

DOMINION OF CANADA

REPORT OF THE DEPARTMENT  
OF  
MINES AND RESOURCES

FOR THE

FISCAL YEAR ENDED MARCH 31, 1946



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OTTAWA  
EDMOND CLOUTIER, C.M.G., B.A., L.Ph.,  
KING'S PRINTER AND CONTROLLER OF STATIONERY

1947

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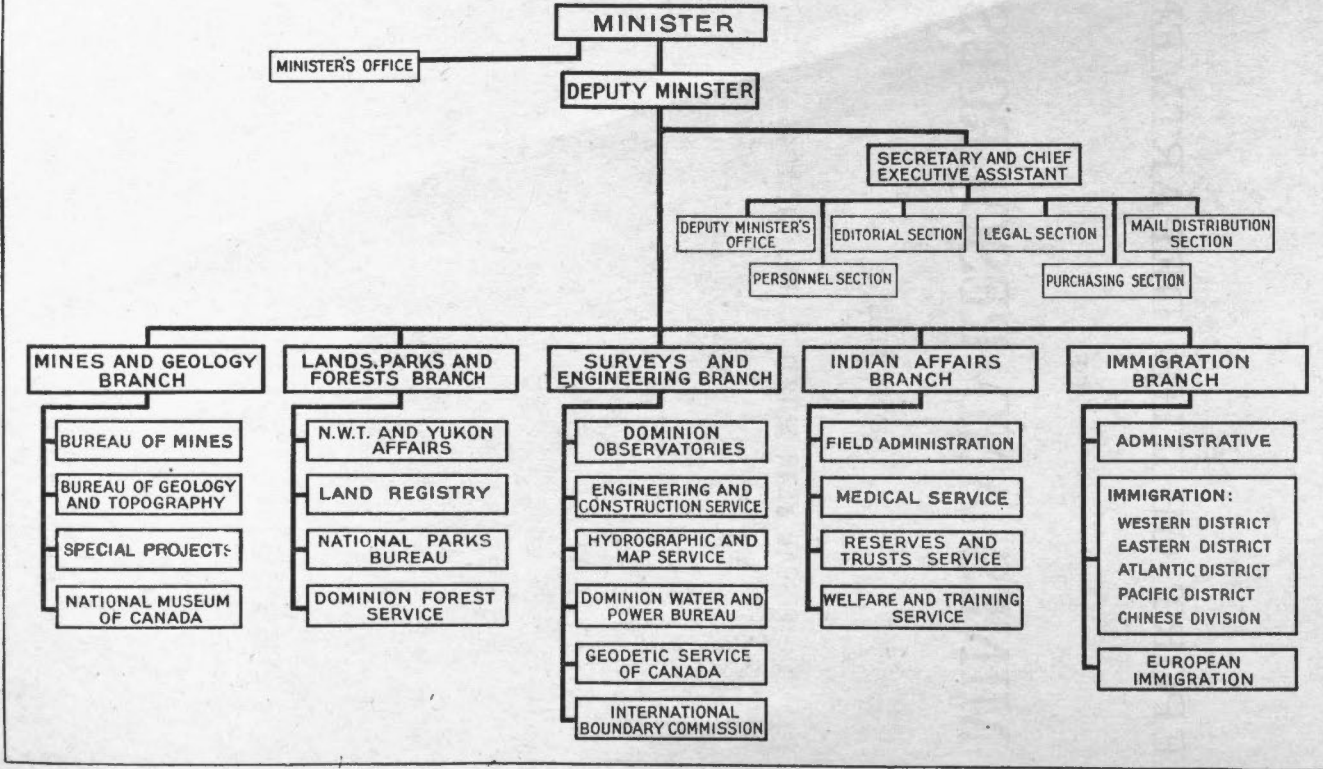
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**DEPARTMENT OF MINES AND RESOURCES**



Organization Chart, Department of Mines and Resources

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REPORT  
OF THE  
DEPARTMENT OF MINES AND RESOURCES  
FOR THE FISCAL YEAR ENDED  
MARCH 31, 1946

To His Excellency Field Marshal the Right Honourable Viscount Alexander  
of Tunis, G.C.B., G.C.M.G., C.S.I., D.S.O., M.C., LL.D., A.D.C., Governor  
General and Commander-in-Chief of the Dominion of Canada.

MAY IT PLEASE YOUR EXCELLENCY:

The undersigned has the honour to lay before Your Excellency the Annual  
Report of the Department of Mines and Resources for the fiscal year ended  
March 31, 1946.

Respectfully submitted,

J. ALLISON GLEN,  
Minister of Mines and Resources.

The following table shows the results of the  
of the Department of Health and Education  
of the Department of Health and Education  
of the Department of Health and Education  
of the Department of Health and Education

Respectfully submitted,  
L. J. [Name]  
Director of Health and Education

**REPORT**  
of the  
**DEPARTMENT OF MINES AND RESOURCES**  
**FOR THE FISCAL YEAR ENDED**  
**MARCH 31, 1946**

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The Honourable J. ALLISON GLEN,  
Minister of Mines and Resources,  
Ottawa.

SIR,—I have the honour to submit the Tenth Annual Report of the Department of Mines and Resources.

The financial statement for the year shows a continuation of the upward trend in departmental revenues, and a sharp decrease of over \$3,000,000 in total expenditures. The latter was attributable to the cessation of certain war-time projects and to the transfer to the Department of National Health and Welfare of responsibility for the health of Indians and Eskimos. The resumption of peace-time activities and adjustments in staff resulted in a slight increase in the number of persons employed by the Department during 1945-46 as compared with the previous fiscal year.

Industries related to the development and utilization of our mineral, forest and water-power resources compiled a record of fine achievement under the stress of war. Intimately connected with this great effort were the various services of the Department which made an outstanding contribution in the testing and development of materials and processes and the production of secret components of equipment for the armed services of Canada and other Allied Nations.

Increased attention was given to normal peace-time activities with emphasis on matters affecting services rendered to industry. Full use was made by governmental and industrial agencies of the complete laboratory equipment available for research in physical metallurgy, forest products, ore dressing, fuel testing, and industrial minerals. Additional facilities at present in course of provision and under consideration will enable the department to extend its services to Canadian industry.

Marked progress was made during the year toward the fuller development and conservation of the resources of the Northwest and Yukon Territories. There was a distinct increase in mining and prospecting activity in the Mackenzie District and the decision of the Government to provide an additional supply of hydro-electric power for the Yellowknife area will have a stimulating effect on development and production. A substantial increase in the number of tourists entering the National Parks was recorded.

Geological, geodetic, topographical, hydrographic, water-power and other surveys and investigations were carried on in the Northwest Territories and in other parts of the Dominion as part of the plan of providing full and accurate information and maps and improved transportation facilities for the orderly development and utilization of the country's natural resources.

Reports from the various Indian Agencies indicate that these wards of the Government continued to benefit from the generally prosperous conditions still prevailing. Indians engaged in hunting and fishing reported good returns and employment of Indians in industry remained at a high level.



Immigrants entering Canada reached over 31,000, nearly double the number admitted in the previous fiscal year. The admission from the British Isles of more than 16,000 dependents of members of the overseas Armed Forces and about 6,000 United States citizens was largely responsible for the increase. More than 1,700 persons availed themselves of the provision of the Order in Council dealing with refugees from enemy or enemy-occupied countries who entered Canada as such after the start of the war.

After forty-two years in the public service, during which he added lustre to the position of administrative head of the Department and to his name, Dr. Charles Camsell, C.M.G., has retired from the position of Deputy Minister. He began his leave on January 1 as a preliminary to his superannuation on July 1, 1946.

Departmental revenues and expenditures during 1945-46 are summarized in the following table:

SUMMARY OF REVENUES AND EXPENDITURES FOR THE FISCAL YEAR 1945-46

	Revenue	Expenditures	
		Ordinary	Special including War
<i>Administrative Offices</i> .....	\$ 160,089 72	\$ 13 10	\$ 160,162 82
<i>Mines and Geology Branch—</i>			
Branch Administration.....		29,575 77	
Bureau of Mines.....	28,515 21	455,595 99	
Bureau of Geology and Topography..	5,142 57	768,047 47	
National Museum of Canada.....		50,053 95	
War-Miscellaneous.....	19,216 24		1,706,646 00
	\$ 52,874 02 <sup>1</sup>	\$ 1,303,273 18	\$ 1,706,646 00
			\$ 3,009,919 18 <sup>2</sup>
<i>Lands, Parks and Forests Branch—</i>			
Branch Administration.....		19,771 18	
Northwest Territories.....	321,476 40 <sup>3</sup>	926,013 24	3,730 42
Yukon Territory.....	87,653 31	66,284 61	
Dominion Forest Service.....	29,609 99	361,721 69	170,476 77
Land Registry.....	203,877 55 <sup>4</sup>	98,094 53	36,896 15
National Parks Bureau.....	307,768 64	1,262,207 29	287,906 74
	\$ 950,405 89	\$ 2,734,092 54	\$ 499,010 08
			\$ 3,233,102 62
<i>Surveys and Engineering Branch—</i>			
Branch Administration.....	\$ 9 40	\$ 20,163 23	\$ 611 99
Dominion Observatories.....		127,024 68	14,227 44
Dominion Water and Power Bureau..	146,048 57	274,130 61	15,072 75
Geodetic Service.....	417 61	120,656 81	158,303 83
International Boundary Commission.	40 57	32,885 68	
Engineering and Construction Service.	864 11	92,480 01	415,558 91
Hydrographic Service.....	17,849 28	403,604 63	14,384 85
Legal Surveys and Map Service.....	24,748 13	253,538 18	130,067 49
	\$ 189,977 67	\$ 1,323,483 83	\$ 748,227 26
			\$ 2,071,711 09
<i>Indian Affairs Branch—</i>			
Branch Administration.....		50,029 75	
Indian Agencies—Administration....	3,468 73	871,865 66	
Reserves and Trusts—Administration	928 80	42,682 96	104,188 07
Welfare of Indians.....	6,644 48	912,259 37	
Indian Education.....	3,041 63	2,298,320 69	
Miscellaneous Statutory Items—(Annuities and Pensions).....	56 50	294,341 66	
Miscellaneous Revenue—not including revenue accruing to Indian Band funds.....	4,064 22		
	\$ 18,204 36	\$ 4,469,500 09	\$ 104,188 07
			\$ 4,573 688 16

SUMMARY OF REVENUES AND EXPENDITURES FOR THE  
FISCAL YEAR 1945-46—*Con.*

<i>Immigration Branch—</i>	Revenue	Ordinary	Expenditures	
			Special, including War	Total Expenditures
Administration of the Immigration Act and the Chinese Immigration Act.....	\$	172,156 70		
Field and Inspectional Service—				
Canada.....		1,237,706 97		
Field and Inspectional Service—				
Abroad.....		113,331 98		
Miscellaneous Statutory Items.....		840 00		
War—Miscellaneous.....	184,640 72		562,001 26	
Miscellaneous Revenue.....	7,568 86			
	<u>\$ 192,209 58</u>	<u>\$ 1,524,085 65</u>	<u>\$ 562,001 26</u>	
				<u>\$ 2,086 086 91</u>
Totals for Department.....	<u>\$ 1,403,671 52</u>	<u>\$11,514,525 01</u>	<u>\$3,620,085 77</u>	<u>\$15,134,610 78</u>

NOTES—

- <sup>1</sup> Includes repayment of loans, plus interest, from the War Appropriation; and revenue from sale of equipment, supplies, and materials purchased from the War Appropriation.
- <sup>2</sup> In addition to this amount there was expenditure by the Branch from funds made available from the War Appropriation by other Departments, a sum of \$194,873.04.
- <sup>3</sup> Amounts received from profits on sale of liquor and for liquor fines in the Northwest Territories are not included but are deposited to the Trust Account—Liquor Profits—N.W.T. The credit balance in that account at the close of the fiscal year was \$419,251.77.
- <sup>4</sup> Includes \$45,435.70 to offset similar amount reported as expenditure and covering amounts written off during year from outstanding advances for Seed Grain and Relief.

Your obedient servant,

C. W. JACKSON,  
for Deputy Minister.

## MINES AND GEOLOGY BRANCH

W. B. TIMM, DIRECTOR

This report marks the end of one chapter in the history of the Branch and the commencement of another—the closing phases of a notable contribution to the war effort and the opening phases of a return to peace-time activities. The war record of the Branch like that of the mining, the metallurgical, and the closely related industries it serves is replete with achievements made under pressure of great urgency where failure or only partial success would have greatly handicapped the Canadian war effort.

Faced at the commencement of the war with a task of largely unpredictable magnitude, beyond the knowledge that production would need to far exceed any previous level to meet the requirements, the mineral industry accomplished its purpose under the most trying conditions. As evidence of its impressive production record it may be noted that during 6 years of war Canada produced nickel, copper, lead, and zinc to a total value of approximately a billion dollars. It produced about 816,000 tons of nickel, 1,800,000 tons of copper, 1,600,000 tons of zinc, and 1,300,000 tons of lead. In 1942, the peak production year, Canada's total output of the four metals was ten times greater than in 1921. To help meet the needs of war, Canada also produced a total of 105,000,000 tons of coal, 2,600,000 tons of asbestos, 57,813,000 barrels of crude petroleum, 5,500,000 tons of gypsum, 3,410,000 tons of salt, and clay products and other structural materials valued at \$259,000,000. It produced all the sodium sulphate needed by Canadian industries and shipped large tonnages abroad. For domestic use, but mostly for use in the United States, it produced high quality mica, indispensable for electrical and other uses. It produced fluor spar, graphite, brucite, nephelene syenite, talc, sulphur, barite, quartz, and several other minerals in varying quantities.

The urgent need for production, combined with labour shortages and other wartime factors made it necessary for the industry to largely forego the orderly maintenance of underground development work. Following the end of the war, however, this work was resumed and by the end of the fiscal year much headway had been made by the larger base metal producers toward the strengthening of their ore reserves positions.

When the war ended there was considerable concern as to the immediate outlook for the industry, but within a few months it became readily apparent that for most products of the mines it would be difficult to meet the steadily increasing demand. A temporary world shortage of such metals as copper, lead, zinc, tin, and antimony had developed owing largely to curtailed production attributable to various factors, increased demands for rehabilitation purposes in the war-torn areas, and to the increased demands for consumer, capital, and other goods. At the close of the fiscal year there appeared to be every indication that the demand for most of the base metals would exceed the supply throughout 1946 at least, and probably well into 1947.

Immediately after the end of the war the outlook for the gold industry began to improve and this improvement was maintained during the remainder of the fiscal year. Production of the metal had shown a steady decline since 1941, the peak year. In the meantime, however, exploratory work on gold prospects in areas throughout Canada had been steadily increasing and by the close of the fiscal year several of these prospects had been explored to a stage that warranted the consideration of plans for production.

At the close of the year producers of the non-metallic minerals were also finding it difficult to keep pace with the demand for their products and most of them were operating to the full capacity of their available manpower. The demand for the clay products and other structural materials was especially strong, and in view of the many housing and other building projects underway, a high level of production of these minerals is likely to continue indefinitely.

As this report closes out the war work of the Branch and because of the interest in the subject, summarized statements of this work as it relates to the Bureau of Geology and Topography, the Bureau of Mines, the National Museum of Canada, and the Special Mineral Projects Division are given in the sections dealing with the activities of those units of the Branch.

Brief reference was made in preceding annual reports to the production by the Branch of a secret component of naval equipment. As this operation was one of the more important contributions of the Branch toward the war effort, and as there is less reason than formerly for secrecy in regard to general aspects of the operation, a summarized account of it follows.

In December 1940 the Department of National Defence (Naval Service) asked the Branch to undertake on a commercial scale the production of a major component of secret anti-submarine equipment. This equipment was in use in the British Navy and it was necessary to equip all Canadian Naval units with similar types. Space was provided by the Branch and equipment was set up in the Bureau of Mines. The work was altogether new to Canada and methods of procedure had to be devised, special machines designed and built, and personnel trained. Besides, all employees had to be carefully chosen owing to the secrecy of the work, and each person before being employed was thoroughly investigated by the R.C.M.P.

The nucleus of an operating staff was trained at the National Research Council where preliminary operations had been carried on. Production at the Bureau of Mines was commenced in May 1941, and was continued there until October 1942, with a peak staff during the period of about forty employees.

In May 1942 the Naval Service, which had been doing the assembly of the final units, asked the Branch to take over that part of the work as well, and at the same time to quadruple production of the component in order to meet expanding Canadian requirements and a part of Britain's needs. A larger building was necessary to house the expanding operations and this was obtained in Renfrew, Ontario. It was remodelled to meet the requirements and operations were transferred there in November 1942.

The unit was operated as a commercial plant, filling orders placed by the Department of Munitions and Supply on behalf of the Naval Service and of the British authorities. Operations reached a peak in 1944 with a staff of over two hundred and with a value of production in excess of \$100,000 a month. Total value of production to the end of March 1946 was well in excess of \$3,000,000. With the end of the war, production was drastically cut and plans at the close of the fiscal year envisaged a very small continuing operation at the Bureau of Mines. The use of the component played a vitally important rôle in the transportation of personnel and supplies from the North American Continent and was an important factor in assisting to win the battle of the Atlantic.

Well before the end of the war increasing attention, within such limits as conditions warranted, was being given by the Branch to activities of a peacetime nature, and this was further in evidence during the fiscal year 1945-46. In the Physical Metallurgy Research Laboratories, for instance, increasing emphasis was placed on matters affecting the services that can be rendered to foundrymen and to manufacturers of metal products. The Laboratories are well equipped

for such services and the industries concerned have been making full use of them. By the close of the year work on the installation of equipment in a special laboratory for rolling, extrusion, and die-casting operations was well advanced.

In the Ore Dressing Laboratories there was more test work on gold ores than for several years past, though the number of investigations on such ores was still far below the pre-war level. Much of the test work on gold ores in 1945-46 was on samples from properties in the Yellowknife area, Northwest Territories.

Most of the research and investigative work on fuels related to problems of peacetime concern. Senior fuel engineers of the Branch acted in an advisory and consulting capacity to the Royal Commission on Coal. This work involved several field studies and the preparation of reports based thereon, and included extensive field investigations in Canada and the United States to assess the situation in reference to the possibility of producing synthetic liquid fuels in Canada. Establishment of a proposed hydrogenation pilot plant and laboratory was postponed awaiting a report by a committee appointed to advise on the feasibility of establishing the plant. This report was under consideration at the close of the year. A project for a modern central cleaning and preparation plant in the Minto area of New Brunswick gave rise to a series of special large scale laboratory washing tests on representative mine samples, and a comprehensive report was distributed to the interested parties. The work was undertaken at the request of the Provincial Government.

Industrial minerals have been playing an increasingly important rôle in the national economy, especially in view of the huge housing and other constructional projects under way or contemplated. Work on industrial minerals in the Branch has accordingly been designed to give the industry every advantage of the benefits of research in this field of endeavour. Complete laboratory facilities are available for evaluating, processing, and beneficiating industrial minerals, and for investigating new ways of using them. Of special interest was an investigation that was completed during the year with the purpose of finding the most suitable ceramic bond for use in making refractory brick from granular magnesia obtained from brucitic limestone by a process developed in the Branch. Conclusive and highly satisfactory results were obtained as to the type of bond best suited for the purpose.

In its surveys and studies relating in general to the economics of mining the Branch gave special attention to contributions that mining can make to post-war reconstruction. Studies were made for Government use on the post-war labour requirements of Canadian mines; on the probable duration of mining operations in western Quebec in connection with the amortization period for housing loans; and on the iron ore situation in Canada.

A function of the Branch is the administration of the Explosives Act and of regulatory measures related thereto. To bring the Act into line with present day requirements and to remedy defects revealed by experience in its administration, a proposed revision was drawn up which received first reading in the Senate on March 20, 1946. Production of military explosives having ended, it was necessary for the Branch to assist in desensitizing buildings and equipment and to give attention to the disposal of surplus explosives. By the end of the fiscal year this work was nearing completion.

W. E. Campbell was appointed Chief Inspector of Explosives on April 24, 1945, in succession to F. E. Leach, who had retired on superannuation.

As the war was still in progress at the time, geological field work was again designed to give maximum assistance in the discovery and development of oil and strategic minerals. Thirty-four parties were active in investigating and mapping areas of possible and proved economic importance. Standard geological mapping on scales of either 1 or 4 miles to the inch was done in sixteen areas and

detail mapping was continued in four areas in western Quebec; in the vicinity of the Flin Flon and Mandy mines in Manitoba and Saskatchewan; and in the vicinity of Port Radium on Great Bear Lake.

A total of 4,500 mineral specimens were submitted to the Geological Survey for examination as to the commercial possibilities, and 2,363 mineral and rock collections, comprising close to 90,000 specimens, were prepared and distributed to the public.

Among the publications issued by the Geological Survey was a geological map of Manitoba on a scale of 20 miles to an inch. A companion map on the same scale shows all known mineral occurrences in that province.

Thirteen topographical parties were engaged in field work. About twenty-five personnel taken on the staff of the Topographical Survey were being trained in compilation from air photography.

The National Museum of Canada was enriched by much valuable information and by numerous specimens relating to archæology, biology, and folk-lore as a result of its field work in the Alaska Highway and southwestern Yukon areas, in Quebec, New Brunswick, British Columbia, and Alberta. In an archæological reconnaissance along parts of the Alaska Highway traces of a prehistoric migration route from Siberia into northwest America was found, which on geological evidence is believed to be about 8,000 years old.

R. M. Anderson, Chief of the Biological Division of the National Museum, retired on superannuation on December 30, 1945, and A. L. Rand was placed in temporary charge of the Division.

As noted in the section immediately following, no new special mineral projects were undertaken.

Since its establishment the Branch has endeavoured to maintain its services at a level commensurate with the changing and increasing needs of the mining and metallurgical industries. Its facilities have been extended from time to time to meet the requirements. Present indications are that the demand for its various services will continue to increase, especially in view of the likely expansion in the mining and related industries. This expansion is handicapped at present by labour and other shortages and to an extent by unsettled world conditions in general. It will be greatly aided, however, by the full use by industry of the benefits of science, and it is this service that the Branch is in a position to provide. Much consideration has already been given to the future needs of industry and to the extensions to services that are required. These extensions comprise the following main features in outline:

(1) In an expanded program of resources development it is planned to increase topographical surveys and mapping to three times the pre-war level. The staff of the Geological Survey will need to be increased to at least three times its present size over the period of the next several years.

(2) Mineral dressing services should be extended to keep pace with the expansion of mining, and attention should be directed largely toward working out improvements in treatment methods so as to enable the use of lower grade and complex ores.

(3) In extractive metallurgy, a program of research should be initiated on the ores of the rare metals, the future importance of which was indicated during the war, and which are available in Canada for development.

(4) In physical metallurgy there are several problems that must be overcome in connection with the use of the lighter metals and materials and of new alloys of metals for which wide fields of peace-time applications have been opened up.

