Newfoundland. Before returning to Montreal he spent several days inspecting the diatomite deposit at Digby neck, Nova Scotia, and in discussing details of proposed future operations with the owners.

Arthur Buisson, mineral technologist in charge of the records section of this division, spent two months in the principal mining centres of southern British Columbia; and he also made brief visits to Winnipeg and to Sudbury area. At the end of the season about ten days were spent in Rouyn area of western Quebec. These inspection trips are made annually to secure first-hand knowledge of current developments and local conditions in the various mining camps visited. Mr. Buisson especially remarks on the optimism regarding the mining industry which prevails in both western and eastern Canada. He notes also the introduction of many modern improvements, and the remodelling of concentrators, which is contributing to the present healthy condition of the industry. Mr. Buisson joined the Second Empire Mining and Metallurgical Congress at Vancouver, and returned with the party to Montreal before proceeding to Rouyn area in continuation of his field work.

¹ A report on this work is now in press.

² Mines Branch repts., Nos. 673, 675, and 677.

C. H. Freeman and Eric H. Wait, junior engineers attached to the records section of the Mineral Resources Division, were assigned as field assistants to H. S. Spence and L. H. Cole during the field season. E. H. Wait was loaned to the Second Empire Mining and Metallurgical Congress to act as assistant train secretary for the eastern excursion; Mr. Freeman was retained in the office at Ottawa while other members of the technical staff were absent during the period of the Congress meetings.

J. M. Casey, statistician for the Mines Branch, devoted more than six months to conducting a survey of fuels used for domestic purposes in Ontario and Quebec during 1926. In connexion with this survey about two months were spent in field work in the various cities and towns of these provinces. An inquiry was also conducted respecting bunker coal consumption along the Great Lakes and St. Lawrence river. During the year a number of statistical investigations of old records of mineral production were made for the Dominion Bureau of Statistics, the Ontario Bureau of Mines, or for the use of officers of the Department of Mines.

ORE DRESSING AND METALLURGICAL DIVISION

W. B. Timm, Chief of the Division, reports that the applications for experimental test and research work on ore treatment have steadily increased with the greater activity in the mining industry. The laboratory work of the division, especially on the flotation of base metal sulphide ores is becoming more widely known among mining operators. Their keen appreciation of this work has resulted in the laboratories being taxed to their limit. The amount of work performed was fully 50 per cent greater than in the previous year, with a considerably larger amount in progress and waiting to be undertaken at the end of the year. The division has reached a point where in order to meet the demands of the industry more laboratory space is urgently required.

The permanent staff was increased during the year by the appointment of A. K. Anderson, grade III engineer; by the transfer of J. D. Johnston, junior chemist, from the Fuel Testing Division; by the appointment of H. L. Beer, junior chemist; and W. F. White and A. E. Laroche, laboratory assistants.

Co-operative arrangements were entered into with the Base Metal Extraction Company, Limited, and the Cassel Cyanide Company of Canada, Limited. The Base Metal Extraction Company built and equipped a laboratory for experimental test and demonstration of a hydro-metallurgical process developed in England, for the treatment of bulk concentrates from mixed base metal sulphide ores. The Mines Branch conducted the concentration and roasting tests, the company the leaching, electrolytic, and other tests for the production of the metals. The Cassel Cyanide Company placed in the laboratories under Mines Branch direction and supervision a research fellow on the use of cyanide for the selective flotation of base metal sulphide ores, especially those containing copper and zinc minerals.

W. B. Timm spent three months in the field securing information on the progress made in ore dressing and metallurgical practice. C. S. Parsons, J. S. Godard, and H. C. Mabee accompanied the Empire Mining Congress on their tour of Canada; C. S. Parsons the eastern tour, J. S. Godard the western, and H. C. Mabee part of the eastern. C. S. Parsons and J. S. Godard spent three weeks in the field at Kirkland Lake, Ontario, demonstrating the feasibility of the flotation of cyanide tailings in the milling plants. C. S. Parsons and R. K. Carnochan spent a week visiting the iron ore concentrator at Lyon, and the talc and garnet plants in northern New York state. R. J. Traill visited the

non-ferrous smelting and refining plants of the northwest, including Trail, Tacoma, Kellogg, Anaconda, and Great Falls, and also of the Atlantic seaboard, securing information on the progress made in hydro-metallurgical and electro-chemical practice. He also visited Minneapolis to obtain the latest information on the test work being conducted on the direct reduction of iron ores at the Minnesota School of Mines.

LABORATORY INVESTIGATIONS IN ORE DRESSING AND METALLURGY

C. S. Parsons, A. K. Anderson, and J. S. Godard conducted the investigations on the treatment of metallic ores as follows:

The gold ore of the Sylvania mine, Kirkland Lake, Ont.
 The gold ore of the Blue Quartz mine, Painkiller lake, Ont.
 The lead-zinc-gold of the Yankee Girl mine, Ymir, B.C.
 The lead-zinc-silver ore of the Planet mine, Nicola, B.C.
 The copper-zinc ore of the Amulet mine, Rouyn, Que.
 The gold ore of the Francoeur mine, Boischatel, Que.
 The gold ore of the Cooper mine, Michipicoten, Ont.
 The gold-silver ore of the Premier mine, Premier, B.C.
 The copper-zinc ore of the Sherritt-Gordon mine, Manitoba.
 The gold ore of the Kirkland-Premier mine, Kirkland Lake, Ont.
 The cyanide tailings of the Wright-Hargreaves mine, Kirkland Lake, Ont.
 The cyanide tailings of the Kirkland Lake mine, Kirkland Lake, Ont.
 The copper-gold ore of the Archean mine, Clericy, Que.
 The lead-zinc ore of the Stirling mine, Cape Breton, N.S.
 The gold ore of the Reno mine, Ymir, B.C.
 The silver ore of the Toric mine, Alice Arm, B.C.
 The lead ore of the Confederation Group, Cambourne, B.C.