(5) Modern metallurgy calls for refractory ceramic materials that will withstand much higher temperatures than formerly, indicating the necessity for research on the development of these materials.

(6) Owing to changing conditions in the coal situation more emphasis on coal preparation problems and on scientific research will undoubtedly be advisable.

Canada's dependence upon outside sources for much the greater part of its crude petroleum requirements makes it advisable that research be done on the production of synthetic fuels from such raw materials as bitumen, heavy well petroleum, natural gas, and coals.

(7) A systematic inventory of Canada's mineral resources. This is already in progress. Though the provinces collect the information on their respective mineral resources, the Dominion must have the overall picture for determining such matters as markets, export trade, and employment.

Accounts of the activities of the various units of the Branch follow.

## SPECIAL MINERAL PROJECTS DIVISION

### RÉSUMÉ OF WAR ACTIVITIES

This résumé, is followed by an account of the Division's activities during the fiscal year 1945-46.

As this Division was set up specifically to administer funds provided from the War Appropriation for exploration and development work in connection with the supply of strategic minerals, for investigation of petroliferous deposits, etc., all of its activities related to the war work of the Mines and Geology Branch.

Projects carried out through the Division have been detailed in the Annual Reports of the Department since 1943. They cover a wide range and fall under the following general headings:

1. Loans to producers of strategic minerals.
2. Exploratory drilling of strategic mineral deposits.
3. Development work in tungsten mines.
4. Geophysical surveys for oil.
5. Oil shales investigation, New Brunswick.
6. Bituminous sand investigation, northern Alberta.
7. Transportation facilities to strategic mineral properties.
8. Miscellaneous.

Financial assistance in the form of loans recoverable out of proceeds from the sale of ore produced was extended to two operators of chromite properties near St. Cyr, Quebec; to four operators of fluorspar properties in the Madoc area, Ontario; and to two operators of placer scheelite claims near Mayo, Yukon. A total of \$232,255 was loaned, and \$189,573 had been repaid to the Receiver General of Canada by March 31, 1946. Chromite production during the period of the loan agreements amounted to 20,322 long tons of concentrates, 912 long tons of lump ore, and 500 long tons of magnetic rejects. Metallurgical grade fluorspar to the total of 24,335 tons had been produced up to March 31, 1946, by operators in receipt of Government loans. Production of tungsten concentrates from the two assisted properties in Yukon amounted to 4,935 pounds.

Exploration of strategic mineral deposits included drilling for molybdenite, tin, tungsten, and zinc in British Columbia; for tin in Manitoba; for manganese in New Brunswick and Nova Scotia; for fluorspar in Ontario; and for molybdenite in Quebec. Except in the case of fluorspar, no production resulted as the deposits explored were of a marginal character, though some orebodies were outlined or indicated. The work was done by drilling contractors under supervision of officers of the Branch. Total footage drilled was 34,540 feet.

Development work was done at several tungsten properties in Nova Scotia, under supervision of Provincial Government officers, costs being defrayed by the Dominion. From one of the properties, the Moose River mine, 7,036 pounds of high-grade, and 84,880 pounds of low-grade, scheelite ore was recovered. Net expenditure was approximately \$36,500.

In 1944 Heiland Exploration Company of Shreveport, Louisiana, carried out for the Branch a seismic survey in and near Buffalo National Park, Wainwright, Alberta, and two possible oil-bearing structures were outlined. In the same year a survey with torsion balance and magnetometer was made in New Brunswick to assist in the location of sites for exploratory oil wells; the services of an officer of the Dominion Observatory staff were obtained for this work.

A complete investigation of the oil-shales of Albert and Westmorland counties, New Brunswick, including extensive diamond drilling and assaying of samples, was conducted in 1942 under an agreement with the Provincial Government. One-fourth of the cost was borne by the Province and three-fourths by the Dominion. In the Albert Mines area 100,000,000 tons of oil shale was indicated, but the oil content of 10.6 gallons to the ton was considered too low to warrant commercial development of the shales.

Probably the greatest public interest has been centred on development of the bituminous sand deposits in northern Alberta. Investigations of the deposits had been made over a long period before the war, but results had been inconclusive. In 1942 the urgent need for domestic supplies of oil rendered essential an evaluation of the bituminous sand as a source of petroleum products, and a systematic investigation was commenced. Early results obtained by Consolidated Mining and Smelting Company of Canada, Limited, for the Department served to indicate the magnitude of the problems involved in utilizing the deposits, and focused attention upon three aspects requiring early solution, namely, the blocking out of a readily mineable body of sufficient size and quality to warrant large-scale exploitation; the establishment of efficient methods of mining and separating the sands; and refining of the separated bitumen. To meet the first of these essential requirements an extensive drilling program was carried out by the Mines and Geology Branch from 1943 onward, in several areas having good possibilities. This disclosed the lack of continuity in the deposits and their great variability in quality; nevertheless, in the Steepbank River area, a large tonnage of sand containing 12 per cent bitumen was blocked out. Valuable data on deposits in other areas also were obtained. To cover the mining, separation, and refining aspects of the problem the plant of Abasand Oils, Limited, at Fort McMurray was remodelled, enlarged, and operated as a test plant under agreement. Many difficulties were encountered in this project, however, and only tentative conclusions had been arrived at when the separation plant was destroyed by fire in June 1945.

To facilitate production of strategic minerals, Dominion financial assistance was granted, through the Mines and Geology Branch, to Alberta, British Columbia, Ontario, and Quebec, in respect of roads into various mining properties, involving construction of new roads or improvement of existing ones. Funds were provided also to cover part of the cost of keeping a number of roads open during winter months.

Miscellaneous matters handled by the Special Division included acquisition of four portable compressors and six drilling outfits for rental at low cost to developers of strategic mineral deposits, and purchase and marketing of tungsten concentrates from Yukon. Payment of Dominion Government contributions to construction and equipment of a scheelite concentrator at Val d'Or, Quebec, and to the British Columbia War Metals Research Board, also were made through the Division.

The Division administered funds provided from the War Appropriation and the War Expenditure and Demobilization Appropriation for exploration and development work in connection with the supply of strategic minerals; for investigation of petroliferous deposits and potential petroliferous areas; and for the remodelling and expansion of the plant of Abasand Oils Limited, near Fort



McMurray, Alberta. No new projects were undertaken. Existing strategic mineral projects had been initiated on the recommendation of the Metals Controller, and the petroliferous projects on the recommendation of the Oil Controller. Total expenditure for the fiscal year amounted to \$430,401.95.

#### STRATEGIC MINERALS

An allotment of \$10,000 was provided for continuation of exploration and development work in connection with the supply of strategic minerals. All expenditures from the allotment related to the administration of projects for which loans had been made previously to producers of fluorspar in the Madoc area, Ontario, and of tungsten in Yukon. One of the projects was concluded on recovery by the Government of the funds advanced; one was active without production; and one was inactive throughout the year. A summary of the projects follows:

*Fluorspar.* The Bailey property in Madoc township was operated continuously by Millwood Fluorspar Mines, Limited, successors to H. C. Miller, to whom a Government loan was made in 1942. Shipments of metallurgical grade fluorspar totalled 3,491 tons. Fluoroc Mines, Limited, successors to Trent Mining Syndicate, operated the Johnston property in Huntingdon township intermittently and produced some ore, but made no shipments. Operation of the Noyes mine in the same township was abandoned by R. T. Gilman. Equipment and supplies brought to the property under Government loan agreement were, therefore, disposed of by sale and the agreement was terminated by P.C. 6629 (October 23, 1945).

*Tungsten.* The placer claims of Vilhelm Lunde on Dublin Gulch, near Mayo, Yukon, development of which was assisted by the Government in 1943, were operated in 1945, with production of approximately 3,100 pounds of tungsten concentrates, and 210 fine ounces of gold. The property of Hugo A. Seaholm in the same area was not operated. Part of the equipment was sold and the proceeds were applied in the reduction of his loan.

*Mining Equipment.* Items of mining equipment, including portable compressors, drilling machines, and one mine sinking pump, which had been purchased in 1942 for use in exploring or developing strategic mineral deposits, were declared surplus to requirements of the Branch and were turned over to War Assets Allocation Committee for disposal.

#### OIL EXPLORATIONS

##### *Investigation of Bituminous Sand Deposits in Northern Alberta*

Funds from an allotment of \$200,000, provided for investigation of petroliferous deposits and of potential petroliferous areas in Canada, were used for continuing investigation of the bituminous sand deposits in northern Alberta. The program of closely spaced drilling in the Steepbank River area, which was started in January 1945, was completed in July, with the result that a large body of sand containing about 12 per cent bitumen was definitely outlined. One of the two drills was then employed in reconnaissance drilling immediately north and east of Steepbank River, and the second drill was moved to the Muskeg River area, about 38 miles north of Fort McMurray. In January 1946 a drilling reconnaissance was commenced in the Ruth and Mildred Lakes area on the west side of Athabaska River, in townships 92 and 93. In all areas, ninety-three holes, totalling 19,293 feet, were drilled in the fiscal year by the contractors, Boyles Bros. Drilling Company, under the direct supervision of engineers of the Branch.

*Operations of Abasand Oils, Limited*

The plant of Abasand Oils, Limited, at Fort McMurray, rehabilitated and expanded as a war-time project to test the efficiency of methods of extracting bitumen from the bituminous sand of northern Alberta, was operated until June 16, 1945, when fire destroyed the separation plant, workshops, and warehouse. The loss was covered by insurance, but the fire occurred at a time when the purpose of the project was on the point of being achieved. A new method of extracting bitumen had been evolved and tested on a small scale and an enlarged unit of 600 tons daily capacity was being installed to definitely prove results and to provide continuous feed for refinery operation. After the fire, the plant was closed pending insurance settlement and formulation of plans in regard to the future of the project.

**BUREAU OF GEOLOGY AND TOPOGRAPHY**

As mentioned in the introductory section of the Branch report, a summarized account of the war work of the Bureau is given and is followed by accounts of its activities for the fiscal year under review.

It was recognized at the outset that the services of the Bureau, and especially of its Geological and Topographical Surveys, would be taxed to the utmost in meeting the requirements of the war effort. Investigations and other projects of a purely peace-time nature would have to be subordinated to the much more urgent needs of war. Early in the war there was a great need for gold, and geological field work was, accordingly, largely devoted to the mapping of areas believed to be favourable for the deposition of that metal. Later, the supply situation in respect of the ores of the alloying metals and of certain other metals and minerals became increasingly critical and the Bureau then turned its attention to these minerals in its field work. This work was concentrated largely in areas and mining camps and on properties where strategic minerals or base metal deposits have been found. Crude petroleum was increasingly difficult to obtain in the volume required for the Canadian war effort, and structural conditions that may be favourable for the accumulation of oil or gas were studied and mapped. Structures in the foothills of Alberta, along the Alaska Highway, and in the Northwest Territories received special attention, and several anticlinal structures warranting exploratory and drilling attention were disclosed.

Much attention was given also to the occurrence, structure, and stratigraphy of coal measures in eastern and western Canada.

To facilitate the work of oil company geologists the Bureau continued to improve its classification and storage facilities so that key fossils for productive oil and gas formation were readily available for study and comparison by the Survey's field staff and by visiting geologists. Prospectors had a rôle of the greatest importance to play in the war effort. Thousands of mineral samples collected by them were identified, and thousands of sets of individual samples of strategic minerals were supplied to prospectors and others who were engaged in exploring for such minerals. Determined to make the best possible use of their skill and experience, the prospectors, through the Prospectors and Developers Association, arranged for classes to be held during the winter months in mining centres throughout Canada. Recognizing this as a most useful endeavour, the Bureau co-operated by arranging for several of its geologists to participate in the lecture series and this proved to be a most valuable service to the prospectors.

From time to time throughout the war the services of several of the geologists were used in a consulting capacity in connection with various Army, Navy, and Air Force engineering projects.

Of particular interest, however, were the investigations in relation to the supply of strategic minerals. Although ordinarily the Bureau does not search for mineral deposits, several of its geologists during the war spent most of their field seasons in a search for strategic minerals, and these and other geologists were placed in charge of exploratory and development work on various properties. The work on strategic minerals included: investigation of the chromite resources of the Eastern Townships of Quebec, including detailed geological studies, active prospecting, and supervision of exploratory work and of mining; investigation of the mercury deposits in the Pinchi Lake area, British Columbia; investigation of and prospecting for tungsten deposits, which work contributed to a substantial production of tungsten ore from various properties; and investigation, prospecting for, and exploration of tin-bearing deposits in Northwest Territories, Yukon, and southeastern Manitoba. Although no production resulted from the last-mentioned investigation numerous discoveries were made, and geological conditions in the areas concerned warrant considerable optimism for future prospecting.

During most of the war the Bureau's senior petroleum geologist served as technical consultant to the Oil Controller for Canada, and the wealth of experience of another oil geologist was used to advantage on the Canol project in the Northwest Territories where he served as liaison officer.

The Topographical Survey played a most interesting and valuable rôle in the war effort, though until the end of the war much of its special work remained a secret except to the persons directly concerned.

On the advent of the war a number of its younger men joined the Armed Forces in capacities where their training and experience were most useful, as for instance, the field survey units and mapping organizations. Some members of the staff who were especially familiar with northern work and conditions were loaned to, or worked in co-operation with, the R.C.A.F. in meeting requirements for maps, charts, and air route facilities across northern Canada.

Other features of special interest in the war work of the Topographical Survey are outlined below.

During 1940-41 four of its engineers spent 6 weeks in Newfoundland in detail mapping of sites for coastal defence artillery.

The discovery and first report on the site of the war-famed Goose Bay airport in Labrador was made by an engineer of the Survey.

In 1942 a senior member of the staff was sent to Washington at the request of the United States Army Air Forces to discuss northwest ferrying routes across Canada for aircraft bound for Europe. This work entailed planning, location, construction, and maintenance of airports along three separate over-land routes designed to handle the flow of aircraft coming off the assembly lines in the east, middle-west, and Pacific Coast manufacturing centres, respectively.

Trimetrogon aerial mapping of the northern part of the North American Continent by joint co-operation with the United States Army Air Forces and the R.C.A.F. was agreed upon. The R.C.A.F. provided the ground control, and for this undertaking four of the Survey's engineers co-operated by obtaining the necessary fixations.

The Topographical Survey provides base maps for use in the development of Canada's natural resources, and worthy of special mention was its work during the field seasons of 1941 to 1944, inclusive, in areas in western Canada considered favourable for the accumulation of oil. In 1942, for instance, it had thirteen parties engaged in such work in western Alberta and eastern British Columbia; seven parties continued the work in Alberta in 1943, and three parties in 1944. In the latter year two parties worked on control in the Mackenzie River basin oil areas in the Northwest Territories, and one party was engaged in detail mapping in the vicinity of Echo Bay, Great Bear Lake.

In other directions also the Bureau of Geology and Topography made important contributions to the war effort, certain of the more interesting of which are outlined below.

Preparation of blue-print and photostat material for various Government Departments and war organizations. From September 1939 to March 1946, for instance, 1,004,585 square feet of such material, comprising 229,544 prints, was processed and trimmed.

The Aerial Photographic Library identified aerial photographs and supplied the negative numbers covering areas that were being considered as sites for military camps, aerodromes, etc. The staff examined many photographs to determine the suitability of proposed sites for war plants and transportation facilities.

Loaned four draftsmen to Master General of Ordnance for many weeks for purpose of secret work in the drawing of ordnance equipment and mechanical engineering.

Prepared large wall convoy charts used for plotting of positions of convoys by the Royal Canadian Navy.

Prepared postal maps for the Dominion showing divisions and districts for the purpose of national registration.

Prepared charts showing employment of wage earners engaged on war construction.

The program of the Bureau in 1945-46 was again dictated by the needs of war and was designed to give maximum assistance in the discovery and development of oil and strategic minerals.

Forty-seven field parties were active in investigation and mapping in areas of potential and proved economic importance. Of these, thirty-four were geological and thirteen were topographical. Four of the Geological Survey parties operated in the Northwest Territories, two in Yukon, six in British Columbia, five in Alberta, one in Alberta and Saskatchewan, two in Saskatchewan, one in Manitoba and Saskatchewan, two in Manitoba, three in Ontario, five in Quebec, one in New Brunswick, and two in Nova Scotia. Four of the topographical parties were in Alberta, one in Manitoba, one in Quebec, one in New Brunswick, two in Nova Scotia, one in the Northwest Territories, one in Yukon, one in Yukon and British Columbia, and one in Ontario.

Fifty-four maps were published, of which thirty-one were topographical, twenty-two geological, and one mineral.

Two memoirs, two Geological Survey Bulletins, and twenty-nine preliminary geological reports and maps were published.

A total of 120,537 copies of reports, maps, and other publications were distributed, including 481 publications in French that were distributed through the office of the Chief Editor. Fifteen different notification lists were prepared at intervals during the year and sent to selected lists of mining companies, prospectors, educational institutions, and to the public interested in mining development.

## GEOLOGICAL SURVEY

Work was devoted mainly to the search for potential sources of oil, gas, coal, strategic minerals, and base metals, and to other projects that have been associated with the war effort. Standard geological mapping on scales of either 1 or 4 miles to an inch was done in sixteen areas. Detail mapping was continued in Beauchastel, Rouyn, Bourlamaque, and Louvicourt townships on the western Quebec mineral belt; in the vicinity of the Flin Flon mine in Manitoba and Saskatchewan, and of the Mandy mine in Manitoba; and on the shores of Great Bear Lake near Fort Radium, Northwest Territories. Other detailed studies were made of pitchblende occurrences east of Great Bear Lake and on the north shore of Lake Athabaska in Saskatchewan. A reconnaissance geological survey

was made along and tributary to the Alaska Highway northwest of Whitehorse, Yukon, and another was continued along the Canol road in Yukon. Studies were also resumed on the Pleistocene deposits and underground water supply of the Orillia and adjacent areas bordering Lake Simcoe, Ontario. Palaeontological field studies and collections were made in western and eastern Canada to assist stratigraphic and structural interpretations in the search for oil, gas, and coal, or industrial minerals.

In Ottawa, the work of visiting oil geologists employed in Canada was facilitated by providing them with office accommodation and placing at their disposal the records and facilities of the Palaeontological and Water Supply and Borings Sections.

J. S. Stewart continued to act as liaison officer between the Department of Mines and Resources and the United States Army on the Canol Project, and as supervisory engineer for the Department on this project. Since its termination in May 1945 he acted as supervisory engineer for the Deputy Commissioner of Northwest Territories. He spent much of the summer in observing the conditions encountered in the program of exploratory deep well drilling in Mackenzie River Valley, and later visited the McMurray tar sand deposits, and reported on the results of the Government project there.

G. S. Hume continued on loan to the Oil Controller for Canada, Department of Munitions and Supply, until October 1945 when, with the abandonment of the Oil Controller's Office, he returned to the Geological Survey.

The temporary field staff was augmented during the summer by several graduate students recently discharged from Active Service, and who later commenced or renewed their post-graduate studies in geology at universities in Canada or the United States. The Geological Survey lost from its permanent staff the able services of J. W. Ambrose, J. D. Bateman, C. O. Hage, and A. W. Jolliffe, and of J. B. Thurber from its temporary staff.

## FIELD WORK

### NORTHWEST TERRITORIES

M. Feniak and J. B. Thurber made detailed geological investigations in the area between Glacier Bay and the southwest arm of Echo Bay, Great Bear Lake. The work was designed to aid the discovery of pitchblende deposits in this and neighbouring districts, and provided additional information on the stratigraphy of the region.

J. F. Henderson studied and mapped in detail a narrow belt of mainly sedimentary and volcanic rocks between Hottah and Beaverlodge Lakes, about 100 miles south of Port Radium on Great Bear Lake. Pitchblende occurrences were known in this area, and other discoveries were made as a result of systematic Geiger-Müller counter surveys.

Y. O. Fortier completed geological mapping in the Ross Lake area (longitude  $113^{\circ}$  to  $113^{\circ} 30'$ , latitude  $62^{\circ} 30'$  to  $62^{\circ} 45'$ ) in which showings of tantalite and cassiterite, tungsten minerals, lead and zinc ores, and gold-bearing quartz veins have been discovered. He examined some tantalite showings near Hearne Channel, Great Slave Lake.

A. W. Jolliffe visited the Yellowknife area to become acquainted with more recent mining developments. He visited Geological Survey parties operating at Great Bear Lake and Hottah Lake, and in the latter half of August acted in an advisory capacity for the Co-ordinator of Resources Development, Department of Reconstruction and Supply, on an air tour of centres of mineral interest and oil development in the Northwest Territories.

## YUKON

H. S. Bostock investigated the geology and mineral resources of areas readily accessible from the Alaska Highway and connecting roads west and northwest of Whitehorse, to bring information up to date on lode and placer deposits, and to gain knowledge on those parts of the region not previously examined.

E. D. Kindle completed a geological reconnaissance along the Canol road for 290 miles northeast of the north end of Teslin Lake to MacMillan Pass at the Yukon-Northwest Territories boundary. The road traverses a region underlain mainly by Palæozoic and older sedimentary rocks. These have been intruded by several granitic stocks, in the vicinity of which evidence of mineralization has been noted and a few claims have been staked. Vein deposits of barite discovered in the course of geological mapping, numerous quartz veins, some containing sulphide minerals, and fine placer gold along Pelly River have provided incentives for further prospecting.

## BRITISH COLUMBIA

C. S. Lord completed geological mapping in the McConnell Creek area (longitude 126° to 127°, latitude 56° to 57°). Some placer gold has been recovered from McConnell Creek, and many occurrences of gold-bearing veins and base metal deposits were observed. Coal seams occur in measures of apparently Jurassic age.

J. E. Armstrong commenced geological mapping of the Aiken Lake area (longitude 125° to 126°, latitude 56° to 57°). Copper and gold-bearing deposits have been staked in the area, and other occurrences of copper, lead, and mercury minerals were noted.

S. Duffell and K. C. McTaggart commenced geological mapping of the Ashcroft area (longitude 121° to 122°, latitude 50° to 51°). A wide variety of mineral deposits is known to be present, and the area is expected to furnish important information on the age and relationships of the batholithic intrusions responsible for the mineralization.

H. M. A. Rice commenced further geological mapping in the Salmon Arm area (longitude 119° to 120°, latitude 50° to 51°), in which considerable work had been done several years before. The area contains a variety of metallic and non-metallic mineral deposits and is expected to provide useful information on which to correlate formations across an area of highly metamorphosed rocks in southern British Columbia.

A. F. Buckham continued geological studies and mapping of the Cumberland and adjoining coalfields and of the Nanaimo coalfield of Vancouver Island. As a result of this study an area of some 700 acres of possible coal-bearing land was delineated near Lantzville. He continued his residence on the island to the end of the fiscal year.

J. L. Usher, under the direction of A. F. Buckham, made extensive palæontological collections from the Upper Cretaceous coal measures in the Cumberland and Nanaimo coalfields of Vancouver Island. Aside from its general scientific importance in correlation, this material should assist in the reconstruction of palæogeographic conditions when the coal seams were formed, and hence be an aid to further prospecting.

W. E. Cockfield was engaged early in the field season in certain investigations for the Canadian Army at the request of the Director of Works and Construction, General Staff, Ottawa. Later he made surveys of work in progress in the Bridge River area and in the Nelson district. He also visited the property of Hedley Amalgamated at Hedley; made a brief examination of the Skagit River Development Company property (formerly the Invermay Annex) on Skagit River; and investigated a reported pitchblende occurrence near Clinton.

## ALBERTA

A. H. Lang completed geological mapping of the Brûlé area (longitude  $117^{\circ}45'$  to  $118^{\circ}$ , latitude  $53^{\circ}15'$  to  $53^{\circ}30'$ ) and commenced mapping the Moberly Creek area (longitude  $118^{\circ}$  to  $118^{\circ}15'$ , latitude  $53^{\circ}30'$  to  $53^{\circ}45'$ ). He mapped several possible oil structures and obtained further stratigraphic information on this section of the western Foothills Belt and the adjoining eastern range of the Rocky Mountains. Important coal deposits occur in the Lower Cretaceous, Luscar formation of the Brûlé area.

E. J. W. Irish mapped the geology of the Gregg Lake area (longitude  $117^{\circ}45'$  to  $118^{\circ}$ , latitude  $53^{\circ}30'$  to  $53^{\circ}45'$ ) and commenced work on the Moon Creek area (longitude  $118^{\circ}15'$  to  $118^{\circ}30'$ , latitude  $53^{\circ}30'$  to  $53^{\circ}45'$ ). He mapped one structure of possible economic interest in the Gregg Lake area, and observed thin coal seams in late Upper Cretaceous and Paleocene formations.

O. A. Erdman commenced geological mapping of the Cripple Creek area (longitude  $115^{\circ}45'$  to  $116^{\circ}$ , latitude  $52^{\circ}$  to  $52^{\circ}15'$ ). The area occupies part of the inner Foothills Belt and the first range of the Rocky Mountains. One anticlinal structure 20 miles long crosses the northeast corner of the area. Coal occurs in the Nikanassin (Lower Cretaceous) and Luscar (Upper Cretaceous) formations, seams in the latter being as much as 4 feet thick.

R. J. W. Douglas completed the geological mapping of the Callum Creek area (longitude  $114^{\circ}$  to  $114^{\circ}15'$ , latitude  $49^{\circ}45'$  to  $50^{\circ}$ ) and extended work into the adjoining Langford Creek area (longitude  $114^{\circ}$  to  $114^{\circ}15'$ , latitude  $50^{\circ}$  to  $50^{\circ}15'$ ). Drilling for oil was in progress, and special attention was given to possible oil structures. Further information was gained on the probable correlation of the late Upper Cretaceous and Paleocene formations.

W. A. Bell spent the months of July to September, inclusive, in western Alberta gathering palæobotanical data and collections that should be useful and diagnostic in distinguishing between Upper Cretaceous and Paleocene formations.

## ALBERTA AND SASKATCHEWAN

R. T. D. Wickenden made examinations, in the field, of drill cores obtained from deep wells in Saskatchewan and Alberta, and selected representative material for further examination at Ottawa. This work will provide useful information on the subsurface geology of the Plains wherever drilling for oil and gas is contemplated or in progress.

## SASKATCHEWAN

A. W. Jolliffe conducted detailed geological investigations in the Cornwall Bay-Fish Hook Bay area, near Goldfields on the north shore of Lake Athabaska. These were designed to aid the further discovery of pitchblende or other uranium-bearing minerals in this and neighbouring districts.

J. B. Mawdsley investigated the geology and mineral possibilities of an area in the vicinity of Rottenstone Lake, and of another, some 40 square miles in extent, west of the south end of Reindeer Lake. Gold and base metal deposits have been discovered in this latter area.

## MANITOBA AND SASKATCHEWAN

C. H. Stockwell completed the detailed study of an area that included the Flin Flon and Mandy mines, to work out the structure and sequence of the volcanic rocks and their relationship to the ore deposits.

## MANITOBA

J. M. Harrison completed the geological mapping of the Snow Lake area (longitude  $100^{\circ}$  to  $100^{\circ} 15'$ , latitude  $54^{\circ} 45'$  to  $55^{\circ}$ ). Important discoveries have been made in this area, which is known to contain base metal and gold deposits. He gave special study to structures and rock types that control or are favourable for mineral deposition, and did detailed mapping on the holdings of Nor-Acme Mines, Limited.

M. S. Stanton mapped geologically the Tramping-Reed Lakes area (longitude  $100^{\circ}$  to  $100^{\circ} 30'$ , latitude  $54^{\circ} 35'$  to  $54^{\circ} 45'$ ). The area borders and lies north of the Precambrian-Palaeozoic contact, and its eastern half adjoins the Snow Lake area. He examined one gold mine, one extensive iron-sulphide deposit, and several minor prospects.

C. H. Stockwell commenced the geological mapping of Crowduck Bay area (longitude  $99^{\circ} 30'$  to  $99^{\circ} 45'$ , latitude  $54^{\circ} 45'$  to  $55^{\circ}$ ). The area includes one gold property, and a large body of pre-batholithic sedimentary and volcanic rocks in which further discoveries may be made. At the close of the field season he visited the San Antonio mine.

## ONTARIO

T. L. Tanton continued the study of iron ore deposits on the Michipicoten and Matawin iron ranges; on iron properties that were being explored near Iron Bridge and Leeburn; and in the recently explored deposits at Steeprock Lake. He made an examination of gold occurrences in the vicinity of Beardmore and Port Arthur.

J. F. Caley extended the study and mapping of the Palaeozoic formations eastward from Lake Simcoe, and continued investigations of the gas and oil fields of southwestern Ontario.

R. E. Deane, under the supervision of J. F. Caley, mapped the Pleistocene deposits and studied groundwater conditions in the Orillia area (longitude  $79^{\circ} 15'$  to  $79^{\circ} 30'$ , latitude  $44^{\circ} 30'$  to  $44^{\circ} 45'$ ), Lake Simcoe district.

M. E. Wilson examined the operating fluorspar mines of the Madoc district. Most of the fluorspar being mined is from deposits discovered by diamond drilling during the war. Much of it averages 60 per cent or more  $\text{CaF}_2$ , and by sorting on a picking belt a product of metallurgical grade is being obtained.

## QUEBEC

G. W. H. Norman revised the geological mapping of the Vassan-Dubuisson and Bourlamaque areas, and mapped in detail an area of 35 square miles on the south side of Bourlamaque township. He examined and logged about 125,000 feet of drill core, representing some 250 diamond drill holes.

L. P. Tremblay, under the supervision of G. W. H. Norman, commenced geological re-mapping, in more detail, of the LaCorne area (longitude  $48^{\circ} 15'$  to  $48^{\circ} 30'$ , latitude  $48^{\circ} 15'$  to  $48^{\circ} 30'$ ), which is the west half of the former Fiedmont map-area. A productive molybdenite mine, and numerous occurrences of spodumene- and beryl-bearing pegmatite dykes have been found in LaCorne township.

George Shaw continued the detailed geological mapping of western Beauchastel township, which is crossed from east to west by the southern mining belt of western Quebec. Important gold and copper-gold production has been won in recent years from this part of the belt.

M. E. Wilson spent most of the field season in bringing detailed geological information up to date in southern Rouyn and southeast Beauchastel townships. This work included the examination of more than 100,000 feet of diamond drill core, most of which had been drilled during the previous year. He made short visits to several properties in western Quebec outside the area of special study.



H. C. Cooke continued systematic geological mapping in the Eastern Townships, covering most of Sherbrooke area (longitude  $71^{\circ} 30'$  to  $72^{\circ}$ , latitude  $45^{\circ} 15'$  to  $45^{\circ} 30'$ ), and correlating the stratigraphy and structure with those of adjoining areas. The region contains a variety of metalliferous and non-metallic deposits.

G. W. Sinclair studied available sections of Ordovician formations, and collected fossil faunas for further study. The result should prove useful in future correlations in various parts of Canada.

#### NEW BRUNSWICK

F. J. Alcock continued systematic geological mapping in southern New Brunswick, completing the St. Stephen (longitude  $67^{\circ}$  to  $67^{\circ} 30'$ , latitude  $45^{\circ}$  to  $45^{\circ} 15'$ ) and Honeydale (longitude  $67^{\circ}$  to  $67^{\circ} 30'$ , latitude  $45^{\circ} 15'$  to  $45^{\circ} 30'$ ) areas in Charlotte county. Occurrences of copper-nickel sulphides have been found in the St. Stephen area, and there are several stone quarries and peat bogs.

#### NOVA SCOTIA

L. J. Weeks continued systematic geological mapping and investigation within a group of five map-areas centring around the Stirling lead-zinc deposit in Richmond county, Cape Breton Island.

S. A. Ferguson mapped geologically most of the Strait of Canso area (longitude  $61^{\circ} 15'$  to  $61^{\circ} 30'$ , latitude  $45^{\circ} 30'$  to  $45^{\circ} 45'$ ), and paid special attention to the structure and composition of formations on either side of the strait and to the probable conditions beneath it.

W. A. Bell directed operations of the party under S. A. Ferguson early in the field season, and later examined the deposits at the Malagash salt mine.

#### OFFICE WORK

Special reports and maps based on field examinations were prepared for limited distribution in compliance with specific requests by the Department of Mines and Resources or other Departments. These dealt in part with occurrences of, or investigations for, pitchblende or other uranium-bearing minerals; with strategic mineral resources; or with potential oil and gas structure and coalfields; but included also assistance in military or civilian engineering projects.

The paper series of mimeographed reports and preliminary blue-line maps continued to provide the interested public with advance information on the results of field investigations in 1944 and 1945. Among these publications were four that included plates of index fossils for the guidance of oil geologists in western Canada. Another printed paper of this series dealt at length with the results of Canol geological investigations in the Mackenzie River area, Northwest Territories. Twenty-one reports and thirty-seven maps were prepared for publication in this series.

Among the printed publications issued was a geological map of Manitoba on a scale of 1 inch to 20 miles. A companion map on the same scale indicates all known mineral occurrences in that province. Other maps and reports prepared for publication included one report of the Economic Geology Series, two memoirs, six Geological Survey Bulletins, one Museum Bulletin, and six final editions of maps.

#### PALÆONTOLOGICAL SECTION

Reports were made on 44 fossil collections submitted for identification and age determination. Of these collections, 23 were submitted by officers of the Geological Survey, 14 by oil companies prospecting in western Canada, 5 by the Department of Mines, British Columbia, and 2 by private donors.

Alice E. Wilson reported on collections of Palæozoic invertebrates from the following areas: McConnell Creek, British Columbia; McMurray and Hay River areas, Alberta and Northwest Territories; Brûlé and Blairmore areas, Alberta; and Simcoe area, Ontario. She continued the work of preparing for publication a description of the stratigraphy and faunas of the Ottawa-St. Lawrence Lowland.

F. H. McLearn reported on Mesozoic collections from Mackenzie River, Northwest Territories; from areas in northeastern British Columbia; from Aiken Lake, McConnell Creek, Peace River, Texada Island, and Ashcroft areas, British Columbia; and from Athabaska River, Hay River, Alexo-Saunders, Moberly Creek, Moon Creek, Brûlé, and Callum Creek areas, Alberta.

W. A. Bell reported on Mesozoic and Tertiary plant collections from Omineca River, Kusawak Mountains, Peace River, Ashcroft, and Fraser River areas, British Columbia; from Cripple Creek, Hay River, Pinto, Moberly Creek, Moose River, Brûlé, and Callum Creek areas, Alberta; and from the Martin and Edgerton oil wells, Alberta. He reported also on Carboniferous shells and plants from Strait of Canso area, Nova Scotia.

C. M. Sternberg, who was on loan during the war to assist in special work on mineral projects, returned to the section early in January, and was engaged on preparatory work on dinosaur specimens from Alberta. He reported on some vertebrate remains from the St. Mary River formation, Alberta.

Donations of fossil collections are gratefully acknowledged from Imperial Oil, Limited; Socony-Vacuum Oil Company; Shell Oil Company; McColl-Frontenac Oil Company; Phillips Petroleum Company; British Columbia Department of Mines; and Dr. L. J. O'Brien, Grande Prairie, Alberta.

#### MINERALOGICAL SECTION

The volume of work was appreciably larger than in the previous year.

Eugene Poitevin and H. V. Ellsworth spent most of their time in the study of mineral specimens submitted by the public and by specialists interested in the mining industry. The 4,500 specimens submitted were examined as to their commercial possibilities, and their descriptions were included in 525 issued reports. Special petrographic and chemical studies were undertaken or continued.

R. J. C. Fabry made several analyses of rare basic dyke rocks related to essexite, from the Sherbrooke district, Quebec. He also made a large number of qualitative chemical tests in co-operation with the work of the mineralogists.

Mineral and rock collections totalling 2,363, comprising 89,853 specimens, were prepared and distributed to the public. This is a notable increase over the previous year and is due mainly to 1,000 special mineral collections, containing 40,000 specimens, that were assembled for the Quebec Department of Mines. Noteworthy also were the increasing requests from the western provinces for mineral and rock specimens, particularly the prospector's sets of minerals and rocks. Orders for specimens of strategic minerals declined with the end of the war. Eighty-five to 90 per cent of the requests for specimens come from individual prospectors, local chambers of mines and boards of trade, provincial governments, universities, vocational and high schools, mining corporations, and individuals interested in mining.

J. R. Marshall reports that the 2,363 collections were made up of 626 sets of prospector's minerals; 527 sets of prospector's rocks; 1,000 special sets for the Department of Mines, Quebec; 100 sets of strategic minerals; 25 standard collections; and 85 miscellaneous collections. The collections were distributed as follows: British Columbia and Northwest Territories, 427; Alberta, 255; Saskatchewan, 75; Ontario, 280; Quebec, 1,224; Maritimes, 51; and United States, 14.

## WATER SUPPLY AND BORINGS SECTION

The work includes the collection, organization, and filing of records dealing with the occurrence of oil and gas, coal, and ground water from all parts of Canada. Samples of rock cuttings from wells drilled for oil and gas and ground water are prepared for examination, and stored, and a considerable number are examined and reported on. Altogether, 947,205 samples are now available for study, and of these, 90,821 were prepared for examination during the past year.

The number of drill samples received may be subdivided as follows: Alberta, 50,784 samples from 129 wells; Northwest Territories, 5,860 samples from 11 wells; Nova Scotia, 1,474 samples from 5 wells; Ontario, 15,042 samples from 73 wells; Prince Edward Island, 199 samples from 1 well; Quebec, 258 samples from 3 wells; and Saskatchewan, 4,186 samples from 13 wells.

Some of the Alberta samples came from wells in unproved territory, but most of them were from wells drilled to test the production limits of known oil and gas fields. Samples from Ontario were mostly from areas in which oil or gas had previously been found. Most of those from Saskatchewan came from deep wells put down by Imperial Oil, Limited, but some were from other wells, several of them in unproved territory. Most of the samples from Nova Scotia came from the Mary well of Lion Oil and Refining Company in Inverness county, and from the Sunoco No. 1 well drilled by Sun Oil Company in Cumberland county. Some of the samples from Quebec were from Continental Petroleums No. 2 well in Gaspé county, and the Lincoln well in the city of Montreal, which was drilled for water. All samples from the Northwest Territories were from exploratory wells drilled by Imperial Oil, Limited, in an attempt to locate new sources of oil in the Far North. Pure Oil Company provided 391 samples from a well drilled in the State of Michigan. These provided a useful standard of reference for comparison with deep wells drilled in southwestern Ontario.

Acknowledgments and thanks are due to the following firms and organizations through whose co-operation the samples were received: Petroleum and Natural Gas Conservation Board of Calgary, for all samples received from wells in Alberta; E. Swain, Supervisor of Mines, Department of Natural Resources, Regina, and F. H. Edmunds, University of Saskatchewan, Saskatoon, for samples from Saskatchewan; Imperial Oil, Limited, Norman Wells office, for samples from wells in the Northwest Territories; R. B. Harkness, Natural Gas Commissioner for Ontario, Toronto, for samples from Ontario; I. W. Jones, Geological Survey Branch, Quebec, for samples from wells in that province; M. G. Goudge, Deputy Inspector of Mines, Halifax, Lion Oil and Refining Company, and Sun Oil Company, for samples from Nova Scotia; and Island Development Company of Charlottetown, for samples from Hillsborough No. 1 well near Charlottetown, Prince Edward Island.

Grateful acknowledgment is made to officials of the Petroleum and Natural Gas Conservation Board, who supplied periodical information on the progress of drilling in the wells, and tabulations, maps, interim reports, and electrologs; to F. H. Edmunds for the logs of many oil wells and many hundreds of test holes and shot holes put down in Saskatchewan in the search for structural conditions favourable to the accumulation of oil and gas; to Imperial Oil, Limited, for much valuable information; and to Paul Payette of Continental Petroleums Limited, Montreal, who continued to supply all available information on the company's drilling operations in Gaspé county, Quebec.

D. C. Maddox examined a large number of samples from wells drilled for oil and gas.

Helen Belyea re-examined in detail samples from all deep wells drilled for oil and gas in the St. Lawrence Lowlands of Quebec, and also examined some samples from wells in Ontario and Saskatchewan.

In conjunction with an official of Shell Oil Company, officers of the Mines and Geology Branch made a detailed examination of about 300 boxes of core samples from test holes put down in the McMurray bituminous sand of northern Alberta.

Geologists of Shell Oil Company, Imperial Oil, Limited, Union Gas Company, Phillips Petroleum Company, and Sun Oil Company availed themselves of the services of the Section to collect records, and examined well samples available for inspection.

Much interest is being shown in groundwater conditions, and inquiries were received from many parts of the Dominion. The collection of records of water wells in Saskatchewan is under the control of the Provincial Government, but several hundred logs of water wells were received from F. H. Edmunds, under whose supervision the samples from these wells were examined. In Alberta, the Petroleum and Natural Gas Conservation Board recently undertook the work of collecting records of water wells being drilled in that province. Copies of these records are periodically forwarded to this office. Copies of maps and tabulations of the groundwater survey carried out in southern Alberta by the Geological Survey in 1935 and 1936 were supplied to the Prairie Farm Rehabilitation Board. Samples and records from several water wells in Nova Scotia were received through the co-operation of M. G. Goudge of Halifax, O. V. Kennedy of Bridgetown, and Trask Drilling Company of New Glasgow. Samples from several wells drilled in the Ottawa district were examined and reported on.

At the request of the Royal Commission on Coal, all available information on the coal resources of Canada was assembled and classified, and maps showing the distribution, geological age, and rank of the coal were prepared. From these data an estimate of the total available coal commercially obtainable is being prepared.

#### BRITISH COLUMBIA OFFICE

The work showed a considerable increase, indicative of greatly increased interest in the mining industry. A total of 4,593 visitors registered at the office, and many additional inquiries were handled by mail and telephone. A total of 4,189 reports and 2,520 separate maps were issued in response to requests from the public. Determinations were made of a large number of rock and mineral specimens.

#### TOPOGRAPHICAL SURVEY

The Topographical Survey made original surveys for ground and air mapping and prepared maps therefrom; and compiled base maps for use in the development of mineral and other natural resources. It is organized in three sections, the Topographical Mapping Section, responsible for field surveys; the Air Survey Section, which plots air photographs into map form; and the Map Compilation Section, which does the final editing and finishing of map manuscripts, makes compilations, and does other related work.

The work of the Topographical Mapping Section falls into two parts, control surveys for air photographic maps and topographical mapping. The following parties were engaged in control surveys in the areas specified:

FIELD WORK  
Control Surveys

Officer in charge	Sheet name	Sheet number	Latitude and longitude	Scale of publication
<i>Alberta</i>				
J. V. Butterworth.	Chicken Creek . . . . .	83 L/6, W. $\frac{1}{2}$	} 54° 15' - 54° 30' 119° 15' - 119° 30'	1 in. to 1 mi.
	Wolf Creek . . . . .	83 L/6, E. $\frac{1}{2}$		
	Meadow Creek . . . . .	83 L/7, W. $\frac{1}{2}$	} 54° 15' - 54° 30' 118° 45' - 119° 00'	1 in. to 1 mi.
	Copton Creek . . . . .	83 L/3, W. $\frac{1}{2}$		
M. E. Nidd . . . . .	Kvass Flats . . . . .	83 E/14, W. $\frac{1}{2}$	} 53° 45' - 54° 00' 119° 15' - 119° 30'	1 in. to 1 mi.
	Grande Cache . . . . .	83 E/14, E. $\frac{1}{2}$		
	Kakwa Mountain . . . . .	83 L/4, W. $\frac{1}{2}$	} 54° 00' - 54° 15' 119° 45' - 120° 00'	1 in. to 1 mi.
	Lynx Creek . . . . .	83 L/4, E. $\frac{1}{2}$		
Floyd and Nidd . . . . .	Adam's Lookout . . . . .	83 E/10, E. $\frac{1}{2}$	} 50° 30' - 53° 45' 118° 30' - 118° 45'	1 in. to 1 mi.
A. M. Floyd . . . . .	Grizzly Creek . . . . .	83 L/1, W. $\frac{1}{2}$		
	Bolton Creek . . . . .	83 L/2, E. $\frac{1}{2}$	} 54° 00' - 54° 15' 118° 30' - 118° 45'	1 in. to 1 mi.
	David's Flats . . . . .	83 L/2, W. $\frac{1}{2}$		
	Daniel's Flats . . . . .	83 L/3, E. $\frac{1}{2}$	} 54° 00' - 54° 15' 119° 00' - 119° 15'	1 in. to 1 mi.
H. N. Spence (Triangulation) . . . . .		83 L/1, 2, 3, 4		
		83 L/6, 7	} 54° 15' - 54° 30' 118° 30' - 119° 30'	
		83 E/14		
<i>Manitoba</i>				
C. M. Duncan . . . . .	Kipahigan Lake . . . . .	63 N/5	} 55° 15' - 55° 30' 101° 30' - 120° 00'	1 in. to 1 mi.
	Duval Lake . . . . .	63 N/4		
	Herb Lake . . . . .	63 J/13	} 54° 45' - 55° 00' 99° 30' - 100° 00'	1 in. to 1 mi.
	Saw Lake . . . . .	63 J/14, W. $\frac{1}{2}$		