R. K. Carnochan and R. A. Rogers conducted the investigations on the preparation of non-metallic minerals, as follows:

Calcite tailing from the Kingdon mine, Galetta, Ont.
 Silica sands from Silico Limited, Montreal, Que.
 Garnet rock from Langlade Garnet Syndicate, Langlade, Que.
 The drying of epsom salts.
 Graphite tailings from Dominion mine, Buckingham, Que.
 Asbestos rock from the Nicolet mine, Danville, Que.
 Sandstone from the Canada Glass Products, Limited, East Templeton, Que.
 Gypsum from the Manitoba Gypsum Company, Falkland, B.C.
 Quartz pebbles from Cypress hills, Alberta.
 Silica sands from Black island, lake Winnipeg, Man.
 Diatomite from lake Michel, Chertsey, Que.
 China clay from Huberdeau, Que.

During the year there was undertaken an investigation on the concentration of Canadian graphite ores for the production of crucible flake and a comparison of Canadian, United States, Madagascar, and Ceylon flake for the manufacture of crucibles.

R. J. Traill, W. R. McClelland, and J. D. Johnston conducted the following investigations:

The application of a modified Eustis process to the treatment of high iron-copper concentrates for the recovery of the copper and precious metal values, and of the iron as electrolytic iron, and the sulphur content as elemental sulphur.

The metallization of the iron content in ilmenite ores for the purpose of determining operating conditions and data as a guide to proposed commercial plant installation and the production of a quantity of metallized material for further investigation by private enterprise on the production of titanium pigments.

H. C. Mabee, chief chemist in charge of the chemical laboratories of the division, reports that approximately 7,000 determinations were made on 1,684 samples of ores and products of test operations. B. P. Coyne, R. A. Rogers, and H. L. Beer performed the analytical, and L. Lutes the assay, work. Some preliminary work was done on the Eckel process for the production of iron slag cement, and on a hydrometallurgical process for the treatment of stibnite ore for the recovery of metallic antimony.

FUELS AND FUEL TESTING DIVISION

B. F. Haanel, Chief of the Division, reports increased activity in investigational and routine work. The chemical staff was increased by the appointment of E. J. Burrough as engineer, grade II. G. P. Connell continued on loan as junior chemist from the Chemical Division, and R. J. Offord was appointed to the junior chemist vacancy resulting from the resignation of A. F. Gill. Temporary appointments during the year were: C. J. Coleman, E. G. O. Way, and H. T. Fortune, all as laboratory helpers.

In addition to planning and directing the work of the division, Mr. Haanel attended the regular meetings of the Dominion Fuel Board. He was largely occupied with construction and equipment details in connexion with the new fuel research station as well as with the erection and tryout of the peat plant at Alfred. He visited the coke plant of Hamilton By-Products Limited in that city. During the year he prepared several reports on low-temperature carbonization, coal liquefaction, and other processes for the treatment of coals, among which was the N-T-U process for distilling oil-shales. A plant for distilling oil-shales according to this process was operated in California, but owing to a drop in crude oil prices it was temporarily closed down. Mr. Haanel also prepared a paper entitled "The Bearing of High and Low Temperature Carbonization, and Synthetic Fuel Processes, on Canada's Fuel Problems" for presentation at the World Fuel Conference to be held in London, England, during September, 1928. He also attended the opening meetings of the Empire Mining and Metallurgical Congress held in Montreal, in August, 1927; the annual meeting of the Engineering Institute of Canada held in Montreal, February, 1928; and the annual meeting of the Canadian Institute of Mining and Metallurgy held in Quebec city during March of the same year.

E. S. Malloch and C. E. Baltzer completed the full report on the tests of various fuels made in a domestic hot water boiler. During the month of May work was commenced on the Fuel Power Survey for the province of Ontario, with particular reference to the district of the city of Peterborough. This work was completed and fully reported on at the end of the fiscal year.

A. W. Mantle, mechanical superintendent attached to the Division of Fuels and Fuel Testing, reports increased activity in the mechanical section. The construction and installation of, and repair to, apparatus, machinery, etc., involved a total expenditure, for labour and materials, of over \$23,000.

Under the direction of the chief engineer and the immediate supervision of R. E. Gilmore, superintendent of the fuel testing laboratories, the investigational work was conducted under four sections, viz.:

- (A) Coal carbonization and briquetting, engineer, R. A. Strong;
- (B) Oil-shale and bituminous sands, engineer, A. A. Swinnerton;
- (C) Oils and gases, engineer, P. V. Rosewarne;
- (D) Chemical laboratory (solid fuels), chemist, J. H. H. Nicolls.

Mr. Gilmore spent some time in connexion with the new laboratories, the selection of carbonization equipment for which took him and Mr. Strong on an extensive trip to coal experiment stations in Pennsylvania, Ohio, and Illinois. He assisted in the preparation of the annual report on fuels and fuel testing, and did considerable work in the matter of the classification of coals. As representative of the Department of Mines he attended two meetings of the A.E.S.C. Sectional Committee on coal classification.

J. H. H. Nicolls, besides looking after the routine analyses of solid fuels, conducted experiments on the caking index of Canadian bituminous coals. With the assistance of J. L. Bowlby, he carried out a large number of tests for the purpose of comparing methods of analysing coal and other solid fuels, as a pre-

liminary to the publication of the "Standard Methods of Analysis as used in the Fuel Testing Laboratories", and also continued his study of the application of different schemes for classifying Canadian coals according to the chemical and physical characteristics.

P. V. Rosewarne, assisted by R. J. Offord, conducted the fifth annual gaso-line survey, consisting of 83 samples from 13 widely separated Canadian cities, and made a further study of the feasibility of reclaiming of used automobile crankcase oils. In addition to attending to the analytical work pertaining to samples of liquid fuels coming in from other Government departments, commercial firms, and private individuals, Mr. Rosewarne prepared for publication a set of standard methods for analysing lubricating oils. He represented the division at the Detroit meeting of the American Chemical Society, and at the Petroleum Congress at Tulsa, Okla.

R. A. Strong paid special attention to coal carbonization and briquetting problems. The results of tests that were made in the by-product ovens of the Winnipeg Electric Company were quite promising, for it was shown that certain Canadian coals from the Crowsnest area will produce as good coke as that obtained from the imported coal now used. Mr. Strong, with the assistance of E. J. Burrough, also conducted a series of high temperature carbonization tests on Canadian coals in the new (Koppers) laboratory electric tube furnace for the purpose of determining the yield and quality of the tar and gas by-products. The results of these tests will be published in the "Investigations of Fuels and Fuel Testing for 1927".