## FIELD WORK—Cont.

## Control Surveys—Cont.

Officer in charge	Sheet name	Sheet number	Latitude and longitude	Scale of publication
	<i>Manitoba—(contd.)</i>			
C. M. Duncan.....	Iskwasum Lake.....	63 K/10	} 54° 30'— 54° 45' 100° 30'—101° 00'	1 in. to 1 mi.
	Tramping Lake.....	63 K/9		} 54° 30'— 54° 45' 100° 00'—100° 30'
	<i>Quebec</i>			
F. DuVernet.....	Dasserat tp.....	Detail		1 in. to 1,000 ft.
	Beauchastel tp. W. ½	Detail		1 in. to 1,000 ft.
	Vauquelin tp.....	Detail		1 in. to 1,000 ft.
	Pershing tp.....	Detail		1 in. to 1,000 ft.
	Haig tp.....	Detail		1 in. to 1,000 ft.
	<i>New Brunswick</i>			
J. W. Spence.....	Minto.....	21 J/1, E. ½	} 46° 00'— 46° 15' 66° 00'— 66° 15'	1 in. to 1 mi.
	Mount Hope.....	21 J/1, W. ½		} 46° 00'— 46° 15' 66° 15'— 66° 30'
	Taymouth.....	21 J/2, E. ½	} 46° 00'— 46° 15' 66° 30'— 66° 45'	
	Burtts Corner.....	21 J/2, W. ½		} 46° 00'— 46° 15' 66° 45'— 67° 00'
	McGivney.....	21 J/7, E. ½	} 46° 15'— 46° 30' 66° 30'— 66° 45'	
	Napadogan.....	21 J/7, W. ½		} 46° 15'— 46° 30' 66° 45'— 67° 00'
	Muzroll Lake.....	21 J/8, E. ½	} 46° 15'— 46° 30' 66° 00'— 66° 15'	
	Boiestown.....	21 J/8, W. ½		} 46° 15'— 46° 30' 66° 15'— 66° 30'
	Grand Manan.....	21 B/10, W. ½ 21 B/11, E. ½	} 44° 30'— 44° 45' 66° 45'— 67° 15'	
	Campobello and Deer Islands.	21 B/14, E. ½ 21 B/15, W. ½		} 44° 45'— 45° 00' 66° 45'— 67° 15'
	Juniper.....	21 J/11, E. ½	} 46° 30'— 46° 45' 67° 00'— 67° 15'	
	Beaufort.....	21 J/11, W. ½		} 46° 30'— 46° 45' 67° 15'— 67° 30'
	Kilburn.....	21 J/12	} 46° 30'— 46° 45' 67° 30'— 67° 47'	
	Aroostook.....	21 J/13		} 46° 45'— 47° 00' 67° 30'— 67° 47'
	Plaster Rock.....	21 J/14, W. ½	} 46° 45'— 47° 00' 67° 15'— 67° 30'	

FIELD WORK—*Conc.*  
Control Surveys—*Conc.*

Officer in charge	Sheet name	Sheet number	Latitude and longitude	Scale of publication
<i>Nova Scotia</i>				
R. W. Clark.....	Framboise.....	11 F/9, W.½	} 45° 30'– 45° 45' 60° 15'– 60° 30'	1 in. to 1 mi.
	St. Peters.....	11 F/10, E.½ 11 F/10, W.½		
<i>Northwest Territories</i>				
Eric Fry.....	Tumpline Lake.....	85 I/10	} 62° 30'– 62° 45' 112° 30'–113° 00'	1 in. to 1 mi.
	Ross Lake.....	85 I/11		

*Topographical Mapping*

Officer in charge	Sheet name	Sheet number	Latitude and longitude	Scale of publication
<i>Yukon</i>				
R. J. Parlee.....	Dezadeash <sup>1</sup> .....	115A	} 60° 00'– 61° 00' 136° 00'–138° 00'	1 in. to 4 mi.
A. C. Tuttle.....	Whitehorse <sup>1</sup> .....	105D		
<i>British Columbia</i>				
A. C. Tuttle.....	Bennett <sup>1</sup> .....	104M	} 59° 00'– 60° 00' 134° 00'–136° 00'	1 in. to 4 mi.
<i>Ontario</i>				
C. H. Smith.....	Purdy Mica Mines....	Special		1 in. to 100 ft.
<i>Nova Scotia</i>				
J. A. Macdonald..	Kennetcook.....	11 E/4, E.½	} 45° 00'– 45° 15' 63° 30'– 63° 45'	1 in. to 4 mi.
	Shubenacadie.....	11 E/3, W.½		
	Middle Musquodoboit.	11 E/3, E.½	} 45° 00'– 45° 15' 63° 00'– 63° 15'	1 in. to 1 mi.
	Upper Musquodoboit..	11 E/2, W.½		

<sup>1</sup> Commenced 1944, completed 1945.

## OFFICE WORK

## Air Survey Section

- I. (a) Map sheets covering areas mapped either wholly or in part from trimetrogon air photography in Northwest Territories and Yukon, on a scale of 1 inch to 1 mile:

Sheet No.	Publication scale	Approximate area in square miles
94 K.....	1 in. to 4 mi.	1,290
94 O.....	1 in. to 4 mi.	1,390
94 J.....	1 in. to 4 mi.	2,560
95 N.....	1 in. to 4 mi.	4,170
95 O.....	1 in. to 4 mi.	4,060
105 A.....	1 in. to 4 mi.	1,200
105 B.....	1 in. to 4 mi.	3,160
105 G.....	1 in. to 4 mi.	4,500
105 H.....	1 in. to 4 mi.	570
105 O.....	1 in. to 4 mi.	420
105 P.....	1 in. to 4 mi.	640
106 E.....	1 in. to 4 mi.	1,250
106 F.....	1 in. to 4 mi.	1,900
106 G.....	1 in. to 4 mi.	250
106 J.....	1 in. to 4 mi.	140
106 M.....	1 in. to 4 mi.	770
106 O.....	1 in. to 4 mi.	180
115 F.....	1 in. to 4 mi.	460
115 G.....	1 in. to 4 mi.	2,860
115 K.....	1 in. to 4 mi.	780
		Total.....32,550

- (b) Previous compilations in the following map sheet areas were added to and revised in order to incorporate later air photography and further ground surveys:

96 C.....	1 in. to 4 mi.
96 D.....	1 in. to 4 mi.
96 E.....	1 in. to 4 mi.
105 P.....	1 in. to 4 mi.
106 A.....	1 in. to 4 mi.

## II. Compilation from vertical air photography:

- (a) Cleared to Topographical or Map Compilation Sections:

	Sheet No.	Publication scale	Approximate area in square miles
<i>Manitoba</i> .....	63 K/9.....	1 in. to 1 mi.	350
	63 K/10.....	1 in. to 1 mi.	350
	63 K/15.....	1 in. to 1 mi.	350
	63 K/16.....	1 in. to 1 mi.	350
	63 N/2.....	1 in. to 1 mi.	340
<i>Quebec</i> .....	Dasserat tp.....	1 in. to 1,000 ft.	100
<i>New Brunswick</i> .....	21 T/13.....	1 in. to 1 mi.	410
	21 J/2, W. ½.....	1 in. to 1 mi.	205
			Total.....2,455



## (b) Sheets compiled but not cleared:

	Sheet No.	Publication scale	Approximate area in square miles
Northwest Territories.....	Eldorado mine area.....	1 in. to 1,000 ft.	170
Alberta.....	83 E/14.....	1 in. to 1 mi.	340
	83 L/4.....	1 in. to 1 mi.	340
Manitoba.....	63 J/13.....	1 in. to 1 mi.	350
Quebec.....	Parts of 32 C/SW 1½ townships..	1 in. to 1,000 ft.	150
New Brunswick.....	21 I/12, W.½....	1 in. to 1 mi.	205
Nova Scotia.....	11 F/9.....	1 in. to 1 mi.	65
			Total.....1,620

Flight maps were prepared for R.C.A.F. vertical photographic operations, requested by the Department of Mines and Resources and the Department of Agriculture, covering areas in the Northwest Territories and in every province except Prince Edward Island.

Some twenty-five new personnel taken on the staff were being instructed and trained in compilation from air photography.

#### Map Compilation Section

The Map Compilation Section forwarded nineteen topographical map sheets for reproduction, six of which were in the Northwest Territories, four in Alberta, two in Saskatchewan, six in Manitoba, and one in Nova Scotia. Two bases for geological maps in Ontario were also forwarded.

The production of preliminary geological maps, which make immediately available to the public the results of recent surveys, is an important part of the work. Thirty of these maps were produced; ninety-one projections were made; and numerous manuscripts were inked for other sections, tracings made, and special drawings and index maps prepared.

#### DEVELOPMENT DIVISION

This Division is responsible for the general executive and administrative work of the Bureau; for the maintenance of the National Air Photographic Library; and for survey equipment and supplies, mechanical and carpentry facilities, photographic reproduction processes, and library and information services.

Of outstanding interest was the 70 per cent increase in the demands by the public for geological information and maps, indicative of a quickening interest in mining development. Also illustrative of tangible steps towards furthering post-war plans for natural resources development generally was the receipt of 145,552 aerial photographs, resulting from photographic flights during 1945. This is an increase of almost 150 per cent over 1944. Similarly, there was an increase of more than 110 per cent in the number of photographs purchased by other government services, by public utilities, mining and engineering organizations, educational institutions, and the public.

## NATIONAL AIR PHOTOGRAPHIC LIBRARY

A total of 145,552 new photographs was added to the library collection as compared with 59,639 in the previous year. Of the 1945 total, 2,508 were low altitude scenic views taken during the war and were illustrative of training camps and other activities of the armed forces; 798 were trimetrogon photographs taken by the Royal Canadian Air Force, and covered areas in British Columbia and the Northwest Territories. The remainder were vertical aerial photographs and covered areas in every province and in the Northwest Territories. The library has on file approximately 1,246,000 prints of aerial negatives. These cover an area of approximately 1,150,000 square miles.

Aerial photographs are especially useful in the study and development of Canada's natural resources. The National Air Photographic Library is organized to give all needed assistance in the use of aerial photographs, either to applicants personally or by correspondence. Index maps of areas photographed and other related information are prepared and supplied to applicants on request. Facilities for stereoscopic study of the photographs are provided and expert assistance in their interpretation is given.

During the year, 140,800 prints of aerial negatives were purchased through the library by private companies and others engaged in activities connected with the development of Canada's natural resources. Many representatives of Federal and Provincial Government services and of commercial organizations visited the library and were assisted in the selection and interpretation of aerial photographs covering areas in which they were interested. This assistance included the examination and selection of large numbers of aerial photographs covering areas in the Northwest Territories for mining companies engaged in development work; timbered areas in the different provinces for pulp and paper companies; and areas in Alberta and the Northwest Territories for oil companies doing exploratory work.

Supervision and assistance were provided for two employees of the Department of Agriculture who were engaged in the preparation of municipality folders of aerial photographs and drainage plans for the Water Development and Economic Branches operating under the Prairie Farm Rehabilitation Act. Folders covering fifteen municipalities, and miscellaneous areas involving prints of 1934 aerial negatives, were prepared and forwarded P.F.R.A. officials in Saskatoon to assist them in the field examination of the areas.

## PHOTOGRAPHIC SECTION

Exposures made in the field by geological, topographical, and museum parties were developed, printed, catalogued, and filed. Maps, specimens, fossils, and many miscellaneous items were photographed and suitable prints were prepared for reproduction or for use in the draughting and other divisions. The work included:

Contact prints, 1½ x 2½ to 36 x 48 .....	11,953
Bromide enlargements, 3 x 4 to 20 x 24 .....	3,356
Exposures developed, 1½ x 2½ to 5 x 7 (field work) .....	3,712
Dry plate negatives, 4 x 5 to 24 x 30 .....	979
Wet plate negatives, 8 x 10 to 24 x 30 .....	15
Kodalith negatives, 8 x 10 to 24 x 30 .....	326
Linen negatives, 30 x 40 .....	7
Van Dyke negatives, 8 x 10 to 35 x 47 .....	70
Van Dyke prints, 5 x 7 to 30 x 40 .....	706
Linen prints, 30 x 40 .....	6
Aero mapping prints, 5 x 7 to 24 x 30 .....	21
Kodachrome colour slides .....	54
Negatives retouched .....	466
Lantern slides .....	441
Photographs and maps dry mounted .....	1,221

Thirty-nine wet plate negatives were shipped to lithographers for reproduction. The number of wet plates produced showed a marked reduction as they were gradually replaced with kodolith negatives, and, more recently, with linen negatives.

### LIBRARY

Following the end of the war in Europe the exchange of publications was resumed. Swedish publications are almost up to date, but some of the other European countries were only beginning to send the war-time issues. The handling of this material was handicapped by a shortage of staff, and cataloguing was much in arrears as there was no cataloguer for the greater part of the year.

There was an increase of 252 in the number of maps and charts added to the library. This was partly due to the release of some that had previously been considered confidential. The Division of Surveys of the Province of Quebec provided a splendid set of county maps of Quebec, and the Bureau of Northwest Territories and Yukon Affairs a set of maps of claims in the Northwest Territories. A start was made in backing the many hundreds of maps in need of this care.

Valuable sets presented to the library included the scarce first ten volumes of the Journal of the Arnold Arboretum, presented by the Montreal Botanical Garden, and a run of thirty volumes of Curtis Botanical Magazine, a gift from the Library of the Lands, Parks and Forests Branch. The Gray Herbarium of Harvard University supplied many missing issues of its splendid series of Contributions, so that the set is now bound and almost complete. The R.C.A.F. contributed seventeen bound volumes of the Journal of the Institute of Metals. The Russian Government kindly brought the Flora of the U.S.S.R. up to date by the gift of the latest four volumes. An outstanding addition to the reference collection was the six volumes of the Encyclopedia of Canada, edited by W. S. Wallace. Additions to many valuable European series were received, among which were forty volumes of the Meddelelser om Grønland. Twenty-one new series were catalogued, and a number of others were received.

Recorded loans were somewhat higher than in the previous year and inter-library and occasional loans increased by 454. Reference work continued to absorb a large amount of time. Although the library is primarily for the use of the staff, its facilities were increasingly used by research workers throughout Canada. Acquisitions by the library were 1,885 more than for the previous year and were as follows:

Books acquired by purchase.....	130
Books (complete unbound volumes by purchase).....	147
Books by transfer, exchange, and gift.....	607
Pamphlets and reprints (by gift).....	241
Canadian Government documents—individual issues (by gift and exchange).....	1,868
British and Foreign Government documents—individual issues (by gift and exchange).....	2,077
Canadian periodicals, individual issues.....	690
British and Foreign periodicals, individual issues.....	1,783
Scientific societies' bulletins, proceedings, and transactions—individual issues (by gift and exchange).....	3,433
<b>Total</b> .....	<b>10,976</b>

#### Other data:

Recorded loans of books, pamphlets, periodicals.....	10,131
Inter-library and occasional loans.....	1,212
Books borrowed from other libraries.....	461
Maps and charts added to the library.....	1,643
Maps and charts borrowed from the library.....	640
Lantern slides loaned.....	697

Photographs loaned (exclusive of albums).....	1,774
Volumes bound.....	234
Volumes accessioned.....	728
Cards added to general catalogue.....	5,016
Cards added to map catalogue.....	368
Letters and cards received .....	1,424
Letters and cards sent.....	2,223

## MECHANICAL SECTION

Photostat material produced amounted to 14,282 sheets, as compared with 11,887 sheets in the previous year. Océ prints were down 18 per cent at 17,883 square feet; and 337,618 square feet of blueprints were made, compared with 338,129 square feet. Mimeograph work showed little change at 519,460 impressions compared with 558,604.

The lapidary shop produced 1,587 thin sections and 35 cut and polished specimens. These were used in mineralogical determinations and research.

The lecture hall was made available with projection and supervisory service for 150 engagements by scientific and educational organizations and for the National Museum lecture series.

## GEOLOGICAL INFORMATION AND DISTRIBUTION

Publications of the Bureau, and of the National Museum, distributed amounted to 120,056, in response to written and personal requests.

## DRAUGHTING AND REPRODUCING DIVISION

*Maps published April 1, 1945, to March 31, 1946*

Publication Number	Title	Remarks
NORTHWEST TERRITORIES		
846A	Ontaratie River, District of Mackenzie; scale, 1 inch to 4 miles.....	Topography. For separate distribution.
848A	Camsell Bend, District of Mackenzie; scale, 1 inch to 4 miles.....	Topography. For separate distribution.
YUKON AND NORTHWEST TERRITORIES		
847A	Arctic Red River (South Sheet); scale, 1 inch to 4 miles.....	Topography. For separate distribution.
BRITISH COLUMBIA		
844A	Takla, Cassiar District; scale, 1 inch to 4 miles..	Geology. For separate distribution.
ALBERTA		
814A	Mount Head, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.

## Maps published April 1, 1945 to March 31, 1946—Continued

Publication Number	Title	Remarks
815A	Waterton, West of Fourth Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
816A	Cowley, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Geology. For separate distribution.
819A	Turner Valley, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
827A	Dyson Creek, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Geology. For separate distribution.
830A	Entrance, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
831A	Pedley, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
833A	Sterco, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
834A	White Creek, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
835A	Coalspur, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
836A	Brûlé, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
838A	Pedley, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Geology. For separate distribution.
840A	Tay River, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Geology. For separate distribution.
843A	Entrance, West of Fifth Meridian; scale, 1 inch to 1 mile.....	Geology. For memoir by A. H. Lang, and separate distribution.
MANITOBA		
305A	Oxford House Sheet; scale, 1 inch to 4 miles. Reprint.....	Geology. For separate distribution.
809A	Beresford Lake, East of Principal Meridian; scale, 1 inch to 1 mile.....	Geology. For separate distribution.

## Maps published April 1, 1945 to March 31, 1946—Continued

Publication Number	Title	Remarks
810A	Rice Lake, East of Principal Meridian; scale, 1 inch to 1 mile.....	Geology. For separate distribution.
811A	Gem Lake, East of Principal Meridian; scale, 1 inch to 1 mile.....	Geology. For separate distribution.
832A	Mikanagan Lake, West of Principal Meridian; scale, 1 inch to 1 mile.....	Geology. For separate distribution.
837A	Sherridon, West of Principal Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
841A	Naosap Lake, West of Principal Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
850A	Geological Map of Manitoba; scale, 1 inch to 20 miles.....	Geology. For separate distribution.
851A	Mineral Map of Manitoba; scale, 1 inch to 20 miles.....	Minerals. For separate distribution.
853A	Cranberry Portage, West of Principal Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
857A	File Lake, West of Principal Meridian; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
ONTARIO		
468A	Haliburton Sheet (East Half), Haliburton and Hastings Counties, and Nipissing District; scale, 1 inch to 2 miles. Second edition....	Topography. For separate distribution.
469A	Haliburton Sheet (West Half), Haliburton County, Muskoka and Nipissing Districts; scale, 1 inch to 2 miles. Second edition.....	Topography. For separate distribution.
470A	Bobcaygeon Sheet (East Half), Peterborough and Haliburton Counties; scale, 1 inch to 2 miles. Second edition.....	Topography. For separate distribution.
471A	Bobcaygeon Sheet (West Half), Victoria, Haliburton, and Peterborough Counties; scale, 1 inch to 2 miles. Second edition.....	Topography. For separate distribution.
586A	Verner, Nipissing, Sudbury, and Parry Sound Districts; scale, 1 inch to 2 miles. Reprint..	Topography. For separate distribution.

## Maps published April 1, 1945 to March 31, 1946—Continued

Publication Number	Title	Remarks
823A	Essex County, and parts of adjacent counties (Northern part); scale, 1 inch to 2 miles.....	Geology. For Memoir 240, by J. F. Caley, and separate distribution.
824A	Essex County, and parts of adjacent counties, (Southeastern part); scale, 1 inch to 2 miles..	Geology. For Memoir 240, by J. F. Caley, and separate distribution.
825A	Essex County, and parts of adjacent counties, (Southwestern part); scale, 1 inch to 2 miles.	Geology. For Memoir 240, by J. F. Caley, and separate distribution.
828A	Windsor-Sarnia, Essex, Kent, and Lambton Counties; scale, 1 inch to 4 miles.....	Geology. For Memoir 240, by J. F. Caley, and separate distribution.
QUEBEC		
543A	Rawdon, Joliette, Montcalm, and Berthier Counties; scale, 1 inch to 2 miles. Second edition.....	Topography. For separate distribution.
547A	Joliette, Maskinonge, Berthier, Joliette, and Richelieu Counties; scale, 1 inch to 2 miles. Second edition.....	Topography. For separate distribution.
NEW BRUNSWICK		
829A	Waterford, Kings and Saint John Counties; scale, 1 inch to 1 mile.....	Geology. For separate distribution.
845A	Sussex, Kings and Queens Counties; scale, 1 inch to 1 mile.....	Geology. For separate distribution.
NOVA SCOTIA		
253A	Bridgetown Sheet, Annapolis County; scale, 1 inch to 1 mile. Reprint.....	Topography. For separate distribution.
509A	Hopewell, Pictou, Guysborough, Colchester, and Halifax Counties; scale, 1 inch to 1 mile. Reprint.....	Topography. For separate distribution.
510A	West River, Pictou, Colchester, and Halifax Counties; scale, 1 inch to 1 mile. Reprint...	Topography. For separate distribution.
821A	Port Greville, Cumberland County; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
822A	Five Islands, Cumberland and Colchester Counties; scale, 1 inch to 1 mile.....	Topography. For separate distribution.

## Maps published April 1, 1945 to March 31, 1946—Concluded

Publication Number	Title	Remarks
826A	Cape Chignecto, Cumberland County; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
839A	Tatamagouche, Colchester and Cumberland Counties; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
842A	Shinimikas, Cumberland County; scale, 1 inch to 1 mile.....	Geology. For separate distribution.
849A	River John, Colchester and Pictou Counties; scale, 1 inch to 1 mile.....	Topography. For separate distribution.
MISCELLANEOUS		
44-17	Palaeontology Revision of the Lower Cretaceous of the Western Interior of Canada (half-tone plates of fossils).....	Palaeontology. To accompany Paper 44-17.
45-27	The Upper Cretaceous and Dunvegan formations of Northwestern Alberta and Northeastern British Columbia (half-tone plates of fossils).	Palaeontology. To accompany Paper 45-27.
45-28	Lower Triassic of Liard River, British Columbia (half-tone plates of fossils).....	Palaeontology. To accompany Paper 45-28.

At the end of the fiscal year, maps of four areas in Northwest Territories, one in Yukon, one in British Columbia, three in Alberta, four in Saskatchewan, four in Manitoba, three in Ontario, and three in Nova Scotia were in progress. Geological and mineral maps of Saskatchewan, and a geological map of the Maritime Provinces were in process of compilation. An index map of Canada showing the National Topographical System was about to be published.

Two hundred and twenty-six map and scientific figure drawings were prepared for reproduction by zinc-cut process for illustrating memoirs, reports, articles, and papers; other draughting and miscellaneous projects necessary for staff, mineral development, and public use, amounted to more than six hundred separate items.

Eleven overseas service men were appointed to the staff.

## GEOGRAPHIC BOARD OF CANADA

The Geographic Board consists of fourteen members, six of whom are officers of the Federal Government, representing two Departments, namely, Mines and Resources, and National Defence. The remaining eight are Provincial members, representing British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, Prince Edward Island, and Nova Scotia. Quebec has its own Board, which deals with geographic nomenclature in that province, but is in direct contact with the Federal Board. The Secretary of the Geographic Board of Canada is an official of the Bureau of Geology and Topography.



Owing to war conditions, no meetings of the Board were held; however, the place names for sixty-four maps and twenty-one charts were considered and dealt with by the Executive Committee. Many inquiries were received from the Departments of the Government and from outside sources. These were investigated and the information supplied.

### NATIONAL MUSEUM OF CANADA

The National Museum of Canada had parties in the field in the Alaska Highway and southwestern Yukon areas, in Quebec, New Brunswick, British Columbia, and Alberta. As a result, the Museum was enriched by much valuable information and by numerous specimens relating to archæology, biology, and folk-lore.

Three Museum Bulletins were published. Forty-one papers and articles prepared by members of the staff appeared in the press, and three books were published. At the end of the year five monographs were in course of preparation. Twenty-six addresses were delivered over the radio and before educational and other organizations.

The Museum was visited by 223,500 persons, an increase of 10 per cent over the previous year, despite the fact that, because of war-time requirements for space, few of the exhibition halls were available. Of this total, about 17,000 adults and children attended the annual series of lectures sponsored by the Museum Lecture Committee. Museum films and slides loaned for educational purposes were viewed by a reported 68,213 persons.

The widespread co-operation and interest shown by other scientific organizations and by the public in the work and upbuilding of the National Museum is gratefully acknowledged.

It may be of interest to note that, during the late war, the staff of the Museum was able to supply the Intelligence Services much information regarding foreign customs, materials, and construction, particularly in the case of Japan. They determined the place of origin of primitive weapons and garments captured or acquired by active service personnel, and made a rodent survey for the medical services. Their most striking effort was the determination of the launching sites of Japanese balloons by the identification of vegetable particles contained in the ballast.

### ANTHROPOLOGICAL DIVISION

D. Jenness, Chief of the Division, continued on loan to the Royal Canadian Air Force.

C. Marius Barbeau, Ethnologist, carried out research and photographic work at various times, mostly in Montreal, Quebec, and Moncton; made a study of the parish archives of Berthier-en-haut; visited Ile-du-Pas; consulted the archives of Hotel-Dieu, Quebec; of Le Séminaire de Quebec, and of Hotel-Dieu de Montreal; spent a few days on investigations and photographic work at the Odanak (Abenaque) Mission, Quebec; and visited several points in the neighbourhood of Montreal. He made these trips in conjunction with a series of lectures given at the Université Laval and at the Université de Montréal.

Among the material or information he collected were 30 folk-songs, 13 of them with melodies; 2 folk tales; about 175 photographs; much linguistic material; notes of all kinds in the archives; measurements of old silver; recipes for food and medicines; and a notebook of linguistic and folk-lore data from Mme. Juliette Caron-Dupont. He recorded six Cree (Indian) songs on the phonograph; obtained the Collection J.-T. Lebland, of Acadian folk-songs, at Memramcook University, near Moncton, New Brunswick; and took photographs of Indian delegates to meetings at Ottawa.

Two of his books were published, namely, *L'Homme aux Trois Femmes* (Beauchemin, Montreal), and *Painters of Quebec* (Ryerson Press, Art Series, Toronto). Mimeographed summaries of his lecture *La Science de l'Homme* were issued by the Université Laval, and of his lecture *Peau-Rouge* by the Université de Montréal. Two of his new books were made ready for publication, namely, *Ceinture fléchée* (Editions Paysana, Montreal), and *Alouette*, a book of French Canadian folk-songs (Collection Humanitas, Montreal). He wrote a series of folk-lore articles for publication in *Archives de folk-lore*, Montreal (Fides), and a number of his other articles were published elsewhere in Canada and the United States. At the Université de Montréal, Université Laval, and the Université d'Ottawa he gave 128 lectures on anthropology, folk-lore, and human geography. These lectures covered the subjects, "Le Jardin de Melusine", "La Science de l'Homme", "Human geography of North America", etc.

Douglas Leechman conducted an archæological reconnaissance along parts of the Alaska Highway in southwestern Yukon. He found traces of a prehistoric migration route from Siberia into northwest America, which is believed, on geological evidence, to be about 8,000 years old. (Attention had been drawn to this material by Mr. Johnstone, Andover, Mass., who visited the same area in 1944.) He discovered a number of new sites and several new types of artifacts of this culture. On his way back from Yukon he spent a few days in the neighbourhood of Winnipeg, where archæological investigations are being made by the Historical and Scientific Society of Manitoba. He prepared an article on the economic importance of the National Museum of Canada; and, for the Royal Society of Canada, an article on distribution of rubbed slate implements in southern Ontario. He prepared a paper on the Aborigines of Yukon for the Northwest Territories Bureau of the Department of Mines and Resources; and prepared a plan for the expansion of the activities of the National Museum in field work and scientific research.

About 320 new anthropological specimens were added to the collections. The study collections now number 72,606. As each of these catalogue entries may represent a number of individual specimens, the collections now include over a quarter of a million specimens.

#### *List of Accessions*

##### *Specimens purchased:*

Nine ceintures fléchées; a collection of Prairie Indian beadwork; and a selection of Yukon and British Columbia Coast Indian specimens.

##### *Specimens collected:*

Archæological and ethnological material from Yukon, and archæological material from Winnipeg, by Douglas Leechman.

##### *Specimens presented:*

Prairie Indian leggings and knife sheath, by Mrs. G. S. Betts, Ottawa, Ontario.  
 Bone lance head from Flin Flon, Manitoba, by W. H. Bryenton, Edmonton, Alberta.  
 Stone net weight from Constance Bay, Ontario, by F. L. Coombs, Ottawa, Ontario.  
 Chipped stone arrow point from Legend, by Mrs. R. Kilpatrick, Legend, Alberta.  
 Archæological material from Lacolle, Quebec, and from Kentucky, by Mylo MacCallum, Lacolle, Quebec.

#### BIOLOGICAL DIVISION

Inadequate space and depleted staff handicapped the work. R. M. Anderson, Chief of the Division, retired on superannuation on December 30, and D. Blakely, Taxidermist, on September 23. A. L. Rand, Associate Zoologist, was placed in temporary charge of the Division.

Field work consisted of the collection of data on birds and mammals in southern Alberta and Saskatchewan by A. L. Rand during 4 summer months. He obtained many specimens, notes, and photographs.

In the Museum, requests for information on a great many aspects of natural history were met, notably one from the National Parks Bureau regarding the pronghorn antelope, which required the preparation of a comprehensive report.

Various specimens were identified for individuals. Research on birds and mammals, especially those of Alberta and the Northwest Territories, was actively prosecuted, together with a general survey of Canadian mammals.

R. M. Anderson completed his "Catalogue of Canadian Recent Mammals" and it was submitted for publication. Various points arising out of the preparation of this work were further developed in shorter papers.

A. L. Rand completed his accounts of "Yukon Mammals", "Mammal Investigation on the Canol Road", and "Mammals of the Ottawa District", which were published. He prepared and submitted for publication a distribution list containing all the information on Yukon birds; prepared a report on the status of the pronghorn antelope; continued work on a report "Mammals of Alberta" and on a report "Alberta Birds", and on a list of Greenland birds in the National Museum. Twelve of his papers on mammals and birds were published in scientific journals.

C. L. Patch, Chief Taxidermist and Herpetologist, modelled replicas of great auks and their eggs and placed them on exhibition in a group; designed a portable habitat group for school loans, and had one constructed that included miniature carved figures of black bears; made a scale model of a case for habitat groups; and collected and prepared a number of mammals and birds for exhibition and for the study and loan collections. He arranged and exhibited a collection of paintings of the larger mammals by the late Allan Brooks; and arranged birds in four exhibition cases for display to local school classes (estimated attendance 1,200 pupils).

C. E. Johnson, Collector-preparator Specialist, made casts of skulls; completed the accessories and background for a miniature habitat group for school loan; and prepared many illustrations for reports.

D. Blakely, Taxidermist, was occupied until his retirement in preparing specimens received, and in relaxing salted material received from the field and preparing it as permanent study material. He remade some old material into more usable specimens.

Notable accessions from private sources include a gift of a fine collection of mammals from W. H. Bryenton, collected in northern Manitoba, and accompanied by excellent field notes; topotypical specimens of newly described subspecies of white-footed mice from British Columbia, a gift of Ian McT. Cowan; and a transfer from the Nanaimo Fisheries Station, through R. E. Foerster, of a collection of sea birds made many years ago by W. Spreadborough.

#### NATIONAL HERBARIUM

A. E. Porsild, Botanist in charge of the Herbarium, was a Canadian delegate to a scientific congress held in Moscow from June 15 to July 2, in connection with the celebration of the 220th anniversary of the Academy of Sciences of the U.S.S.R. Following the Moscow meeting he spent 2 weeks in Sweden studying Swedish methods of forest and wild life management. To reach Moscow he travelled by air via Alaska and Siberia, returning to Ottawa on July 28 via the Atlantic. From August 1 to October 3 he made a survey of the flora of Banff National Park and made reconnaissance trips to Jasper, Kootenay, and Waterton Lakes Parks. At the end of the season he visited the provincial herbaria in Vancouver and Victoria. His survey of Banff Park resulted in a collection of 10,000 plant specimens, numerous ecological and taxonomical notes, and colour photographs.

He prepared a 150-page typewritten report on the Moscow meeting and on his trip through Siberia and Sweden, and made a summary of it, illustrated by photographs taken during the trip, for publication in the Canadian Geographical Journal. His paper, "Plant Life in the Arctic", was prepared for the manual, "The North American Arctic", which is being planned by the North American Arctic Institute. He made considerable progress on his monograph

on the flora of southeastern Yukon, and delivered addresses before the Edmonton Chamber of Commerce; the Ottawa Field-Naturalists Club; the Department of Geography, University of Toronto; staff members of the Royal Canadian Air Force, Ottawa, and the Canadian Geographical Society.

During the year, 263 requests for technical information were dealt with by correspondence; and 111 visitors from Canada and abroad consulted the collections in the Herbarium in quest of special information.

Herbarium specimens received by exchange totalled 1,740 and by donation, 797; 5,217 specimens were distributed to other herbaria on exchange, 987 were loaned, and 72 were borrowed from other herbaria.

Miss H. Harkness, Herbarium Assistant, mounted and inserted 4,795 herbarium specimens, bringing the total number of filed specimens in the National Herbarium to 176,630. She filed four issues of the Gray Herbarium Index and repaired 1,400 mounted sheets in the Herbarium.

To relieve serious overcrowding in the herbarium cases, the entire collection of Canadian plants was re-arranged following the addition of six cases.

## ACCESSIONS

The following accessions, apart from those contributed by members of the field staff, were obtained by donations and exchange, and are acknowledged with thanks.

*Mammals*

Adami, Oscar F., Fort Selkirk, Yukon .....	1
Barr, David C., Sherridon, Man. ....	1
Box, Major, Ottawa, Ont. ....	1
Bostock, Hugh S., Ottawa, Ont. ....	1
Brooks, Mrs. G. H., Brockville, Ont. ....	1
Butterworth, J. V., Ottawa, Ont. ....	1
Bryenton, R. W., Herb Lake, Man. ....	3
Bryenton, W. H., Herb Lake, Man. ....	84
Chambers, R. R., Whitehorse, Yukon .....	2
Cheney, Harry, Ottawa, Ont. ....	4
Clement, R. C., New York, N.Y. ....	1
Cowan, Ian McT., Univ. of British Columbia, Vancouver, B.C. ....	7
Coy, Maurice, Kinistino, Sask. ....	1
Dunk, F. A., Provincial Museum, Regina, Sask. ....	2
Farley, Frank, Camrose, Alta. ....	1
Frazer, F., Ottawa, Ont. ....	1
Green, H. U., Banff, Alta. ....	17
Griffin, Donald, Plymouth Union, Vermont, U.S.A. ....	2
Groves, J. W., Ottawa, Ont. ....	1
Hatt, Robert T., Bloomfield Hills, Michigan, U.S.A. ....	1
Hewitt, Oliver H., Ottawa, Ont. ....	1
Hubbard, Mrs. J., Grenfell, Sask. ....	1
Jones, H. S., Eastend, Sask. ....	2
LaRocque, A., Ottawa, Ont. ....	1
Leechman, D., Ottawa, Ont. ....	1
MacLennan, Canol Road, Yukon .....	1
Martin, D. J., Supt. R.C.M.P., Mackenzie district, N.W.T. ....	3
Manning, Lieut. Tom H., Ottawa, Ont. ....	61
Mould, Thomas, Fort Nelson, B.C. ....	1
Morris, R. F., Edmundston, N.B. ....	15
Patch, Clyde L., staff .....	6
Priestly, Mrs. I. M., Yorkton, Sask. ....	1
Rand, A. L., staff .....	470
Soper, J. Dewey, Winnipeg, Man. ....	10
Staley, Preson, Whitefish, Ont. ....	3
Tufts, R. W., Wolfville, N.S. ....	1
Voisie, Henry, Keewatin district, N.W.T. ....	18

## Birds

Blakely, D., staff .....	26
Bourguignon, A., Britannia, Ont. ....	1
Brooks, Allan, Okanagan Landing, B.C. ....	2
Bryenton, W. H., Herb Lake, Man. ....	10
Criddle, Stuart, Treesbank, Man. ....	1
Curtis, Murray, Ottawa, Ont. ....	1
DeLury, R. E., Ottawa, Ont. ....	1
Dunbar, M. J., Ottawa, Ont. ....	1
Farley, Frank, Camrose, Alta. ....	1
Foerster, R. E., Nanaimo, B.C. ....	49
Hawkins, R., staff .....	32
Hewitt, O. H., Ottawa, Ont. ....	6
Lavigne, J. P., Hull, Que. ....	1
Lawrence, Mrs. L. deK., Rutherglen, Ont. ....	1
Lord, C. S., Ottawa, Ont. ....	1
Mark, James, East Main, Que. ....	1
Melburn, Miss, Ottawa, Ont. ....	1
National Parks Bureau, Ottawa, Ont. ....	4
Ommanney, G. G., Hudson Heights, Que. ....	1
Patch, Clyde L., staff .....	6
Purcell, J., Cobden, Ont. ....	1
Rand, A. L., staff (Alberta collecting) .....	385
Royal Ontario Museum Zoology, Toronto, Ont. ....	5
Stedman, D. F., Ottawa, Ont. ....	1
Sterling, George, Ottawa, Ont. ....	1
Storto, Ernest, Ottawa, Ont. ....	1
Tufts, R. W., Wolfville, N.S. ....	1

## Amphibians and Reptiles

Burling, L. D., Pine River, B.C. ....	1
Criddle, Stuart, Treesbank, Man. ....	1
Dorion, Theo., Cascades, Que. ....	1
Frith, Sylvia, Norway Bay, Que. ....	1
Johnson, C. E., staff, Danford Lake, Que. ....	2
Priestly, Mrs. Isabel M., Yorkton, Sask. ....	2
Rand, R. M., Wolfville, N.S. ....	1
Rand, A. L., staff (Alberta collecting) .....	22
Robitaille, J. S., Jacques Cartier co., Que. ....	1

## Plants

- C. H. Crickmay, Haney, B.C., 42 plants from Franklin Mountains, N.W.T. (donation).  
 Dartmouth College, Hanover, N.H., 64 plants from Greenland (donation).  
 C. Heimburger, Ottawa, 4 plants (donation).  
 Rev. Ernest Lepage, Rimouski, Que., 115 plants from east coast of James Bay (donation).  
 C. S. Lord, Geological Survey, Ottawa, 2 specimens *Abies lasiocarpa* (donation).  
 W. C. McCalla, Calgary, Alberta, 5 specimens *Viola vallicola* (donation).  
 New York Botanical Garden, N.Y., 54 plants from U.S. (exchange).  
 N. Polunin, Oxford, England, 28 plants from Arctic Archipelago (donation).  
 M. P. Porsild, Godhavn, Greenland, 512 plants from Eurasia, Greenland, and U.S. (donation).  
 G. H. Turner, Fort Saskatchewan, Alberta, 25 plants from Alberta (donation).  
 University of Alberta, Edmonton, 182 plants from Alberta (donation).  
 University of Washington, 830 plants from western United States (exchange).  
 Botanical Institute, Uppsala, Sweden, 174 plants from United States and Canada (exchange).  
 State College of Washington, Pullman, Washington, 500 plants from Alberta, British Columbia, and Pacific northwest states (exchange).

## EDUCATIONAL WORK

National Museum educational activities were maintained at a high level, considering that most of the exhibition halls were closed to the public owing to the war-time need for office space. Every effort was made to permit students and others to make full use of the material in such sections of the halls as were accessible. Special educational exhibits were arranged

by the scientific staff for organized study groups, one of which had an attendance of 6,200. The exhibition halls were visited by 153,116 persons, including teachers, students, and members of the armed forces. Other Museum activities were attended by 69,934 persons, making a total attendance of 223,050. The attendance was somewhat larger than that of the previous year, due in part to more favourable transportation facilities, and is indicative of the sustained public interest in Museum displays and activities.

As formerly, a great deal of Museum material on anthropology, biology, and other phases of the natural history of Canada went to teachers, students, and other persons in all parts of Canada. One of the most popular and direct methods of spreading information on these subjects is by means of motion pictures and lantern slides, which were lent to Canadian educational institutions and other museums free of charge, except for cost of transportation one way. Replacements were made of those 16 mm. prints in the loan library that were too much worn for further use. Museum slides and films were seen by 68,213 persons. This figure is not a complete record as many borrowers fail to report attendance.

A large collection of photographs taken by officers of the National Museum and Geological Survey are available, from which many selections were made of photographs to illustrate scientific journals, school textbooks, and magazine and newspaper articles published in Canada, England, and the United States. The staff of the Museum devoted much time to the identification of specimens and to the loan of natural history specimens.

#### GEOLOGY AND MINERALOGY (Geological Survey)

The Geological Survey maintains a mineral exhibit in the Museum arranged in twenty-one separate cases, each designed to illustrate some particular feature, such as: what minerals are, how they occur, their crystal forms, colours, physical properties, chemical composition, and economic value. Collections of mineral and rock specimens available for distribution to the public for educational purposes are also on display in this exhibit. Altogether, 2,363 collections, numbering 89,853 specimens, were prepared and sold during the fiscal year.

#### PALÆONTOLOGY (Geological Survey)

The Palæontological Section of the Geological Survey has charge of the exhibits in the Vertebrate Hall as well as of cases of invertebrate fossils distributed elsewhere on the main floor of the museum. This Hall was recently re-arranged to offer better facilities for viewing the exhibits, which comprise fishes, amphibians, reptiles (dinosaurs, marine reptiles, turtles, crocodiles, and flying reptiles), and fossil birds and mammals. A fossil forest display is in the northeast alcove of the Hall.

#### NATIONAL MUSEUM LECTURES

The National Museum presented the annual series of public educational lectures and motion picture programs on natural history and related subjects, as well as topics of current social interest. The series, which continues to grow in popularity and to attract capacity audiences, is organized by a committee composed of: M. E. Wilson, Chairman, C. L. Patch, M. F. Goudge, F. J. Alcock, Marius Barbeau, and Miss M. Godwin, Secretary. The program of the 1945 season follows:

Call of the Wilderness (motion picture).

India in the British Commonwealth and Empire, by Sir Frederick Puckle, K.C.I.E., C.S.I., Adviser on Indian Affairs to the British Embassy, Washington, D.C., U.S.A.

- Road to Recovery (motion pictures).  
 The Story of DDT, by Dr. C. R. Twinn, Division of Entomology, Science Service, Department of Agriculture, Ottawa.  
 Australia, by Thomas Dunbabin, Press Attache, Australian High Commissioner's Office, Ottawa.  
 Recent Glimpses of Europe, by M. F. Goudge, Bureau of Mines, Department of Mines and Resources, Ottawa.  
 Saga of the St. Lawrence, by Marius Barbeau, National Museum of Canada, Department of Mines and Resources, Ottawa.  
 Yukon Trails, by H. S. Bostock, Ph.D., Geological Survey, Department of Mines and Resources, Ottawa.  
 Danger! Firearms and Explosives, by Inspector J. A. Churchman, R.C.M.P., Ottawa.  
 Atomic Energy, by Squadron Leader Peter M. Millman, Division of Research and Development, R.C.A.F., Ottawa.  
 From the Prairies to the Sea, by J. M. Humphrey, Travelogue Lecturer, Vancouver, B.C.  
 Fishways of the Fraser, by Tom Reid, M.P., Commissioner, International Pacific Fisheries Commission, New Westminster, B.C.  
 Sweden (motion pictures). The program was introduced by His Excellency, Per Wijkman, Minister of Sweden, Ottawa.

As a special event a Film Festival was held on the evenings of February 4, 5, and 6, at which there was a large attendance. Ten of the more outstanding documentary films were shown under the following general headings:

- Canada through the Camera's Eye.
- Britain Looks Forward.
- China Today.

The total attendance at all the lectures and motion picture programs was 8,620 school children, and 8,175 adults.

Members of the Canadian Boy Scouts Association acted as ushers during the children's lectures, along with the Sea Cadets. Their co-operation and that of the Royal Canadian Mounted Police is appreciated.

Particular acknowledgment is made of the co-operation of the local newspapers for reports of the various lectures, and of the Carnegie Library in selecting and providing lists of books related to the lecture subjects on the Museum programs. Copies of these lists were made available at the Museum to all who were interested in supplementary reading.

The donation of a motion picture on the koala bear, "Teddy Bears' Picnic" by the Australian High Commissioner's Office in Ottawa, for use on children's programs, is acknowledged with thanks.

#### LECTURE HALL

The Lecture Hall was made available to scientific, educational, government, and welfare organizations, and 150 reservations were made. The Hall has a seating capacity of 598, and has equipment for showing sound and silent 35 mm. and 16 mm. films, and lantern slides. There was a total attendance of 45,939 persons, and approximately 461,500 feet of film was shown.

#### BUREAU OF MINES

Work in the Bureau's laboratories since the end of the war has been in process of reversion to the solving of peace-time problems facing the mining and metallurgical industries. It seems opportune, therefore, now that the veil of secrecy concerning war-time activities has been lifted, to review briefly the accomplishments of the Bureau during the war in the fields of research in physical metallurgy, ore dressing, industrial minerals, ceramics, refractories, fuels, and in the testing of explosives.

The urgent demands of the Armed Services made it necessary to expand and enlarge the facilities for metallurgical testing and research. This included the erection of a building to house the Physical Metallurgy Research Labora-

tories, in which were handled many hundreds of investigations and thousands of routine tests for the Navy, Army, and Air Force, the British Admiralty Technical Mission, British Air Commission, Inspection Board of the United Kingdom and Canada, and the Department of Munitions and Supply.

Brief descriptions of these laboratories and their equipment appear in the Annual Reports of the Department for the years ended March 31, 1943 and 1944. Without these facilities the truly phenomenal volume of research and testing brought to successful conclusion during the war would have been impossible; and with the plastic deformation laboratories nearing completion, immediate conversion to the needs of peace-time industry is amply provided for. Canadian industry is more research-conscious than ever, and the laboratories are already contributing to industrial development.