A. A. Swinnerton studied processes pertaining to the heat treatment of oil-shales and bituminous sands. He made a field investigation in the Maritime Provinces, conducted retorting tests on oil-shales from New Brunswick, and with the assistance of G. P. Connell made a further study of the alterations of the bitumen from Alberta bituminous sands.

Chemical Laboratory Work

During the year, a total of 850 samples of solid, liquid, and gaseous fuels were examined. Of these, 470, approximately 55 per cent of the total, were sent in from other divisions of the Mines Branch, from the Geological Survey, from other Government departments, from public institutions, commercial firms, and private individuals. The remaining 45 per cent pertained to investigations conducted by the technical staff of the division. Of the total samples submitted from outside the division, 146 were from other divisions of the Mines Branch, mainly from the Mineral Resources Division, 27 from the Geological Survey, 94 from the Department of Soldiers' Civil Re-establishment, 78 from other Government departments, and 125 from public institutions, commercial firms, and private individuals.

The following is a classification of the samples analysed according to standard laboratory methods by Messrs. C. B. Mohr, assistant chemist; G. P. Connell and R. J. Offord, junior chemists; G. E. LeWorthy, senior laboratory assistant; G. Connolly and W. Kritsch, laboratory assistants; and K. W. Bowles, C. J. Coleman, E. G. O. Way, and H. T. Fortune, laboratory helpers.

Solid fuels; total samples examined.....		851
Coals (various kinds).....	328	
Cokes and chars.....	39	
Peat and miscellaneous.....	14	
Liquid fuels; total samples examined.....		290
Gasoline.....	106	
Lubricating oils.....	122	
Other petroleum oils and miscellaneous.....	62	
Gases from coals, oil-shales, etc.....		31
Bituminous sands and oil-shales.....		148

CERAMICS AND ROAD MATERIALS DIVISION

Howells Fréchette, Chief of the Division, reports increased activity in the division and much progress in the investigations under way. In some lines of investigation particularly gratifying results have been obtained.

J. F. McMahon, ceramic engineer, was appointed to the permanent staff as engineer, grade II, July 14, 1927.

J. G. Phillips, ceramic engineer, was appointed to the temporary list as engineer, grade II, August 19, 1927, and was retained as such throughout the balance of the fiscal year.

The growing volume of laboratory work necessitated additional laboratory assistance during the latter part of the year. Laboratory helpers were employed for nine months and one labourer for four months.

CERAMICS

At the request of the Mining Bureau of the Winnipeg Board of Trade, in July Mr. Fréchette was sent to Manitoba to study the difficulties being encountered in the attempts to produce high-grade face-brick within the province. Visits were made to the various plants and the nature of their problems was ascertained. As a result of advice given, considerable improvement in the ware was attained at one plant to the west of Winnipeg, but the problem confronting the operators at Winnipeg was found to be much more serious. At Winnipeg two clays are available for brickmaking. A shallow surface clay which burns to a very light buff has been used for many years in the manufacture of common brick. The supply of this clay is being rapidly depleted, and the cost of winning and transporting it to the brick plants is becoming a very serious item. Underlying this surface clay is a thick bed of red burning clay which, were it not for one very serious fault, would produce good face-brick. This is a tender-drying clay of the type known as gumbo. When moulded into bricks it is almost impossible to dry them without cracking. At one of the Winnipeg plants, face-brick is being manufactured from this under-clay mixed with a silty clay obtained about 100 miles west of Winnipeg. The cost of transportation is high and the results are not very satisfactory. The manufacturers, the Alsip Brick, Tile, and Lumber Company, Limited, are anxious for a means of overcoming the drying difficulties, which will permit them to use the local underclay alone. On Mr. Fréchette's recommendation, the Department undertook the problem, and appointed Mr. Phillips to assist in an exhaustive research on this clay to determine means of processing it so as to overcome the cracking in drying. Coincident with the request for aid from Winnipeg, the Redcliff Brick and Coal Company, Limited, of Redcliff, Alberta, asked the assistance of the Department in overcoming the difficulty of drying their brick rapidly without excessive breakage. This problem, being the same as that of the Winnipeg brick manufacturers, was included in the research. A very comprehensive study of possible means for solving the problem has been made and a large amount of experimental work done on the clays from Winnipeg and Redcliff. As a result of this laboratory work, two methods of overcoming the drying faults of these clays were developed which may be expected to give good results and at a sufficiently low cost to be economic. It is proposed to conduct large-scale tests at a brick plant for the purpose of obtaining cost data and to establish definitely the applicability of the processes to mass production. The successful solution of this problem will mean much to the brick industry throughout the Prairie Provinces, for almost all the brick clays of that section of the country possess the fault of being tender-drying to an extreme degree. By rendering the clay fit for rapid drying, the brick plant capacities may be easily increased and the quality of the ware greatly improved.

In August Mr. Fr chet made a reconnaissance of the clay and shale deposits of Prince Edward Island, preliminary to a detailed study of these resources which is planned for 1928.

In September he visited the Grand Lake coal area in New Brunswick where he studied the possibilities for the establishment of clay working industries to utilize the large tonnage of shales mined incidental to the production of coal. Representative samples were taken for laboratory study. These have been subjected to thorough tests by Mr. McMahon, to determine their suitability for the manufacturing of ceramic wares.

During the summer, Mr. McMahon made a study of the excavation and transportation of clays at thirty brick and tile plants in Ontario. Information as to the cost of the various operations was secured and much general data gathered which will serve in determining the most economic methods of operation under specific conditions.

Grey face-brick is in fairly strong demand in Ontario and Quebec, and the market is being supplied from foreign sources as the local manufacturers have been unable to produce them. Several manufacturers have asked that a method of production be worked out for their clays. Mr. Collin now has this problem under way. It is usual to produce this grade of brick from a low-grade fire-clay, into which is mixed a small percentage of manganese dioxide. The low refractoriness of Canadian brick clays constitutes the main difficulty, as they cannot be burned to a sufficiently high temperature to produce the reaction which seems to be necessary between the manganese and the clay to develop the grey colour.