Development of the materials of war led to a wide range of investigations in the Physical Metallurgy Research Laboratories. For instance:

Nearly every part of the snowmobile developed under the Department of Munitions and Supply for the Canadian Army was submitted for examination.

The service life of tank tracks in 1940 was only 500 miles. As a result of 150 investigations made of tank parts, notably of track and track pins, the service life had been extended to 5,000 miles in 1943.

The only small arms projectile capable of penetrating the armour of the Tiger Tank needed a core of tungsten carbide. The first of these cores made in North America was produced in the Bureau of Mines.

Production of the optimum qualities in steel demanded extensive research in heat treatment and in alloying elements. The fine quality of armour plate developed in Canada is tangible evidence of the success of these investigations. Similarly, the first successful armour-piercing shot made in Canada was a product of the Bureau.

When imports of aircraft control cable ceased, it became necessary to produce the cable in Canada and a testing machine was built in the Laboratories. In conjunction with the R.C.A.F. and the manufacturers, a cable of satisfactory quality was soon in full production.

Scientific principles of sampling were studied and were applied to the inspection of mass-produced articles, with resultant great economy in the work needed in gauging the quality of a batch of material.

The reports and the number in each case that were prepared on metals and their application were:

Subject	Number of reports	Subject	Number of reports
Carbon steels.....	965	White metals.....	52
Alloy steels.....	886	Malleable iron.....	31
Bronze.....	323	Copper and alloys.....	26
Aluminium.....	230	Zinc alloys.....	22
Ferro-alloys.....	169	Bearing alloys.....	19
Magnesium.....	164	Scientific inspection methods.....	17
Welded metal joints.....	119	Measurement of stress in metal.....	10
Brass.....	112	Tool steel.....	7
Corrosion of metal.....	92		

Reports were published also dealing with tungsten carbide, nickel tungsten, powdered iron, copper-nickel, copper-beryllium, nickel (plate), cadmium (plate), tin (plate), chromium (plate), tin, nickel, cobalt, lead, zinc, and uranium.

Brief accounts of some of the more interesting war-time projects that were carried out in the Ore Dressing, Industrial Minerals, and Fuel Research Laboratories follow.



Early in the war the supply of tungsten proved inadequate and the search for new sources and the development of known occurrences were promoted by the Bureau. Scheelite was found to occur in small amounts with the gangue in many gold deposits. Fifty gold mines were investigated and numerous new sources were provided. From 1939 to May 1944, a total of 420,000 pounds of ore was received from sixty different producers, and 126,000 pounds of tungsten concentrate was produced.

Molybdenum by 1942 was becoming difficult to obtain and the Metals Controller authorized the operation of the LaCorne property in LaCorne township, Quebec, by Wartime Metals Corporation, and arranged for the purchase of production from the Indian mine of Dome Mines, Limited, in Preissac township, Quebec. On the basis of the Bureau's investigation, suitable concentrating plants were designed. By diamond-drilling, a new low-grade orebody was found at the old Quyon property and a mill was designed for it.

Chrome ore also became scarce early in 1942 and deposits normally unable to compete with foreign sources were investigated. Beneficiation tests on chromite from the Eastern Townships, Quebec, led to the erection of a 150-ton mill at St. Cyr, Quebec, which produced 96,000 tons of 48 to 50 per cent concentrate, and of a 600-ton mill on the Belanger property near Thetford Mines. The former mill was operated under the supervision of the Bureau, and the latter under Wartime Metals Corporation. A total of 53,000 long tons of concentrate was produced. Ores were also investigated from Oiseau (Bird) River area in Manitoba, and from Lake Abitibi area in Quebec.

Extensive research was done on the beneficiation of iron ores from eastern Ontario, and on the beneficiation and treatment of low-grade manganese ores from different parts of Canada.

Better recovery of uranium at the mill of Eldorado Mining and Refining, Limited was investigated. Research was also begun in co-operation with the National Research Council in developing standard methods of analysis, and in the use of the Geiger counter in mill control. Numerous samples of rock from different parts of Canada were tested for radio-activity.

During the initial stages of adapting the ferrosilicon process for the production of magnesium to Canadian conditions, the Bureau co-operated with the National Research Council, and its grinding, calcining, and briquetting equipment was used for pilot-plant operation, thus appreciably shortening the time required. Asbestos waste rock was investigated as a source of magnesium chloride, as well as a process on pilot-plant scale for the production of electrolytic magnesium, using a bath of fused magnesium chloride.

Later in the war, concentration tests were made of tantalite minerals from various parts of Canada, principally from the Northwest Territories, as the demand for tantalum had become somewhat urgent.

A process had just been developed at the outbreak of war in the Bureau's laboratories for the recovery of magnesia from brucite limestones. Magnesite refractory brick is essential for lining furnaces used for the recovery of nickel and copper and for making steel, and much of the pure magnesia needed came from what was, later, enemy territory. In view of the great demand, a commercial plant for the recovery of magnesia was erected with the help of the Bureau, on the basis of this experimental work. Not only was the entire Canadian demand met, but an exportable surplus for other Empire countries was available.

Lead, zinc, copper, and graphite ores from properties idle because of high costs, but needed to augment supply, were investigated for methods of treatment.

A vast increase in metallurgical operations led also to a large amount of research and testing in the ceramic laboratories for all kinds of refractory material. Early in the war the expanding radio industry in Canada was con-

fronted with a serious shortage of insulator parts, and a similar problem faced the United States, from whence Canadian requirements chiefly came. Owing to their dielectric properties, steatite electrical insulators were found to be particularly suitable for radio and radar equipment, and with the co-operation of the United States War Production Board, experimental work on steatite bodies was undertaken. As a result, the first plant of its kind in Canada was designed and the successful outcome of the work had an important bearing on radio and radar production.

Talc from the Madoc area in Ontario was investigated and it was found that, had imports been restricted, the domestic talc could have been beneficiated satisfactorily.

Heat-resistance tests were made on Canadian phlogopite micas to determine their suitability for spark plugs in heavy duty aviation engines. The dielectric and power factors of Canadian muscovite micas were also studied.

Soils and road-building materials were tested to determine the best treatment to give stability to runway bases and shoulders in airfields.

Efforts were made to concentrate Canadian apatite to a fertilizer grade.

The separation of the small amount of potash that occurs in a salt deposit at Malagash, Nova Scotia, was attempted, and extensive research was done to obtain a much-needed high-grade salt. This work was continued on a pilot-plant scale at the property, under the supervision of the Bureau's engineers.

The facilities of the Fuel Research Laboratories were used early in the war to investigate methods for producing activated carbon suitable for gas masks from coconut shell, and later from selected Canadian coals and other raw materials. Equipment, especially a rotary drying oven, was used by the Directorate of Chemical Warfare, Department of National Defence, in connection with its process for treating activated carbon.

The relative merits of different domestic fuels was determined by tests in the various designs of stove used in Army hutments. Heating equipment at Army and Air Force camps was inspected and the detailed information so obtained was used in advising on the proper selection of coal and other fuels in relation to the supply available.

Exhaustive reviews were made of tenders for coal made to the Department of Munitions and Supply, as an aid in their selection; and, at the request of the Department of National Defence, samples of coal as delivered were tested for compliance with the specifications for purchase.

Degree-day record of weather-temperatures was maintained at various cities and other points throughout Canada and is still in progress. This has been of use to the Coal Controller, Department of Munitions and Supply, in allocating the supply of domestic fuel.

A process was developed in the Bureau whereby non-clinking anthracites can be made into a clinking product by chemical treatment to replace Welsh buckwheat coal for use in domestic blower furnaces. As Welsh buckwheat has been virtually unobtainable, this process, which is patented, has served a highly useful purpose.

Specially prepared peat was produced for the Directorate of Chemical Warfare, Department of National Defence.

Crude oil from Turner Valley, Alberta, was the subject of research as a source of toluene for use in explosives, and whether the octane rating of the gasoline fraction could be raised in both motor and aviation fuels.

Testing of gasolines, lubricating and fuel oils, as to compliance with specification for purchase was maintained for the Navy, Army, and Air Force. In the latter part of the war, research was in progress to determine the yield and quality of motor and aviation gasolines derivable from the bituminous sands of Alberta by hydrogenation.

As a sequel to the war effort, four members of the staff undertook field work on behalf of the Joint Committee on Enemy Science and Technology, under the auspices of the Department of Reconstruction and Supply. G. S. Farnham investigated the metallurgy of iron and steel and of light metals in Germany, being absent from August 2 to October 31, 1945. M. F. Goudge studied the industrial minerals in Germany, Austria, and Italy between August 2 and November 18, 1945. J. G. Phillips was in Germany and the United Kingdom from November 5, 1945 to February 21, 1946, investigating ceramic materials. T. E. Warren studied German methods of hydrogenation and the synthesis of liquid fuels between August 1 and October 13, 1945.

### ECONOMICS DIVISION

The Division is basically concerned with all economic considerations affecting the development and conservation of Canada's mineral resources. Its mineral investigatory and information service is freely used by the mining and allied industries, by Government departments, and by others interested in Canadian mining and its large significance in the national economy.

The year marked the end of war mineral problems and the direction of the Division's special attention to contributions which Canadian mining can make to post-war reconstruction. Its Chief, who had been on loan to the Department of Munitions and Supply since July, 1940, first in the Metals Controller's Office, and later in the Canadian Section of the Combined Resources and Production Board in Washington, returned to the Division in November. Since his return he has also acted as a special liaison officer between the Canadian base-metal producers and the various Government departments, particularly those concerned with problems of domestic supply and the export requirements of foreign countries.

Studies were made for Government use on the post-war labour requirements of Canadian mines; on the probable life of mining operations in an area of northwestern Quebec, as required for arriving at a reasonably assured amortization period for housing loans; and on mining taxation, comparing taxes levied on Canadian and South African gold mines. A study was also begun on the iron ore situation in Canada.

Special attention was given to the correlation and preparation of material on projects proposed by the Mines and Geology Branch for inclusion in the Dominion post-war reconstruction program; and on the varied functions and activities of the Mines and Geology Branch, for inclusion in the Dominion submissions to the Dominion-Provincial Conference on Reconstruction.

Investigations, including field work and laboratory tests, were made on Craigmont corundum concentrate, and on Lakefield nepheline syenite concentrate for rare and heavy minerals; and tests were conducted on garnet from the North Bay and Sudbury areas. An investigation on roofing granules, commenced in 1944, was completed.

Mineral samples examined and reported upon, some after analysis, included: 17 for corundum; 4 for garnet; 2 each for molybdenite and diatomite; 5 for rock granules; and 14 for minerals generally.

The preparation of the annual reviews of Canadian minerals for 1944 was completed with the assistance of engineers of other Divisions of the Bureau, and these were printed as separates. Part of the edition, however, was issued in book form as Report No. 815, "The Canadian Mineral Industry for 1944," and was given selective distribution. These reviews dealt with seventy-six minerals, summarizing in each case the noteworthy Canadian developments for the year. Substantial progress was made on the preparation of the reviews for 1945; also on the revision of the manuscript of the fifth edition of the report,

"The Mineral Industries of Canada", last issued in 1934. This report is designed to present a comprehensive statement of the development of Canada's mineral resources that the annual reviews will supplement and keep up to date.

Revised lists including: Coal Mines in Canada; Milling Plants in Canada, Part I, Metallic Ores; and Metallurgical Works in Canada, Part I, Iron and Steel, and Part II, Non-Ferrous Metals, were issued. A survey of Canadian operators of clay properties, mainly brick plants, was made as the basis for the preparation of a new list in the series.

The annual survey of deliveries for consumption by important uses of petroleum fuels in Canada for 1944 was completed, and the report in the form of a printed tabulated folder was released in August. Report No. 814, "Petroleum Fuels in Canada, Deliveries for Consumption, Calendar Years 1940-1944", consolidating for comparison and permanent record the results of these surveys for the preceding five years, was also completed, and was distributed in January. This survey has been made each year since 1927 for the Dominion Fuel Board and its wartime successors, the Coal Administrator, and the Coal Controller.

Almost 1,000 requests by letter and many by personal call from prospectors, mine operators, and others for information pertaining to Canada's mineral resources, mine development problems, mining laws and regulations, mineral markets, etc., were received and answered. Although more numerous than in the preceding year, and thus reflecting the beginning of a post-war revival in mining interest, these inquiries were fewer than in pre-war years. Incidental to this important function of acting as a central clearing house for all such mineral and related information, as well as to the effective conduct of the economic investigatory work of the Division, was the continuous routine work of assembling, tabulating, recording, and indexing current mineral data from all available sources for addition to the already large pool of such information that has been accumulating for many years. A special addition was made by transfer from the Metals Controller's Office of about 900 of its files on mineral properties of war-time interest and on developments relating to war-time mineral supply. Work was resumed on the mineral resources inventory, correlating for each known mineral deposit all significant data pertaining to discovery, exploration, and past, present, and possible future development.

Reports on mining properties were prepared for the Deputy Minister or the Director to assist the Department of National Revenue in dealing with one application under Section 89, Income War Tax Act, providing for three years' exemption from income tax on profits derived from new metalliferous mines, and with three applications under Section 7(g), Excess Profits Tax Act, providing for a similar exemption from excess profits tax on profits derived from new base metal and strategic mineral mines. Other assistance extended to the Department of National Revenue included the examination of representations made by a mining operator for upward revision of depletion allowances in respect of two properties; and the assignment of a senior member of the staff to serve on a Business Classification Committee, Excess Profits Tax Act, specially created to advise the Minister on the consideration to be given applications under Section 5(4) of the Act for revision of Standard Profits on the basis of a substantial change since the Standard Period in the class of business carried on.

Reports and other material were prepared, with the assistance of the Chief Geologist, for the Minister's information in dealing with 17 applications under Section 8(10) Income War Tax Act, authorizing special tax deductions in respect of expenditures made in drilling deep test oil wells recommended by the Minister of Mines and Resources and approved by the Governor in Council.

The Division, through one of its engineers, co-operated with the Canadian Legion Rehabilitation Committee in arranging for the preparation of four useful handbooks on prospecting and mining in Canada, for use in its vocational educational program for members of the Armed Forces; also with the National Film Board in advising upon and in reviewing documentary films pertaining to mining.

Prospectors' Identification Cards were issued, mostly with the co-operation of the provincial mining recorders, to the number of 1,015, compared with 922 in 1944 and with 790 in 1943. All arrangements for issuing these cards, which are valid for only one year, and which enable their holders to obtain the extra quantities of rationed foods required for active prospecting in remote areas, were made by the Division, which reviewed and filed all applications. With the continuation of food rationing, provision has been made for another issuance of these cards.

A senior officer of the Division continued on assignment to the Director's Office on administration of special mineral projects undertaken for war purposes. A senior map draughtsman continued on loan to the National Research Council. The Division lost two valued members of its staff by the retirement prior to superannuation of John M. Casey, statistician, and of Miss D. M. Stewart, research clerk, with records respectively of over 36 and 32 years of efficient service in the Bureau and its predecessor.

### LIBRARY

The Librarian reports the following additions:

Books and pamphlets ordered.....	304
Bureau of Mines reports added to the circulating division.....	11
Canadian Government documents—individual issues (by exchange and gift) .....	1,434
British and Foreign Government documents—individual issues (by exchange and gift).....	1,364
Scientific societies' bulletins, proceedings, and transactions—individual issues (by exchange and gift).....	1,215
Periodicals (other than scientific societies, Canadian, British and Foreign Government documents)—individual issues.....	2,986
Books and pamphlets (by gift).....	162
Periodicals and annuals subscribed for.....	222
Annuals, continuations and periodicals (by gift).....	433
Cards added to the catalogue.....	900
Volumes bound.....	126
Recorded loans.....	8,262

### METALLIC MINERALS DIVISION

The investigations in the Physical Metallurgy Research Laboratories covered a wide range of work in the development and examination of the materials of war required by the Armed Forces as shown in the "List of Investigations" that follows. Service was also rendered to various Canadian metallurgical industries engaged in war contracts and in peace-time pursuits.

Following V-J day the war work diminished, and the facilities for research in steel and other metals were immediately utilized in service to Canadian industry. At the request of the Steel Castings Institute of Canada, research projects of major importance to this industry were undertaken.

The knowledge gained in the application of magnesium to war uses has been utilized and extended to peace-time needs. This new peace-time industry requires careful planning and much assistance, for its product to find application in the field of metals. An Industrial Advisory Committee set up to supervise magnesium research and to recommend projects of importance is made up of representatives from the Division's laboratories and from the Department of National Defence, and the Canadian magnesium industry.

Progress was made in the setting-up of a special laboratory for rolling, extrusion, and die-casting operations.

A major investigation concerned the prevention of corrosion of magnesium alloys for use in jungle warfare. Considerable work was done on protecting steel and other metals from marine corrosion.

A project of international importance is the standardization of the Anglo-American-Canadian screw thread. Jointly with the National Research Council close liaison is maintained on this project with the work of the National Physical Laboratories, England, and of the Bureau of Standards, Washington.

The Division was asked to assist in the investigation of metallurgical problems arising from the development of atomic energy at Chalk River, Ontario.

Two interrelated projects were in progress for Turbo Research, Limited. One involves the determination of the behaviour of metals under tension at elevated temperatures. A special laboratory, known as a "Creep-Testing Laboratory", was set up for this purpose on a shared cost basis with Turbo Research, the design and erection being entirely the responsibility of the Bureau of Mines. The other project is the search for a new and superior alloy for the blades of gas turbine engines such as are used in aircraft engines, stationary installations, or prime movers. Three specific alloy systems were under investigation and some 150 alloys were produced and subjected to preliminary testing. After the close of the fiscal year, arrangements were made for the National Research Council to take over the work on the two projects.

#### *List of Physical Metallurgical Investigations Reported Upon*

- 1768. Metallurgical examination of defective 4.5-inch shell forgings. (I.B.U.K. & C.) (January 2, 1945.)
- 1769. Metallurgical examination of two S.A.E. 4340 steel plates. (D.M. & S.) (January 2, 1945.)
- 1770. Evaluation of corrosion resistance of selenium-coated steel strip. (Canadian Copper Refiners.) (January 3, 1945.)
- 1771. Progress report on the investigation of selenium-coating methods for magnesium. (Canadian Copper Refiners.) (January 3, 1945.)
- 1772. Metallurgical examination of a Belleville spring washer. (B.A.T.M.) (January 3, 1945.)
- 1773. Metallurgical examination of armour welds of a Sexton 25-pdr. self-propelled gun mount. (I.B.U.K. & C.) (January 6, 1945.)
- 1774. Metallurgical examination of two volute springs for medium tanks. (D.M. & S.) (January 8, 1945.)
- 1777. Examination of Dominion Magnesium, Limited, alloy steel retort No. C-995. (Dominion Magnesium.) (January 9, 1945.)
- 1778. Microscopic examination of fifteen samples of manganese steel. (Sorel Steel Foundries.) (January 10, 1945.)
- 1779. Examination of fractured composite tail tubes of a P.I.A.T. bomb. (I.B.U.K. & C.) (January 24, 1945.)
- 1780. Preliminary longitudinal testing of welds. (D. M. & S.) (January 25, 1945.)
- 1781. Examination of Dominion Magnesium, Limited, alloy steel retort No. C-951. (Dominion Magnesium.) (January 25, 1945.)
- 1782. Preliminary report on investigation into the influence of carbon on the rates of creep of austenitic iron-nickel-chromium alloys of the 35% nickel-15% chromium type of temperatures above 1100°C. (Dominion Magnesium.) (February 2, 1945.)
- 1783. Investigation of corrosion resistance of lightened mortar base plates and bipod. (Army.) (January 25, 1945.)
- 1784. Microscopic examination of twenty-two samples of austenitic manganese steel. (Sorel Steel Foundries.) (February 1, 1945.)
- 1785. Metallurgical examination of a broken high-speed steel mill cutter. (Alexander Fleck.) (February 1, 1945.)
- 1786. Investigation of corrosion resistance and mechanical properties of steel strapping. (D. M. & S.) (February 1, 1945.)
- 1787. Examination of broken tail units of 4.2-inch trench mortar bombs. (I.B.U.K. & C.) (February 7, 1945.)
- 1789. Use of electroplated chromium as a surface protection to aluminium alloy. (D. M. & S.) (February 13, 1945.)
- 1790. Examination of magnaflex indications on three Lancaster aircraft mainplane attachment bolts. (R.C.A.F.) (February 13, 1945.)
- 1791. Examination of welded disk wheel clamping bolts. (I.B.U.K. & C.) (February 13, 1945.)
- 1792. Cause of corrosion in 4-inch twin mounting, Mark XIX, buffer cylinder (B.A.T.M.) (February 16, 1945.)

1793. Examination of six Q.F. 4-inch, Mark IV, gun cartridge cases. (Navy.) (February 17, 1945.)
1794. Microscopic examination of eighteen samples of austenitic manganese steel. (Sorel Steel Foundries.) (February 17, 1945.)
1795. Metallurgical examination of forged steel spring clips. (I.B.U.K. & C.) (February 19, 1945.)
1796. Investigation of cased Universal carrier track pins. (Allied Products and Commercial Steel Treating Corporation.) (February 19, 1945.)
1797. Corrosion resistance of anti-corrosion oils for aircraft engines. (R.C.A.F.) (February 20, 1945.)
1798. Comparison of tensile strength tests on core sand mixtures from the Hull Iron and Steel Foundries. (Hull Iron and Steel.) (February 20, 1945.)
1799. Examination of three U.S. light tank steel track links. (Hull Iron and Steel.) (February 22, 1945.)
1800. Metallurgical examination of steel base plate blanks for 5.5-inch shells. (I.B.U.K. & C.) February 23, 1945.)
1801. Corrosion-resistant coatings for magnesium: a survey. (February 27, 1945.)
1802. Examination of riveted C.D.P. track pins and washers. (I.B.U.K. & C.) (March 1, 1945.)
1803. A process for acid-pickling brass castings to improve their appearance. (Ottawa Car and Aircraft.) (March 3, 1945.)
1804. Metallurgical examination of two manganese steel castings. (Sorel Steel Foundries.) (March 5, 1945.)
1805. Examination of welded tubing from fuselage of Harvard aircraft. (R.C.A.F.) (March 5, 1945.)
1807. Examination of drillings from furnace of S.S. *Albert Park*. (Dept. of Transport.) (March 7, 1945.)
1809. Determination of contraction of parts of a Mark XXIII gun sight at sub-zero temperatures. (B.A.T.M.) (March 10, 1945.)
1810. Examination of surface corrosion on aluminium alloy sheet. (R.C.A.F.) (March 12, 1945.)
1812. Cause of dark streaks on certain types of magnesium alloys after anodizing to improve corrosion resistance. (Dominion Magnesium.) (March 13, 1945.)
1814. Examination of compressed air cylinder. (R.C.A.F.) (March 19, 1945.)
1815. Investigation of T-16 Carrier track pins from Somerville Testing Grounds (I.B.U.K. & C.) (March 20, 1945.)
1816. Hot-strength tests on Hull Iron and Steel Foundry sands. (Hull Iron and Steel.) (March 21, 1945.)
1817. Metallurgical examination of pin from Aircraft Aileron control system. (Dept. of Transport.) (March 19, 1945.)
1818. Metallurgical examination of bulletproof plate for carrier floor. (D.M. & S.) (March 22, 1945.)
1819. Metallurgical examination of broken section of 4-wheel-drive rear axle shaft. (D.M. & S.) (March 23, 1945.)
1820. Identification of some non-ferrous alloys used in the construction of a Japanese balloon. (Army.) (March 26, 1945.)
1821. Corrosion resistance of electroplated steel parts. (I.B.U.K. & C.) (March 26, 1945.)
1822. Construction of welded 3-inch mortar base plates. (Army.) (March 26, 1945.)
1823. Corrosion resistance of an anti-corrosion oil for aircraft engines. (R.C.A.F.) (March 27, 1945.)
1824. Metallurgical examination of defective striker needles for the fuze 119 B Mk. 10. (I.B.U.K. & C.) (March 28, 1945.)
1825. Corrosion products in Pattern 0921 compasses. (B.A.T.M.) (March 29, 1945.)
1826. Salt spray corrosion test on plated steel tee bolt and hand nuts. (I.B.U.K. & C.) (March 29, 1945.)
1827. Comparison on corrosion-resistant coatings on magnesium alloy castings. (Light Alloys, Ltd.) (March 29, 1945.)
1828. Evaluation of corrosion resistance of selenium-coated steel strip. (Canadian Copper Refiners.) (March 29, 1945.)
1829. Metallurgical examination of two broken steel studs from a snowmobile rebound chain assembly. (D.M. & S.) (April 2, 1945.)
1830. Metallurgical examination of mud saw cutting wheels, warped in service. (Navy.) (April 3, 1945.)
1831. Thickness of corrosion-resistant cadmium-plated coatings on steel bolts. (I.B.U.K. & C.) (April 4, 1945.)
1832. Metallurgical examination of two (X.C.R. and T.P.A.) exhaust valves and a valve seat. (I.B.U.K. & C.) (April 6, 1945.)