Much progress was made by Mr. Collin on the investigation of ceramic bodies for electrical heating devices. More than 4,000 test pieces were burned to various temperatures. Impact tests were made on about half that number of test pieces to determine their toughness. The percentage of shrinkage and water absorption was determined on each set of test pieces. A number of plants manufacturing this type of ware were visited and samples of the mixture used were obtained at three of them. Test pieces have been made from these and will be used to determine the relative value of the bodies compounded in the laboratory and the commercial bodies now being manufactured.

During the year 133 samples of clays and shales were tested. Tests were also made on one sample of mineral pigment, four samples of limestone, three samples of marl, three samples of pyrophyllite, and four samples of talc.

Transverse strength was determined on three samples of building brick.

A series of tests was made for a manufacturer desirous of producing dry-press brick from a clay previously used for another type of brick.

Tests were run to determine whether spraying would be more advantageous than dipping in the manufacture of glazed brick.

Experiments were made on the production of buff brick from a red-burning clay.

Four samples of fire-brick were tested and reported on for Government departments.

Numerous refractory shapes were made for use in the ceramic laboratory and for other laboratories of the Department.

The facilities of the laboratories and the assistance of the staff were, on several occasions, placed at the disposal of other departments for special tests.

In co-operation with the Research Council of Canada, an exhaustive laboratory investigation of the suitability of the magnesite from Grenville township, Quebec, for the manufacture of high-grade refractory brick, has been under way during the entire year. This work was conducted at first by Mr. R. T. Watkins, and later by Mr. J. W. Craig, ceramic engineers, and the results so far obtained show good prospects of success.

ROAD MATERIALS

During the early part of the field season, R. H. Picher, road materials engineer, visited thirteen stone quarries in the province of Quebec in districts not previously covered, and eight samples were collected for testing. Most of these quarries are not worked for the production of road metal, but have a large amount of waste rock which constitutes an important and easily available source of supply for road material and concrete aggregate.

Mr. Picher began a detailed investigation of the road material resources of Prince Edward Island.

The laboratory work consisted in testing the samples collected during the field season and also in conducting an investigation on cement mortars with various types of stone aggregates.

CHEMISTRY DIVISION

F. G. Wait, Chief of Division, reports:

From April 1, 1927, to March 31, 1928, twelve hundred and seventy-eight specimens have been reported on.

The work of the different members of the chemical staff has been as follows:

H. A. Leverin during the summer investigated the rate of drying of peat under the climatic conditions prevailing at Alfred, Ontario. He made numerous chemical analyses of a wide variety of materials, including abrasives, gypsums, silica sands, rock salt, brine, and alloys. He has also made several mineral identifications.

E. A. Thompson made chemical analyses and microscopic examinations, with photomicrographs, of two telluride ores for the Ore Dressing Division, and of sand from the Alberta bituminous sands. A metallographic examination and analysis was made of a piston from an airplane engine for the R.C.A.F. Complete analyses were made of seven samples of mineral water, of nineteen feldspars, and two micas, as well as a number of partial analyses and mineral identifications.

A. Sadler had charge of the furnace assays. He examined five samples of earths as to their suitability for use as fullers' earth, and determined the dehydration point and the behaviour on heating of six diatomites. He made complete analyses of eight rocks and minerals, and partial analyses of a large number of specimens.

James Moran's principal work has been the analysis of the air sampled in the coal mines of western Canada. Two hundred and fifty-two such samples have been analysed and reported on. He made partial analyses of a large number of limestones, assisted in the identification of minerals, and made tests of two rocks for radio activity.

C. L. O'Brien was engaged in the analysis of limestones and dolomites collected by the Mineral Resources Division.

R. J. Offord, prior to his promotion and transfer to the Fuel Testing Division on August 23, 1927, made 144 furnace assays for gold and silver, tested two specimens for radio activity, and made partial analyses of several limestones.

James Rivington, appointed senior laboratory assistant in November, 1927, working under direction and supervision of Mr. Sadler, made a large number of furnace assays. He assisted in the preparation of stock, volumetric solutions, and in the general work of the laboratory.

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

The report of the Assay Office for the calendar year ending December 31, 1927, shows a decrease of business as compared with that of the previous year.

The net value of gold bullion deposited during the year was \$1,750,599.35, being a decrease of \$773,738.23 as compared with the year 1926. This is due chiefly to a lower production of bullion by a few of the principal shippers to this office and a fall in the value of placer gold production in British Columbia during the year. There is, however, every indication of a betterment during 1928; it is expected that the large gold dredge which operated throughout 1926 at Antler creek, Cariboo district, B.C., and which was being moved during the whole of last season to its new location at Cunningham pass, will be producing again in the late spring. Developments in other parts of the Cariboo and in Lillooet district also promise to further augment the gold yield during the coming season as compared with the year just closed.

GOLD BULLION

The following is a statement of gold bullion deposits at this office from the opening of the institution in July, 1901, to the close of business on December 31, 1927:

Number of deposits.....	28,324
Troy ounces.....	2,914,729.90
Net value.....	\$46,260,262.99

The purchase and disposal of the gold bullion deposited during the year 1927 required a total of 1,645 meltings and 1,645 assays, quadruplicate assays being made in each instance, including the melting into large bars of the smaller deposits after purchase, and the assaying of same before shipment.

The aggregate weight of all deposits before melting was 108,080.89 troy ounces, and after melting 102,224.55 troy ounces, included in which were 59 deposits containing a large proportion of lead requiring to be cupelled in a large muffle furnace. The total weight of these deposits before melting was 11,689.19 troy ounces and after melting and cupelling 7,642.76 troy ounces, showing a loss by melting and cupellation of 34.617 per cent.

The average loss of melting all other bullion deposited, viz.: 96,391.70 troy ounces before melting and 94,581.79 troy ounces after melting, was 1.878 per cent.

The loss in weight by assaying (base and parted silver) was 31.62 troy ounces, making the weight of bullion after melting and assaying 102,192.93 troy ounces, the average fineness of same being 827½ gold and 135½ silver.