1833. Tests on Beach Foundry Limited moulding sands. (Beach Foundry.) (April 10, 1945.)
1834. Examination of riveted C.D.P. track pins and washers (I.B.U.K. & C.) (April 9, 1945.)
1837. Metallurgical examination of broken bogie pin from 20-ton transporter. (D.M. & S.) (April 16, 1945.)
1838. The sliding quench treatment for steering end ball sockets. (Hull Iron and Steel.) (April 19, 1945.)
1839. Corrosion protection afforded to steel by a typical organic silicon oxide polymer. (B.A.T.M.) (April 16, 1945.)
1840. Corrosion resistance of identity disks and chains. (Army.) (April 17, 1945.)
1841. Anti-corrosion properties of three compounds submitted by Imperial Oil, Limited. (Imperial Oil.) (April 17, 1945.)
1842. Preliminary report on metallurgical examination of 60 mm. British armour plate. (I.B.U.K. & C.) (April 18, 1945.)
1843. Heat treatment of jungle track link connectors to increase surface hardness. (Army.) (April 18, 1945.)
1844. Corrosion resistance of cadmium-plated steel bolts. (I.B.U.K. & C.) (April 18, 1945.)
1845. Corrosion protection afforded to steel by Shell Ensis Fluid 211 in the Dynamic Humidity Cabinet Test. (R.C.A.F.) (April 19, 1945.)
1846. Corrosion-resisting properties of a zinc coating sprayed on steel. (Navy.) (April 20, 1945.)
1847. Effect of varying cleaning procedure in corrosion protection test in Specification C-27-587. (R.C.A.F.) (April 26, 1945.)
1848. Adherence of a thick rubber coating to magnesium alloys containing zinc. (Army.) (April 26, 1945.)
1849. Metallurgical examination of induction-hardened snowmobile sprockets. (I.B.U.K. & C.) (April 24, 1945.)
1850. Metallurgical examination of copper trolley wire. (B.C.W.M.R.B.) (April 25, 1945.)
1852. Examination of brazed aluminium rods. (R.C.A.F.) (April 27, 1945.)
1853. Examination of extruded magnesium alloy channel section assembly with steel locking device. (Army.) (April 28, 1945.)
1854. Metallurgical examination of flame-hardened cast iron cylinder blocks. (I.B.U.K. & C.) (April 26, 1945.)
1855. Metallurgical examination of a welded steel, enemy incendiary container. (Army.) (April 30, 1945.)
1856. Corrosion resistance of painted and electroplated steel nuts, bolts, and washers. (Dept. of Transport.) (May 1, 1945.)
1857. Analysis of metal deposited from various welding electrodes. (I.B.U.K. & C.) (May 8, 1945.)
1858. Rubber coating processes for protecting magnesium from corrosion and abrasion. (May 2, 1945.)
1859. Investigation of synthetic moulding sand from British Columbia. (B.C.W.M.R.B.) (May 9, 1945.)
1860. Investigation of residual stresses in welded ship plate. (Canadian Vickers.) (May 3, 1945.)
1861. Corrosion resistance of identity chains and disks. (Army.) (May 17, 1945.)
1863. Metallurgical examination of a Pitman shaft gear, twisted in service. (I.B.U.K. & C.) (May 9, 1945.)
1864. Corrosion resistance of Galv-Weld alloy coating applied to steel pipe. (Navy.) (May 10, 1945.)
1865. Corrosion protection afforded to steel by a typical organic silicon oxide polymer. (B.A.T.M.) (May 10, 1945.)
1866. Prevention of hydrobromic acid corrosion by corrosion preventive compounds (Specification C-27-587). (R.C.A.F.) (May 11, 1945.)
1867. Nature of corrosion on under surfaces of wings, fuselages, and tail units of Lockheed Model 12A Aircraft CF-BZM and CF-BZN. (Dept. of Transport.) (May 14, 1945.)
1868. Metallurgical examination of snowmobile sprocket and cross link after field test. (D.M. & S.) (May 30, 1945.)
1869. Examination of a fractured cast iron generator crankshaft from H.M.C.S. *Lachine*. (Navy.) (May 30, 1945.)
1870. Metallurgical examination of 2-inch mortar signal bombs (I.B.U.K. & C.) (July 13, 1945.)
1871. Metallurgical examination of steering end ball sockets from armoured truck (D.M. & S.) (May 30, 1945.)
1872. Cause of corrosion in Pattern 0921 compasses. (B.A.T.M.) (May 22, 1945.)
1873. Corrosion prevention value of Shell Ensis Fluid 211 (Specification D.N.D. 702 for dewatering corrosion preventive compounds.) (R.C.A.F.) (May 23, 1945.)



1874. Metallurgical examination of broken bolt from Type C-4 Liberator gas filter. (R.C.A.F.) (June 1, 1945.)
1875. Metallurgical examination of a broken camshaft from a 3-ton Dodge truck. (D.M. & S.) (June 2, 1945.)
1876. Examination of a broken steel mould. (Dominion Plastics.) (June 1, 1945.)
1877. Corrosion resistance of copper sleeves for bilge pumps for Phoenix steel nesting barges. (Dept. of Transport.) (June 4, 1945.)
1878. Corrosion resistance of aluminium and tin-coated steel mess tins. (Army.) (June 7, 1945.)
1879. Corrosion resistance of black coatings on steel tubes. (Ottawa Car and Aircraft.) (June 7, 1945.)
1880. Investigation of hot strength of moulding and core sands from the Hull Iron and Steel Foundries. (H.I.S.) (May 7, 1945.)
1882. Protection afforded by corrosion-preventive compound for aircraft engines (Specification D.N.D. C-27-587). (R.C.A.F.) (June 7, 1945.)
1884. Metallurgical examination of failed lever arm tubing from control system of a Crane aircraft. (R.C.A.F.) (June 21, 1945.)
1885. Metallurgical examination of fractured end stud from bogie spring rebound chain assembly (armoured snowmobile). (D.M. & S.) (June 22, 1945.)
1886. Behaviour of foot valves and steam cocks for 60-foot Phoenix steel nesting barges, S-4, under corrosive conditions. (Dept. of Transport.) (June 21, 1945.)
1887. Metallurgical examination of broken track re-inforcing cleats from armoured snowmobile. (D.M. & S.) (June 25, 1945.)
1888. Corrosion resistance of small steel parts (nuts and bolts) coated with a removable organic protective coating. (Dept. of Transport.) (June 21, 1945.)
1889. Heat treatment of cast iron cylinder blocks. (I.B.U.K. & C.) (June 6, 1945.)
1890. Corrosion resistance of an Intava anti-corrosion compound for aircraft engines (Specification C-27-587). (R.C.A.F.) (June 25, 1945.)
1891. Corrosion resistance of anti-corrosion compound for aircraft engines (Specification C-27-587). (R.C.A.F.) (June 26, 1945.)
1892. Hydrobromic acid neutralization by two unknown oils (Specification C-28-34). (R.C.A.F.) (June 25, 1945.)
1893. Chopper plates for grain grinders. (N.B. Lindsay.) (July 9, 1945.)
1894. Corrosion resistance of identity disks and chains issued to the U.S. Army. (Army.) (June 30, 1945.)
1895. Examination of aircraft crankcase centre section. (T.C.A.) (July 9, 1945.)
1896. Cause of corrosion of metal parts for Marine Compass W.D. 32. (B.A.T.M.) (July 6, 1945.)
1897. Bismuth in molybdenic oxide; its effect in steelmaking. (July 9, 1945.)
1898. Corrosion resistance of blackened steel tubes treated with protective organic material. (Ottawa Car and Aircraft.) (July 11, 1945.)
1899. Corrosion resistance of coated and uncoated magnesium and aluminium alloys. (Fairchild Aircraft.) (July 12, 1945.)
1900. Effect of corrosion on the strength of certain magnesium and aluminium alloys and steel. (Army.) (July 6, 1945.)
1901. Metallurgical examination of aluminium connecting rod bearing from Leyland Diesel engine. (D.M. & S.) (July 13, 1945.)
1903. Metallurgical examination of a damaged aluminium alloy truck wheel. (D.M. & S.) (July 19, 1945.)
1904. Longitudinal testing of welds of armour plate. (D.M. & S.) (July 23, 1945.)
1905. Metallurgical examination of an experimental jungle track shoe steel casting. (D.M. & S.) (July 16, 1945.)
1906. Alternative technique for cleaning the surface of steel test panels prior to coating with rust preventive compounds (D.N.D. 700, 701, 702, 703.) (July 20, 1945.)
1907. Metallurgical examination of a broken spring leaf. (D.M. & S.) (July 25, 1945.)
1908. Metallurgical examination of cast ring finishing dies for hot drawing of seamless tubing. (Page-Hersey.) (August 2, 1945.)
1909. Effect of salt spray and ordinary atmosphere corrosion on steel strapping. (U.K. Ministry of Transport.) (August 16, 1945.)
1910. Investigation of striations in welded ice-breaker ship plate. (Dept. of Transport.) (July 30, 1945.)
1911. Electropolishing of chains for identification disks in an attempt to improve their corrosion resistance. (Army.) (August 2, 1945.)
1912. Corrosion resistance of Prestitico sealer for spot-welded joints. (Canadian Marconi.) (August 2, 1945.)
1913. Effect of corrosion on magnesium alloy AZ31X, aluminium alloys 17ST and 75ST, and mild steel. (Army.) (August 9, 1945.)
1914. Preferred method of applying a corrosion-resistant coating to used magnesium parts. (Army.) (August 8, 1945.)

1915. Effects of bentonite, cereal flour, silica flour, and water on moulding characteristics of a No. 60 sand. (Hull Iron and Steel Foundries.) (August 24, 1945.)
1916. Investigation into the influence of nickel and chromium on the rates of creep of austenitic iron-nickel-chromium alloys at temperatures above 1100°C. (2012°F.) (Dominion Magnesium.) (August 30, 1945.)
1919. Corrosion resistance, composition, and hardness of clasp-knife parts. (Army.) (August 8, 1945.)
1920. Metallurgical examination of iron powders. (H. Freeman.) (September 6, 1945.)
1922. Metallurgical examination of three austenitic manganese steel samples. (Sorel Steel Foundries.) (September 6, 1945.)
1923. Low temperature impact tests on 60 mm. British armour plate. (I.B.U.K. & C.) (September 22, 1945.)
1924. Examination of cracked welds in 35% Ni-15% Cr steel retorts used for production of magnesium. (Dominion Magnesium.) (September 29, 1945.)
1925. Resistance of painted steel to salt spray corrosion. (D.M. & S.) (September 10, 1945.)
1926. Corrosion resistance of metal name plates for export packing cases. (D.M. & S.) (September 8, 1945.)
1927. Corrosion resistance of anodized magnesium sheet coated with plastic. (Shawinigan Chemicals.) (September 12, 1945.)
1928. The use of different lubricating oils in testing corrosion preventive compounds for aircraft engines. (September 13, 1945.)
1929. Properties of two corrosion preventive compounds for aircraft engines. (September 8, 1945.)
1930. Metallurgical examination of portion of submarine propeller blade exhibiting cavitation pitting. (Navy.) (September 25, 1945.)
1931. Metallurgical examination of iron powder. (Sorel Industries, Limited.) (September 14, 1945.)
1933. Relationship of paint thickness and steel microstructure to corrosion resistance of painted steel sheets. (D.M. & S.) (September 27, 1945.)
1934. Corrosion resistance of pure magnesium and typical magnesium alloys produced by different manufacturers. (Dominion Magnesium.) (October 16, 1945.)
1935. Report on properties of mould and core sand used at Hull Iron and Steel Foundries, Limited. (Hull Iron and Steel.) (September 18, 1945.)
1936. Metallurgical examination of iron powder. (Consolidated Mining and Smelting Co.) (September 24, 1945.)
1937. An investigation of the nickel-aluminium alloy system between 70%Ni-30%Al and 80%Ni-20%Al. (Turbo Research.) (October 12, 1945.)
1938. Investigation of defects in aluminium sand castings. (A. C. Boak.) (September 27, 1945.)
1939. The relative creep strength of a 35% Ni-15% Cr alloy and a 28% Cr-20% Ni alloy at temperatures above 1100° C. (2012° F.) (Dominion Magnesium.) (October 3, 1945.)
1940. Anodising and colouring of aluminium for improved corrosion resistance and appearance. (E.D.H. Co.) (September 29, 1945.)
1941. Metallurgical examination of a cast iron mould (Alexander Fleck, Ltd.) (October 6, 1945.)
1942. Corrosion resistance of various zinc coatings on steel wire. (Steel Company of Canada.) (October 4, 1945.)
1943. Corrosion protection of dewatering rust preventive compounds. (Canadian Government Purchasing Standards Committee.) (October 13, 1945.)
1944. Metallurgical examination of a high-speed steel broach. (I.B.U.K. & C.) (October 9, 1945.)
1945. Corrosion resistance of pure magnesium and typical magnesium alloys produced by different manufacturers. Part II—Chemical analysis and mechanical properties of the materials tested. (Dominion Magnesium.) (October 27, 1945.)
1946. Metallurgical investigation of rock drill bits for Lake Shore Mines, Limited. (Lake Shore Mines.) (October 26, 1945.)
1947. Preliminary report on some physical properties of stellite. (Deloro Smelting and Refining Co.) (November, 1, 1945.)
1949. Metallurgical examination of cracked flame-hardened rail segments from a revolver gantry crane. (Navy.) (October 31, 1945.)
1950. Corrosion protection of exterior rust preventive compounds. (Canadian Government Purchasing Standards Committee.) (October 31, 1945.)
1951. Cause of pitting of magnesium parts during application of corrosion-resistant coating. (Army.) (October 31, 1945.)
1952. Investigation of the cause of leaking in a boiler casting. (Warden King, Limited.) (October 31, 1945.)

1953. Metallurgical examination of enameled cast iron stove plate containing pin hole defects. (Findlay's, Ltd.) (November 6, 1945.)
1954. Corrosion protection of interior rust-preventive compounds. (Canadian Government Purchasing Standards Committee.) (November 8, 1945.)
1955. Plant specifications for anodizing and colouring aluminium parts for electric toasters. (E.D.H. Co.) (November 6, 1945.)
1956. Treatment of pure magnesium and magnesium alloys by the D. C. Electrolytic Coating Process of the H.D.A. Co. (Dominion Magnesium.) (November 8, 1945.)
1957. Investigation of the cause of "Burn-in" on steel castings. (Hull Iron and Steel.) (November 10, 1945.)
1958. Corrosion protection of exterior rust-preventive compounds (hot application). (C.G.P.S.C.) (November 10, 1945.)
1959. Investigation of cause of failure of grate bars in Dwight Lloyd sintering machine. (Algoma Ore Properties.) (November 10, 1945.)
1960. Flame hardening of Naval gun racer plates. (B.A.T.M.) (November 21, 1945.)
1961. Metallurgical examination of iron powder. (H. Freeman.) (November 29, 1945.)
1963. Dynamic stress analysis with brittle lacquer performed on 3-inch mortar, No. 6, Mk. I Baseplate. (Army.) (December 4, 1945.)
1964. Investigation of the cause of "Burn-In" on steel castings. (Hull Iron and Steel.) (December 7, 1945.)
1966. Investigation of surface roughness in manganese steel castings. (Hull Iron and Steel.) (December 5, 1945.)
1967. Corrosion resistance of pure magnesium and typical magnesium alloys produced by different manufacturers. Part III—Rapid intermittent corrosion test. (Dominion Magnesium.) (December 12, 1945.)
1968. Metallurgical examination of zinc die cast and cast iron motor end heads. (McKinnon Industries.) (December 4, 1945.)
1969. Investigation of adhering sand on light steel castings. (Dept. of Reconstruction.) (December 6, 1945.)
1971. Corrosion protection afforded to magnesium and its alloys by C.I.L. BM-502 White Chemical-Resistant Coating and TUX-6014 Matico Grey Air Dry Coating. (Canadian Industries, Ltd.) (December 13, 1945.)
1972. Resistance of various metals to corrosion by molten salt and aqueous salt solution. (Malagash Salt Co.) (December 14, 1945.)
1973. Metallurgical examination of iron powder. (KafI Tewes.) (December 13, 1945.)
1974. An investigation of the tensile properties of the nickel-aluminium alloy system between 75%Ni-25%Al and 80%Ni-20%Al. (Turbo Research.) (December 18, 1945.)
1975. Cathodic protection of Fourdrinier wire screening in Greenwood stock by magnesium alloy AZ63X. (Dominion Magnesium.) (December 18, 1945.)
1976. Investigation of defective grey iron casting. (Canadian Foundry Supplies & Equipment, Ltd.) (December 28, 1945.)
1977. Cathodic corrosion protection of steel immersed in Noranda Mines water by magnesium alloy AZ63X. (Dominion Magnesium.) (December 26, 1945.)
1978. Metallurgical examination of failed grader stub axles. (Dom. Road Machinery Co., Ltd.) (December 27, 1945.)
1979. Metallurgical examination of a broken grey iron casting. (Division of Fuels.) (December 27, 1945.)
1980. Resistance of two types of stellite to corrosion by molten salt and aqueous salt solution. (Deloro Smelting & Refining Co.) (December 27, 1945.)
1981. Improving the corrosion resistance and appearance of fishing rod handle castings of magnesium alloy AZ70. (Light Alloys, Ltd.) (January 11, 1946.)
1982. Improving the corrosion resistance and appearance of machined castings of magnesium alloy AZ80. (Dominion Magnesium.) (January 11, 1946.)

A partial list of the sixty-two informational memoranda prepared for use in the war departments and organizations follows:

- Residual stresses in cartridge cases.
- Shoe cleats for Canadian army boots.
- Corrosion and abrasion resistant coating for small brass parts.
- Magnesium in aircraft.
- Fatigue tests for determination of turbine blade casting quality.
- Fusion welding of grey cast iron.
- Electrolytic polishing.
- Bright nickel plating.

During the year, 377 reports were issued by the Physical Metallurgy Laboratories. These reports cover all routine testing to check the quality of materials, and include endurance tests of aircraft control cable, tensile tests on

many hundreds of test specimens of steel, bronze, and magnesium, and chemical analyses of samples of various metals. The following list indicates the variety of materials dealt with:

- Connecting rod bearings for battery-charging engine. (D.N.D.—Army.)
- Condenser tubes for H.M.C.S. *Belleville*. (Navy.)
- Charpy impact tests on cast steel bars. (Navy.)
- Mechanical tests on magnesium alloy bars. (Light Alloys, Limited.)
- Macro examination of a 2-inch trench mortar barrel. (I.B.U.K. & C.)
- Test corrosive properties of non-corrosive plugs for soft soldering. (R.C.A.F.)
- Examination of a sample of defective boiler plate. (R.C.A.F.)
- Bend tests on monel metal identity disks. (Army.)
- S.A.E. 4130 steel proposed for experimental sprockets for the mudcat. (Army.)
- Bulletproof plate. (D.M. & S.)
- Effective stress-relieving magnesium alloy sheet. (Army.)
- Magazines for 20-mm. fuse. (I.B.U.K. & C.)
- Load deflection tests on mild steel bolts. (R.C.A.F.)
- Examination of propeller shaft bearing. (Navy.)
- Properties of two corrosion-preventive compounds for aircraft engines. (R.C.A.F.)
- Compression and hardness tests on an extruded bar of 75 ST aluminium alloy. (Army.)

The war demand for metallic minerals having eased considerably, the work in the Ore Dressing Laboratories reverted to meeting the general requests of the mining industry.

A shortage of fluorspar created interest in several dormant Canadian deposits in Nova Scotia, Ontario, and British Columbia, and brought requests for investigative tests. The results showed that a suitable grade of fluorspar concentrate for metallurgical and chemical uses can be produced.

The demand of the steel industry for high-grade iron ore stimulated interest in several Canadian deposits and the staff has co-operated in various ways to assist the operators in overcoming difficulties in connection with grade and recovery.

A process was devised for the separation and recovery of bismuth from the molybdenite concentrate of the LaCorne property in western Quebec. The process will enable the removal of an undesirable impurity from this product, thereby making it more readily marketable.

Several sample shipments were received from Giant Yellowknife Mines, Limited, in the Yellowknife area, Northwest Territories, for preliminary work to develop a suitable flow-sheet for treatment of this ore. Interim reports were issued showing a favourable recovery, and further work is intended before the mine goes into production on a large scale.

In co-operation with American Nepheline Corporation, Limited, an investigation of the nepheline syenite deposits of the Bancroft area in Ontario was undertaken late in 1945, and favourable progress was made. The product will be utilized principally in the glass and ceramic industries and a successful process should result in establishing a new industry in Canada.

Various problems associated with the supply of the raw material of radioactive minerals were also being investigated. They concern ore dressing, chemical and radio-metric methods of analysis, etc., and form part of the joint international research into atomic energy, and involve close co-operation with the work in the United Kingdom and the United States.