The net value of the gold and silver contained in deposits was \$1,750,599.35 and was received from the following sources:

	Number of deposits	Before melting and assaying	After melting and assaying	Net value	
		Troy ozs.	Troy ozs.	\$	cts.
Bars, Nuggets, Dust, Amalgam, etc.—					
British Columbia.....	459	60,882.71	56,317.85	1,044,755	11
Yukon territory.....	405	39,436.44	38,852.50	649,502	72
Alaska.....	4	23.29	22.39	344	91
Dental and Jewellery Scrap—					
British Columbia.....	521	6,136.71	5,602.68	40,588	96
Alberta.....	111	744.43	644.50	6,294	11
Saskatchewan.....	52	450.17	352.67	4,593	69
Manitoba.....	2	193.96	187.41	569	89
Unclassified.....	1	213.18	212.93	3,949	96
	1,555	108,080.89	102,192.93	1,750,599	35

DRAUGHTING DIVISION

H. E. Baine, Chief Draughtsman, reports:

Maps published during the fiscal year ending March 31, 1928, and listed in the catalogue of Mines Branch publications, are as follows:

Map No. 171, Sudbury nickel region; scale, 1 mile to 1 inch (reprint).

Map No. 692, Diatomite deposits in the Maritime Provinces; scale, 17 miles to 1 inch (approx.).

Maps Prepared (not published)

FUEL POWER SURVEY

Map of northern portion of the province of Ontario (4 sheets); scale, 35 miles to 1 inch.

Map of western portion of the province of Ontario (4 sheets); scale, 12 miles to 1 inch.

Map of eastern portion of the province of Ontario (4 sheets); scale, 12 miles to 1 inch.

Maps on Hand

Map showing the distribution of the principal limestone formations in southern Quebec; scale, 8 miles to 1 inch.

Map showing the distribution of Ordovician limestone formations in Ontario; scale, 8 miles to 1 inch.

Map showing the distribution of the Silurian and Devonian limestone formations in southern Ontario; scale, 8 miles to 1 inch.

Map of limestone formations in Nova Scotia.

Map of limestone formations in New Brunswick.

Map of limestone formations in Gaspé peninsula, Quebec.

Map of limestone formations in southern Manitoba.

Map of limestone formations in southern Alberta.

Map of limestone formations in British Columbia.

Two hundred and forty-seven page maps, drawings, charts, and flow-sheets were prepared during the year.

Nine hundred and eighty-three negatives, and black and white prints were made from the photostat machine.

Five hundred and sixty-one negatives, black and white, and blue prints were made from the blue-print machine.

Seventy-one half-tone blocks and zinc cuts were sent out, received, and filed during the year.

DISTRIBUTION OF PUBLICATIONS

During the fiscal year ending March 31, 1928, the distribution of Mines Branch reports, bulletins, memorandum series, press bulletins, maps, lists of mine operators, etc., amounted to 137,498 copies. This is the largest distribution made in a single year by the Mines Branch, and it is accounted for to a great extent by the wide distribution of the pamphlet entitled: "Instructions for Burning Coal, Coke, and Peat."

Mr. H. A. Adams and Mr. C. R. Herbert were employed temporarily as clerk, grade II, and packer and helper, respectively, during the year, to assist in the distribution work.

LIBRARY

Mrs. O. P. R. Ogilvie, Librarian, reports:

Accessions to the library, 1927:

Books (by purchase).....	355
Books (by gift).....	74
Books (annual binding).....	166
Books (complete unbound volumes).....	166
Canadian Government documents (by gift and exchange).....	1,737
British and Foreign Government documents (by gift and exchange).....	1,114
Scientific societies, bulletins, proceedings, and transactions (by gift and exchange).....	1,263
Pamphlets (by gift).....	67
Trades catalogues (by gift).....	196

Accessions to the library during 1927 exceeded those for 1926, and much time was devoted to readjusting the shelves, that this increase might be properly placed.

Requests for translations of French and German technical articles were received in the library with such frequency that the services of a temporary assistant were required in order to meet this constantly increasing demand.

The year's work was marked by the installation of additional equipment, and much progress was made toward a general readjustment through the library.

[The following text is extremely faint and largely illegible due to the quality of the scan. It appears to be a detailed report or abstract of a technical paper, possibly related to the library's collection or a specific project mentioned in the header. It contains several paragraphs of text, some of which are partially legible, such as 'The demand for commercial explosives...', 'The year's work was marked by the installation of additional equipment...', and 'The year's work was marked by the installation of additional equipment...'. The text is oriented vertically on the page.]

EXPLOSIVES DIVISION

Lt.-Col. G. Ogilvie, Chief Inspector of Explosives

Explosives Factories

The only new factory licensed in the year ending March 31, 1928, was that of the Dominion Fireworks Manufacturing Company, Dixie, Ont. Two factories ceased operation: the National Explosives Company, Limited, Camp Mohawk, which closed in August, 1927, and the Mexco Company, Swastika, Ont., at the end of the calendar year.

The demand for commercial explosives, judged by their production, continues to increase, the output during 1927 having been over 10 per cent more than that of 1926.

A fatal accident occurred at the factory of the Canadian Explosives Limited, Beloeil, Que., on January 21, 1928. The unfortunate victim was engaged in the weekly cleaning of an outside catch tank in which the final waste waters from a nitroglycerine house are collected. This waste, which is largely in the form of a thin mud, is absorbed with sawdust and removed to the burning-out grounds. It contains a small quantity of occluded nitroglycerine. At the time of the accident the temperature was below zero Fahrenheit and it is believed that the nitroglycerine was detonated by some inadvertent blow. The man was killed instantly. The presence of nitroglycerine in the wash water is normal, as is also the procedure adopted in a flat terrain for the removal of the waste, but the possibility of the introduction of new devices for the more complete elimination or destruction of the nitroglycerine is engaging the attention of the manufacturers.

An accident whereby the operator lost the sight of an eye and sustained other injuries, and an associate worker was also injured, occurred at the Dominion Cartridge Company's factory, Brownsburg, Que., on October 14. Primed .22 shells were being shaken into a loading tray when the accidental explosion of one of these caused an *en masse* explosion of the primed shells on the bench—a wholly unexpected sequel with these shells. This accident has been dealt with in the Annual Report of the Explosives Division, but it is of interest to note here that the same phenomenon was observed on February 20, 1928, but thanks to the precautionary measures adopted, no injuries were sustained by the personnel.

Magazines

There were 271 magazines under license on March 31, 1928. Licences had also been granted for 200 temporary magazines during the year.

Two permanent magazines were broken into. A case of detonators was stolen from one and two cases of dynamite from the other. A temporary magazine was also broken into and four cases of dynamite stolen.

Temporary magazine buildings, used for the keeping of explosives required in harbour construction at Port Colborne, were destroyed by the storm of December, 1927, and the contents—747 cases of dynamite and 18 cases of electric detonators—were swept into lake Erie. An officer of the division attended the salvaging operations and examined the explosives. All were recovered, 427 cases repacked with serviceable dynamite, and the remainder destroyed.

Explosives Condemned

Seven considerable stocks of high explosives, totalling 2,008 cases on inspection, were condemned, deterioration having been accelerated by exposure

when kept on outlying operations. These were destroyed by the owners. In addition, the equivalent of 1,720 pounds, distributed over 11 magazines, was condemned or destroyed, also 2,375 pounds of black blasting powders, 1,500 detonators, and a few minor items.

Prosecutions

Prosecutions were taken in nineteen cases. One, on a charge of failing to safeguard explosives awaiting transshipment, was dismissed. Convictions were obtained and fines imposed in the others. In nine cases the offence was unlawful keeping of explosives, in eight failing to keep records of receipts and issues, and in one, intoxicated when in charge of a vehicle conveying explosives.

Importations

Six hundred and eighty-one permits for importation and thirty-four special permits were issued during the year. The rejections of Chinese fireworks presented for importation continue to be high—over one-quarter of those entering via Vancouver having been refused admission in 1927. Shipments made to merchants in eastern Canada, through wholesale dealers in the United States, have latterly been practically free from rejection, as these dealers, knowing what is authorized in Canada, take the precaution of examining the consignments from China before distribution—by no means a simple task judging by the variety found in direct shipments.

Authorization of Explosives

Two new explosives were presented for authorization, examined and accepted. Of 186 samples of manufactured fireworks 79 were authorized.

Accidents

The summary of accidents occurring in the use of explosives, as given in the annual report for the division, shows a slight decrease, but those arising from playing with explosives still form its most notable, and regrettable, feature. Playing with explosives accounted for 40 accidents with 4 killed and 49 injured, out of a total from all causes (manufacture and use) of 127 accidents with 38 killed and 135 injured.

The leaflet, referred to in last report, has been issued to all schools and school inspectors in Ontario, and to the Departments of Education in all western provinces, Quebec, and Nova Scotia, who have also kindly co-operated in the matter. Many of the accidents are undoubtedly due to ignorance, and it is hoped that the admonitions and instructions given in schools may be of very material assistance in reducing the number of these accidents.

General

The activities of the deputy inspectors of the Royal Canadian Mounted Police have made possible the inspection of unlicensed premises throughout the country. During the year about 2,200 inspections were so made, besides 700 by inspectors of the division. The reports received record relatively few cases of failure to comply with the regulations. The difficulty of adequately covering the ground has been felt most in eastern Canada, but this, in the last two years, has been largely overcome by the special patrols made by the Royal Canadian Mounted Police.

The deputy inspectors of that force have also co-operated in the inspection of magazines, in the conduct of prosecutions, examination of imported fireworks, and have rendered notable service in the promotion of public safety by the instructions they have given, on all appropriate occasions, regarding the safe handling of explosives.

EDITORIAL DIVISION

F. Nicolas, Editor-in-Chief

The strength of the English publication section of the Editorial Division remained unchanged during the fiscal year ending March 31, 1928.

During the fiscal year thirty-three separate English publications were issued by the Department, consisting of annual reports, memoirs, bulletins, and pamphlets; there were issued also twenty-one lists of mine operators and mines. Ten reports were published in French.

At the end of the fiscal year there were in the hands of the King's Printer four English reports and one French translation of the Geological Survey, seven English reports of the Mines Branch, and one English report of the Explosives Division. Several reports, also, were being edited preparatory to dispatch for printing, and several French translations are now nearly ready for the printer.

The following list includes the publications issued by the various branches of the Department during the fiscal year, under the supervision of the Editor-in-Chief, and the French publications distributed¹ during that period:

DEPARTMENT OF MINES

Report
No.

English Publications

2142. *Report of the Department of Mines for the Fiscal Year ending March 31, 1927*: 59 pages; 3,000 copies; published January 31, 1928.
- Canada: Geology, Mines, and Metallurgical Industries* (Handbook for the Second Empire Mining and Metallurgical Congress)—by Wyatt Malcolm and A. H. A. Robinson; 214 pages; 40 plates; 16 maps; 2,500 copies; published June 20, 1927.
- Department of Mines: Some of the Services it Performs* (Pamphlet reproducing a series of twelve advertisements relating to the Department of Mines); 17 pages; 12 plates; 2,000 copies; published July 15, 1927.

French Translations

2123. *Rapport du Ministère des Mines pour l'année se terminant le 31 mars, 1926*; 83 pages; 1,200 copies; published August 26, 1927.
2148. *Rapport du Ministère des Mines pour l'année se terminant le 31 mars, 1927*; 63 pages; 1,250 copies; published March 29, 1928.

GEOLOGICAL SURVEY

English Publications

2115. *Memoir 151. Geological Series 132. Minto Coal Basin, N.B.*—by W. S. Dyer; 42 pages; 3 figures; 2 maps; 2,500 copies; published May 2, 1927.
2118. *Summary Report of the Geological Survey, Department of Mines, for the Calendar Year 1926, Part C*; 175 pages; 3 plates; 14 figures; 4 maps; 3,500 copies; published July 7, 1927.
- Separate: *Destor Area, Que.*—by B. S. W. Buffam; 105 pages; 1 plate; 3 figures; 1 map; 306 copies; published September 14, 1927.
2120. *Memoir 152. Geological Series 133. St. Urbain Area, Charlevoix District, Que.*—by J. B. Mawdsley; 58 pages; 2 plates; 9 figures; 1 map; 2,000 copies; published June 9, 1927.

¹ The distribution of English publications was made as usual by the branches that prepared them.

Report
No.

2121. Memoir 153. Geological Series 134. *Banff Area, Alberta*—by P. S. Warren; 94 pages; 7 plates; 1 figure; 1,800 copies; published August 29, 1927.
2125. Bulletin 46. Geological Series 47. *Contributions to Canadian Mineralogy and Petrography*—by E. Poitevin, H. C. Cooke, and H. C. Gunning; 45 pages; 3 plates; 10 figures; 1,500 copies; published September 24, 1927.
2127. *Summary Report of the Geological Survey, Department of Mines, for the Calendar Year 1926, Part B*; 57 pages; 4 figures; 3,000 copies; published April 7, 1927.
2131. Economic Geology Series 4. *Arsenic-bearing Deposits in Canada*—by M. E. Hurst; 181 pages; 21 figures; 2,500 copies; published September 24, 1927.
2135. *Summary Report of the Geological Survey, Department of Mines, for the Calendar Year 1926, Part A*; 60 pages; 1 plate; 2 figures; 1 map; 3,000 copies; published September 13, 1927.
2136. *Summary Report of the Geological Survey, Department of Mines, for the Calendar Year 1926, Part C*; 143 pages; 1 plate; 21 figures; 1 map; 3,000 copies; published December 5, 1927.

French Translations

2122. Mémoire 144. Série géologique 128. *La région cartographiée du mont Albert, Québec*—by F. J. Alcock; 79 pages; 6 plates; 5 figures; 1 map; 1,000 copies; published September 15, 1927.
2126. *Rapport sommaire de la Commission géologique, Ministère des Mines, pour l'année civile 1924, Partie C* (extraits); 50 pages; 2 plates; 3 figures; 3 maps; 1,000 copies; published September 8, 1927.
2139. *Rapport sommaire de la Commission géologique, Ministère des Mines, pour l'année civile 1925, Partie C* (extraits); 124 pages; 1 plate; 4 figures; 4 maps; 1,000 copies; published March 31, 1928.

NATIONAL MUSEUM OF CANADA

2133. Museum Bulletin 48. Biological Series 13. *A Study of Buteo borealis, the Red-tailed Hawk, and Its Varieties in Canada*—by P. A. Taverner; 20 pages; 3 plates; 1 figure; 1,000 copies; published December 16, 1927.

MINES BRANCH

English Publications

671. *Investigations of Fuels and Fuel Testing, 1925*; 184 pages; 7 plates; 17 figures; 4,000 copies; published October 27, 1927.
- Separates:
Examination of Typical Cokes Sold in Canada as Household Fuels—by R. E. Gilmore, C. B. Mohr, and others; 27 pages; 2 plates; 1 figure; 1,500 copies; published August 31, 1927.
Tests of Various Fuels made in a Domestic Hot-water Boiler at the Fuel Testing Station in Co-operation with the Dominion Fuel Board—by C. S. Malloch and C. E. Baltzer; 30 pages; 6 figures; 1,000 copies; published August 14, 1927.
Low-temperature Carbonization of Bituminous Coals—by R. A. Strong; 41 pages; 4 plates; 5 figures; 500 copies; published August 31, 1927.
Analyses of Solid Fuels—by J. H. H. Nicolls; 31 pages; 500 copies; published August 14, 1927.
673. Abrasives, Part I: *Siliceous Abrasives*—by V. L. Eardley-Wilmot; 119 pages; 14 plates; 8 figures; 4,000 copies; published September 2, 1927.
675. Abrasives, Part II: *Corundum*—by V. L. Eardley-Wilmot; 51 pages; 5 plates; 6 figures; 4,000 copies; published May 30, 1927.
677. Abrasives, Part III: *Garnet*—by V. L. Eardley-Wilmot; 69 pages; 4 plates; 19 figures; 4,000 copies; published May 27, 1927.
Pamphlet: *Experimental Ore Testing and Research Laboratories*—by W. B. Timm; 9 pages; 3,000 copies; published June 10, 1927.
682. *Preliminary Report on Limestones of Quebec and Ontario*—by M. F. Goudge; 75 pages; 16 plates; 3 figures; 4,000 copies; published August 1, 1927.
684. *Use of Alberta Bituminous Sands for Surfacing of Highways*—by S. C. Ells; 37 pages; 5 plates; 10 figures; 4,000 copies; published July 13, 1927.
Canadian Shale Oil and Tar Sand Bitumen as Sources of Gasoline by Pressure Cracking—by R. E. Gilmore; 8 pages; 500 copies; published July 16, 1927.

Lists of Mines and Mine Operators in Canada:

- Natural Gas and Petroleum Wells; 1,500 copies; published July 20, 1927.
 Asbestos; 1,000 copies; published June 11, 1927.
 Cement Mills; 500 copies; published June 7, 1927.
 Sand-Lime Brick Plants; 500 copies; published June 7, 1927.
 Lime Kilns; 1,000 copies; published June 21, 1927.
 Sand and Gravel Deposits; 1,000 copies; published July 19, 1927.
 Stone Quarry Operators; 1,000 copies; published July 18, 1927.
 Metallurgical Works; 1,000 copies; published July 9, 1927.
 Milling Plants; 1,500 copies; published August 1, 1927.
 Feldspar; 1,000 copies; published July 26, 1927.
 Graphite; 1,000 copies; published July 23, 1927.
 Mica; 1,000 copies; published August 1, 1927.
 Copper and Nickel-Copper; 1,500 copies; published July 7, 1927.
 Silver-Lead-Zinc; 1,500 copies; published July 30, 1927.
 Gypsum; 1,000 copies; published August 1, 1927.
 Salt Wells and Mines; 1,000 copies; published July 20, 1927.
 Talc and Soapstone; 1,000 copies; published July 19, 1927.
 Gold; 1,500 copies; published August 18, 1927.
 Silver; 1,500 copies; published August 11, 1927.
 Quartz; 1,000 copies; published August 6, 1927.
 Producers of Miscellaneous Non-Metallic Minerals; 1,000 copies; published March 12, 1928.

Report
No.

French Translations

685. *Recherches touchant les Ressources minérales et l'Industrie minière, 1924* (extraits); 72 pages; 4 figures; 1,200 copies; published March 19, 1928.

DOMINION FUEL BOARD

English Publications

8. *Why You Should Insulate Your Home*—prepared by G. D. Mallory, for the Dominion Fuel Board; 15 pages; 7 drawings; 25,000 copies; published August 4, 1927.
 Reprint of No. 8: 25,000 copies; published in January, 1928.
Instructions for Burning Coal, Coke, and Peat; 14 pages; 2 figures; 100,000 copies; published September 17, 1927.
Regulations Pertaining to the Domestic Fuel Act; 8 pages; 250 copies; published October 31, 1927.
Agreement and Regulations; 8 pages; 100 copies; published November 19, 1927.

French Translations

9. *Avantages de l'Isolation thermique de votre Maison*; 16 pages; 7 drawings; 5,000 copies; published January 5, 1928.
Instructions pour le Chauffage au Charbon, au Coke et à la Tourbe; 11 pages; 2 figures; 25,000 copies; published January 9, 1928.

EXPLOSIVES DIVISION

English Publications

21. *Annual Report of the Explosives Division of the Department of Mines for the Calendar Year 1926*; 23 pages; 2,000 copies; published May 5, 1927.
Storage of Explosives; Reprint: 21 pages; 5,000 copies; published July 6, 1927.
Beware of Detonators; 4 pages; 1 plate; 20,000 copies; published July 9, 1927.

French Translations

22. *Rapport annuel de la Division des Explosifs du Ministère des Mines pour l'année civile 1926*; 24 pages; 1,000 copies; published August 12, 1927.
Méfiez-vous des détonateurs; 4 pages; 1 plate; 5,000 copies; published July 9, 1927.

DISTRIBUTION OF FRENCH PUBLICATIONS

The French publications of the Department of Mines, including those of the Geological Survey, the Mines Branch, and the Explosives Division, are distributed by the Editorial Division of the Department, the distribution being under the direct supervision of P. E. Levesque, who is also in charge of the translation section of the Editorial Division. During the fiscal year 1927-28, 14,928 copies were distributed in Canada and foreign countries, as follows: 3,251 to addresses on the mailing lists, through the Printing Bureau Distribution Office; 4,677 copies in compliance with written or personal requests, distributed from our distribution office; and approximately 7,000 copies of the pamphlet on "Instructions for Burning Coal, Coke, and Peat" to coal dealers. This distribution does not include, however, the publications sent by the Dominion Fuel Board and the Explosives Division to their correspondents.

Table with columns for 'Number of copies', 'Value', and 'Description of publications'. The table lists various publications such as 'Rapport sur le combustible', 'Les mines canadiennes', and 'Instructions for Burning Coal, Coke, and Peat', along with their respective copy counts and values.

ACCOUNTING DIVISION

ACCOUNTANT'S STATEMENT

P. R. Marshall

The funds available for the work and the expenditure of the Department of Mines for the fiscal year ending March 31, 1928, were:

	Grant	Expenditure	
		Amount	Total
	\$ cts.	\$ cts.	\$ cts.
DEPARTMENT—			
Amount voted by Parliament.....	106,169 00		
Civil Government salaries.....		75,035 00	
Grant to Imperial Institute.....		12,848 00	
Expenses of Explosives Division.....		9,912 00	
Civil Government contingencies.....		5,172 40	
Grant to Canadian Institute of Mining and Metallurgy.....		3,000 00	
			105,967 40
Balance unexpended and lapsed.....			201 60
GEOLOGICAL SURVEY—			
Amount voted by Parliament.....	644,780 00		
Civil Government salaries.....		298,456 86	
Explorations, surveys, and investigations.....		189,669 30	
Publication of reports and maps.....		47,868 66	
Wages.....		19,743 41	
Sundry printing and stationery.....		18,292 08	
Museum equipment.....		15,000 00	
Miscellaneous.....		10,454 48	
Compassionate allowance.....		3,000 00	
Instruments and repairs.....		2,696 89	
Photographic supplies.....		1,954 60	
Specimens for Museum.....		1,925 76	
			600,062 04
Balance unexpended and lapsed.....			35,717 96
MINES BRANCH—			
Amount voted by Parliament.....	504,493 88		
Civil Government salaries.....		180,878 65	
Expenses of fuel testing plant and laboratory.....		69,914 19	
Operation of peat plant, Alfred, Ont.....		64,128 80	
Expenses of ore dressing and metallurgical laboratories.....		40,368 37	
Investigation of mineral resources and deposits.....		27,104 80	
Chemical laboratories.....		19,394 66	
Expenses of Dominion Fuel Board.....		16,705 43	
Printing and stationery.....		27,575 05	
Wages.....		13,721 16	
Miscellaneous.....		2,590 58	
Compensation to J. H. Fortune for quarters, etc.....		400 00	
Miscellaneous gratuity.....		168 88	
Advances 1927-28 to be accounted for in 1928-29.....		1,300 00	
			464,250 57
Balance unexpended and lapsed.....			40,243 31
DOMINION OF CANADA ASSAY OFFICE—			
Amount voted by Parliament.....	26,000 00		
Earnings.....	133 50		
Salaries of staff.....		20,285 00	
Assayers' supplies.....		1,466 42	
Contingencies.....		1,043 41	
Premium on bonds.....		462 50	
Electric burglar alarm service.....		360 00	
			23,597 33
Balance unexpended and lapsed.....			2,536 17
	1,281,576 38		1,281,576 38

ANNUAL REPORT

Summary

	Grant		Expenditure		Grant not used	
	\$	cts.	\$	cts.	\$	cts.
Civil Government salaries.....	578,025	00	559,542	91	18,482	09
Department.....	25,849	00	25,760	00		89 00
Geological Survey.....	338,000	00	310,605	18	27,394	82
Mines Branch.....	313,400	00	283,203	04	30,196	96
Dominion of Canada Assay Office, Vancouver, B.C.....	\$26,000	00				
Earnings.....		133 50				
Miscellaneous gratuities.....	26,133	50	23,597	33	2,536	17
	168	88	168	88		
	1,281,576	38	1,202,877	34	78,699	04

Casual Revenue

Sales of equipment, explosives permits, publications, etc.....	\$3,790 88
Fines for violation of Explosives Act.....	205 00
Gold bullion recovered from residue.....	\$ 712 23
Less loss on gold bullion.....	59 80
Arrears from 1926-27.....	652 43
Miscellaneous.....	432 32
	111 40
	<u>\$5,192 03</u>

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