An investigation of how to recover barite from a waste product in a barite milling operation gave satisfactory results.

The facilities of the laboratory were utilized by Wasa Lake Gold Mines, Limited, for work on a gold ore; by Francoeur Gold Mines, Limited, on a gold ore; by Canadian Industries, Limited, on a gold-antimony separation process on Cochinour Willans ore; and by Maritime Exploration Company on a process for separating siderite from barite. The results obtained by the first three companies will lead to new mining plants being built.

Of 43 sample shipments received for investigation, 3 originated from British Columbia, 1 from Alberta, 2 from Yukon, 5 from Northwest Territories, 15 from Ontario, 13 from Quebec, and 4 from Nova Scotia.

*List of Ore Dressing Investigations Reported Upon*

1775. Concentration of iron ore from the Tomahawk Iron Mines, Limited, Lake township, Hastings county, Ontario. (January 9, 1945.)
1776. Concentration tests on a sample of manganese ore from the Steep Rock Iron Mines, Limited, Steep Rock, Ontario. (January 10, 1945.)
1808. A process for eliminating bismuth from molybdenite concentrate. (March 14, 1945.)
1811. Concentration tests on a fluorite-barite ore from the Trout River (Papke) vein, Lake Ainslie district, Nova Scotia. (March 14, 1945.)
1813. Concentration and amalgamation of a gold ore from the Metcalf shaft dump, King Solomon's Dome mine, Dawson, Yukon Territory. (May 1, 1945.)
1835. Flotation tests on a sample of gold-silver-copper-lead-zinc from the Big Bull property on Taku River, northern British Columbia. (May 1, 1945.)
1836. Summary of flotation and cyanidation tests on a sample of gold-bearing rock from the Thompson Bousquet property, Bousquet township, Quebec. (May 8, 1945.)
1851. Concentration tests on barite fluorite ore from the Johnson mine, Lake Ainslie district, Nova Scotia. (April 27, 1945.)
1862. Frothing tests on a series of reagents submitted by Shawinigan Chemicals, Ltd., Shawinigan Falls, Quebec. (May 9, 1945.)
1881. Concentration of tantalite ore from Bighill No. 2, near Hearne Channel, Great Slave Lake, Northwest Territories. (June 5, 1945.)
1883. Cyanidation and flotation tests on a gold-silver-lead ore from the Delhi (Temagami) Gold Mines, Limited, in the Temagami district of northern Ontario. (June 4, 1945.)
1902. Re-treatment of molybdenite concentrate from the La Corne Molybdenum Project of the Wartime Metals Corporation, Val d'Or, Quebec. (July 20, 1945.)
1917. Laboratory separation of Alberta bituminous sands, using cold water medium. (August 17, 1945.)
1918. Investigation of the effect of intrusive rock on the flotation of copper and zinc minerals from a sample of ore from the Normetal Mines, Normetal, Quebec. (August 17, 1945.)
1921. Preliminary tests on a sample of gold ore from Sapawe, in Rainy River district, Ontario. (August 22, 1945.)
1932. Disposal of bismuth concentrate from the La Corne Molybdenum Project, Val d'Or, Quebec. (October 15, 1945.)
1962. Concentration of specular hematite from the New Telluride Gold Mines of Canada, Limited, Telluride, Ontario. (December 1, 1945.)

Thirteen investigations were reported as interim reports or in letter form, and thirteen received late in the year were carried over.

In the Mineragraphic Laboratory, 27 studies were completed, 7 of which were for outside parties. This work involved the study of some 300 polished sections, 25 of which were prepared for mining companies equipped to make their own examinations.

The staff of the Spectrographic Laboratory improved the equipment, developed new techniques, and did a wide variety of analytical work. Three grating spectrographs with different dispersions, and suitable for practically all types of emission spectroscopy, were in operation; two new instruments having been built in the laboratory. Progress was made in developing source apparatus for the excitation of samples, and, owing to its urgency, work on this problem is to be continued. De-humidification of the air supplied to the laboratory was provided in the hope that during the summer months the very serious errors arising from great fluctuations in relative humidity will be minimized. Facilities for the preparation of samples were improved.

Methods were developed and standardization was done for the quantitative analysis of magnesium and its more common alloys; aluminium and some of its alloys; and alloy steels. Among the many methods remaining to be developed are those utilizing solutions and briquettes. Experimental work was begun on the solution method, but owing to lack of sufficient staff it was suspended.

A total of 1,181 samples was analysed in the Spectrographic Laboratory, involving many thousands of determinations of the individual elements. Until the end of the war all the magnesium used by the Royal Canadian Air Force was analysed. Considerable work was done for the Crime Detection Laboratory of the Royal Canadian Mounted Police. This was of material assistance in the successful completion of certain cases and furnished results that were useful in other investigations.

In the Chemical Laboratories, 4,517 samples were received and reported during the calendar year 1945; 19,270 determinations were made on these, representing approximately 41 different mineral constituents.

The samples were from the following sources:—

	Samples	Deter- minations	Per cent of samples	Per cent of deter- minations
Metallic Mill.....	1,488	4,208	32.97	21.84
Industrial Minerals Division.....	714	1,953	15.81	10.14
Division of Economics.....	87	251	1.93	1.30
Physical Metallurgy Research Labor- atories.....	1,097	7,523	24.28	39.04
Bureau of Geology and Topography....	81	324	1.79	1.68
Miscellaneous.....	302	1,137	6.68	5.90
Department of National Defence.....	99	889	2.19	4.61
Inspection Board of United Kingdom and Canada.....	94	780	2.08	4.05
British Air Commission.....	16	193	0.35	1.00
Department of Munitions and Supply..	27	249	0.59	1.30
Department of Transport.....	3	33	0.07	0.17
National Research Council.....	11	79	0.24	0.41
British Admiralty Technical Mission..	7	62	0.15	0.32
Fuel Testing Laboratories.....	20	203	0.44	1.05
Customs assays and analyses.....	471	1,386	10.43	7.19
Totals.....	4,517	19,270	100.00	100.00

Total determinations.....	19,270		
Total gold assays.....	1,858	Per cent of determinations....	9.64
Total silver assays.....	303	Per cent of determinations....	1.57

## INDUSTRIAL MINERALS DIVISION

The Division deals with the resources and utilization of non-metallic minerals, sands, clays, rocks, and industrial waters, collectively termed "industrial minerals". These minerals, very necessary to the successful prosecution of the war, are destined to play an increasingly important rôle in the national economy. Complete laboratory facilities are available for evaluating, processing, and beneficiating industrial minerals, and for investigating new ways of utilizing them.

Information was made available to the public by printed reports, special memoranda, technical articles and papers, and by correspondence and consultation.

The Division maintained close contact with scientific and industrial research institutions in Britain, the countries of the British Commonwealth of Nations, and the United States.

Following release of information on the atomic bomb, data on Canadian uranium and radio-active minerals were compiled for use of the War Information Board and other Government agencies; and a suite of specimens of Canadian uranium minerals was sent to the Geological Survey Museum, London, England.

One hundred samples of soil from the Rockcliffe Airport, near Ottawa, were tested for the Department of National Defence in connection with an investigation to find a remedy for trouble being experienced with the runways.

An investigation to find the most suitable ceramic bond for use in making refractory brick from granular magnesia obtained from brucitic limestone by a process developed in the Division was completed. Bricks made were tested in the laboratory and in a commercial electric furnace at a steel plant. The investigation showed conclusively that a forsterite bond is superior to a dicalcium silicate bond for this granular material. The results appear in a paper to be published by the American Ceramic Society.

Work was continued on the process developed in the laboratories for the purifying of rock salt. Much of this work was on the design of a rotary furnace for melting the salt, but a large amount of laboratory and consulting work was done in improving the process, which is being tried on a pilot-plant scale at Malagash, Nova Scotia.

The investigation into the industrial waters of Canada was continued and sixty-five samples were examined and analysed.

Many inquiries were received for information on rock wool, including requests for information on possible sources of raw material other than those indicated in the published reports of the Division. Tests were made on twenty-two varieties of rock and slag, collected and submitted from various parts of Canada, to determine their suitability. Tests were made on the ability of various commercial refractories to withstand the action of molten rock-wool material. The original report on rock wool (Memorandum Series Report No. 50) was again reprinted.

Further work was done, with favourable results, on the activation of magnesia to develop a domestic source of high-grade active magnesia suitable for use in insulation and oxychloride cements.

Acid-resistant filter fibre was successfully prepared from samples of Canadian amphibole asbestos, and a flow-sheet for processing the material was worked out.

Much investigational work was done on behalf of companies and individuals. In some cases laboratory facilities and the assistance of the staff were made available to companies and to consulting engineers wishing to make investigations. One such investigation involved the processing of 200 pounds of asbestos-bearing rock, and another the making of roofing granules from a shipment of 40 tons of slate.

Large-scale calcination tests in the rotary kiln were made on limestone from the property of Dominion Lime, Limited, Lime Ridge, Quebec, and a study was made of the characteristics of the resultant lime in comparison with lime made in a vertical kiln from the same limestone.

At the request of the Nova Scotia Department of Mines, an investigation was begun on Nova Scotia quartzite deposits to determine their suitability for the making of silica brick for use by the steel industry.

Consulting work was continued in connection with the production of magnesia from brucitic limestone at the plant of Aluminum Company of Canada, Limited, Wakefield, Quebec.

In anticipation of an increased program of highway construction, reports were prepared on road materials in Ontario.

#### INDUSTRIAL MINERALS LABORATORIES

Laboratory work on minerals and mineral products:

*Amphibole Asbestos.* A sample of amphibole fibre was processed partly into filter fibre, and partly into a product all passing a 200-mesh screen, for L. M. Carswell, Renfrew, Ontario.

*Apatite.* Log-washing tests for the removal of earthy and clay impurities were made on apatite submitted by Ontario Phosphate Industries, Limited, Toronto.

*Asbestos.* Fibre-recovery and grading tests were made on a sample of drill cores from a chrysotile asbestos property in Quebec, submitted by C. L. Coleman, Toronto.

*Barite.* A large sample was pulverized in a hammer mill in preparation for test work.

*Brucite Magnesia.* A sample of granular brucite magnesia was pulverized to -200 mesh in the buhr mill, for Aluminum Company of Canada, Limited.

*Calcite.* Crushing, pulverizing, and air-separation tests to obtain products of certain definite grain sizes were made on a 3¼-ton sample submitted by H. J. Emery, Toronto.

*Corundum Tailings.* A tailing sample submitted by Wartime Metals Corporation, Montreal, was processed by magnetic separation and other means to obtain a clean feldspar product.

*Dolomite.* Four tons submitted by Canadian Dolomite Company, Portage du Fort, Quebec, was crushed, ground, screened, and air-separated to obtain material for use as stucco dash and mineral filler.

*Fluorspar.* A 20-ton sample from B. C. Fluorspar Syndicate, Birch Island, B.C., was subjected to froth flotation on a pilot-plant scale to obtain a product suitable for use in the steel industry and to ascertain the possible recovery of celestite, gold, and silver. (Investigation Report 45-01.)

*Garnet.* Tests to determine the efficiency of garnet as a sandblasting medium on steel and granite were made on two samples of crushed garnet from the property of Canada Garnet Company, Labelle, Quebec, and submitted by the Quebec Department of Mines. (Investigation Report 45-02.)

Gravity concentration tests were made on a sample of lump garnet submitted by A. G. Chew, Sudbury, Ontario. (Investigation Report 45-04.)

*Oyster Shells.* Two hundred pounds was pulverized for the Poultry Division, Experimental Farm, Department of Agriculture, Ottawa.

*Salt.* Small-scale fusion tests were made on a sample of refuse salt submitted by Canadian Industries, Limited, Montreal, and on a similar sized sample of vacuum-pan salt submitted by Dominion Tar and Chemical Company, Limited, Montreal.

*Silica Sand.* Three samples submitted by Canada China Clay and Silica, Limited, Kasil, Quebec, were tested for their efficiency as sand-blast material. (Investigation Report 45-03.)

Flotation tests were made on a sample of silica sand from the sea coast at Barrington, Nova Scotia.

*Slate.* A carload submitted by C. L. Coleman, Toronto, from Kingsbury, Quebec, was processed into roofing granules for a commercial-scale test.

*Trap Rock.* A sample submitted by N. B. Davis, Department of Reconstruction and Supply, Ottawa, was made into two grades of roofing granules.

Petrographic examinations were made of numerous rock and mineral samples, and minor laboratory work was done on a number of samples sent in for identification and evaluation.

## DIVISION OF FUELS

The Chief of the Division and senior technical officers, by means of inspection trips, interviews, and correspondence, kept informed on technical problems of the coal mining and preparation industry, and of the by-product coke and gas, the petroleum oil refining, and the natural gas industries. They attended com-



mittee meetings and conferences with the Royal Commission on Coal, the National Research Council, and other Government organizations on matters relating to testing and research work on Canadian coals and petroleum oil products. As indicated below, reports were prepared and distributed to interested parties on physical and chemical surveys of coals from Canadian collieries and on coal cleaning, carbonizing, and briquetting processes as applied to Canadian coals.

Special work in a consulting capacity, analytical work, and work on a plant scale was continued for the Department of National Defence and for the office of the Coal Controller.

In collaboration with the Division of Metallic Minerals, an experimental investigation was made of a method for separating bitumen from bituminous sand using cold water; and, as part of the Department's investigation of potential petroliferous deposits, assays were made of the drill cores from the exploratory drilling of the bituminous sand of northern Alberta. Nearly 1,200 samples from 94 drill-holes were assayed and reported.

The investigation of peat moss, formerly conducted by the Industrial Minerals Division, was transferred to the Fuels Division, and in July and August the deposits in Western Canada were visited. Manuscript of a report, "Peat Moss Deposits in Canada", by H. A. Leverin, was revised for the printer; and Memorandum Series Report No. 90, "Peat Moss Industry in Canada", was prepared for distribution in mimeograph form.

Additional data were collected for the revision of the "Analysis Directory of Canadian Coals" (F.R.L. No. 1-R.I.C.S. No. 200) that was prepared in 1944-45 for limited distribution. This directory, which is comprised of the analyses of the different sizes of coal produced and marketed by Canadian collieries, is now being revised for wider distribution.

Samples sent in regularly by the Penitentiaries' Branch, Department of Justice, and by the Department of Veterans' Affairs were analysed in reference to the purchase of coal according to specification; and, as a service to the Department of National Defence, the quality of coal deliveries as per samples submitted was checked against that guaranteed by contract.

#### WORK FOR ROYAL COMMISSION ON COAL

Technical officers of the Division acted in an advisory and consulting capacity for the Royal Commission on Coal. Many requests for information were attended to verbally, as well as supplying pertinent memoranda and reports. In addition to the coal analysis directory mentioned above, the following report was prepared for use by the Commission:

F.R.L. No. 2. Canadian Coals, Their Classification, Analysis, and General Characteristics.

Conferences and hearings were attended and extensive field investigations were undertaken, including visits to Western Canada during July; to Sydney, N.S. in September; and to Hamilton, Ont., and Pittsburgh, Pa., in October. By means of these investigations, information was obtained concerning new processes for the development of the coke and gas industry. In addition to special reports on this field work, the following reports were prepared.

F.R.L. No. 11. The Coke and Gas Industry of Canada.

F.R.L. No. 17. Report of Inspection of the Travelling Grate Carbonization Process as designed and operated by the Shawinigan Chemical Company.

#### HYDROGENATION INVESTIGATIONS

Experimental work was directed towards a study of the rate of deterioration of fixed catalysts in the vapour phase hydrogenation of gas-oil and gasoline produced by liquid phase hydrogenation of Alberta bitumen. The vapour phase apparatus was improved and distillation equipment for accurate fractionation

of gasoline and gas-oil was put into operation. A study was made of methods for estimation of asphaltenes in feed stocks and products of hydrogenation. Comprehensive reports on the work, to date, on liquid and vapour phase hydrogenation of bitumen and oils produced from it were prepared.

Establishment of the proposed pilot plant and laboratory was postponed. Specifications and list of parts for the plant were revised in the light of new information obtained from the German hydrogenation industry that became available during the year. A committee appointed to advise on the proposal to establish a pilot plant convened on January 21 and 22, and submitted a report in March that was under consideration at the close of the year.

Officers engaged in the hydrogenation investigation assisted the Royal Commission on Coal to assess the situation as regards the possibility of producing synthetic liquid fuels in Canada. Extensive field work in the United States and Canada was done at the request of the Commission.

An officer also took part in the investigation of German industry sponsored by the Department of Reconstruction and Supply. In particular he inspected four hydrogenation plants and six Fischer-Tropsch plants in western Germany, and prepared several reports and memoranda on the work. A translation was made of a detailed description of the synthetic oil plants of Ruhrchemie at Sterkrade-Holten. Arrangements were made to obtain a set of micro-films of captured German documents dealing with the general subjects of fuels and lubricants.

#### COMBUSTION ENGINEERING INVESTIGATIONS

The routine weather study in regard to the degree-day heating load for Ottawa and forty-five additional representative points throughout Canada was continued. Degree-day data in summarized and tabulated form were supplied to the Coal Controller monthly throughout the year. Information regarding this project furnished to the Research and Development Branch, Department of Reconstruction and Supply, resulted in inclusion of the degree-day as an element in plans for post-war research in building construction.

The services of engineers were made available to other Government departments, public institutions, industrial firms, and to individuals seeking advice on fuel, heating, and allied problems. Owing to complaints on the poor quality of coal and coke, post-war plans for reconditioning heating equipment, and the revised interest in oil heating, many more individual requests were handled than usually.

A member of the staff continued to serve as liaison officer and consultant on fuel and heating problems to the Coal Control, to the Fuel Purchasing Section of the Department of Munitions and Supply, and to the Army and the Air Force. He prepared reports and memoranda of information dealing with many phases of fuel and heating. He also prepared several samples of granular coal and supervised the preparation of 10 tons of this specialized material for the Hydraulics Laboratory of the National Research Council. A member of the staff attended the four-session course in heat control provided by an industrial firm as part of its post-war educational program; and, in January, he attended the Annual Meeting of the Stoker Institute of Canada.

Meetings of the Associate Committee of Substitute Fuels for Mobile Internal Combustion Engines and those of the Subcommittee on Producer Gas were attended. The second general report of the Subcommittee was received by the Associate Committee and adopted.

#### COAL PREPARATION, STORAGE, CARBONIZATION, AND BRIQUETTING

The survey of coals from Canadian collieries with reference to their physical and chemical characteristics and beneficiation was continued. That portion of the survey concerned with the fundamental study of the properties of the coals

as mined included non-coking sub-bituminous coals in the Coalspur, Drumheller, Taber, and Brooks areas of Alberta, as well as certain new operations in the Mountain Park and Highwood areas of Alberta, and the Crowsnest area of British Columbia. Several lignite operations in the Souris area of Saskatchewan were studied. Interim reports on the surveys were prepared for limited distribution.

A project for a modern central cleaning and preparation plant in the Minto area of New Brunswick gave rise to a series of special large-scale laboratory washing tests on several representative mine samples. A comprehensive report was prepared and distributed to the interested parties. This was done at the request of the Government of New Brunswick.

Reports dealing with the above studies and issued during the year are listed below. Many of these reports are of a semi-confidential nature and are available only to authorized persons.

- Physical and Chemical Survey Report No. 100 (F.R.L. Report No. 9-R.I.C.S. No. 206): Atlas Mine, No. 3 (East Coulee) seam, Drumheller area, Regal Coal Co., Ltd., East Coulee, Alta.
- Physical and Chemical Survey Report No. 101 (F.R.L. Report No. 10-R.I.C.S. No. 207): Western Crown Mine, No. 3 (East Coulee) seam, Drumheller area, Monarch Coal Mining Co., Ltd., East Coulee, Alta.
- Physical and Chemical Survey Report No. 102 (F.R.L. Report No. 13-R.I.C.S. No. 210): Minute Mine, No. 7 seam, Drumheller area, Minute Coal Co., North Drumheller, Alta.
- Physical and Chemical Survey Report No. 103 (F.R.L. Report No. 15-R.I.C.S. No. 211): Star Mine, No. 1 seam, Drumheller area, Rosedale Collieries, Ltd., Rosedale, Alta.
- Physical and Chemical Survey Report No. 104 (F.R.L. Report No. 16-R.I.C.S. No. 212): Midland No. 2 Mine, No. 1 seam, Drumheller area, Midland Coal Mining Co., Ltd., Alta.
- Physical and Chemical Survey Report No. 105 (F.R.L. Report No. 21-R.I.C.S. No. 213): Red Deer Valley Mine, No. 1 seam, Drumheller area, Red Deer Valley Coal Co., Ltd., Nacmine, Alta.
- Physical and Chemical Survey Report No. 106 (F.R.L. Report No. 24-R.I.C.S. No. 214): McLeod River Hard Coal Mine, Val d'Or seam, Coalspur area, McLeod River Hard Coal Co. (1941), Ltd., Mercoal, Alta.
- Physical and Chemical Survey Report No. 107 (F.R.L. Report No. 25-R.I.C.S. No. 215): Alexo Mine, Saunders area, Alexo Coal Co., Ltd., Alexo, Alta.
- Physical and Chemical Survey Report No. 108 (F.R.L. Report No. 26-R.I.C.S. No. 216): Saunders Creek Mine, Saunders area, Bighorn and Saunders Creek Collieries, Ltd., Saunders, Alta.
- F.R.L. No. 23 (C.S.M. No. 32): Report on a Field Visit to the Properties of the Highwood Coal Mines, Ltd., Highwood area, Alta.
- Physical and Chemical Survey Report No. 109 (F.R.L. Report No. 28-R.I.C.S. No. 218): Western Dominion Strip Mines, Bienfait Division, Souris area, Western Dominion Coal Mines, Ltd., Taylorton, Sask.
- Physical and Chemical Survey Report No. 110 (F.R.L. Report No. 29-R.I.C.S. No. 219): Western Dominion Deep Mine, Lower seam, Bienfait Division, Souris area, Western Dominion Coal Mines, Ltd., Taylorton, Sask.
- F.R.L. No. 31 (R.I.C.S. No. 221): Study of the Crushing Characteristics of the Coal from Rosedale Mine, No. 5 seam, Rosedale Collieries, Ltd., Rosedale, Alta.
- Physical and Chemical Survey Report No. 111 (F.R.L. Report No. 30-R.I.C.S. No. 220): M. & S. Strip Mines, Upper seam, Bienfait Division, Souris area, Manitoba and Saskatchewan Coal Co., Ltd., Bienfait, Sask.
- Physical and Chemical Survey Report No. 112 (F.R.L. Report No. 32-R.I.C.S. No. 222): M. & S. Deep Mine, Lower seam, Bienfait Division, Souris area, Manitoba and Saskatchewan Coal Co., Ltd., Bienfait, Sask.
- Physical and Chemical Survey Report No. 113 (F.R.L. Report No. 34-R.I.C.S. No. 224): Glover seam, Highwood Coal Mines, Ltd.
- Physical and Chemical Survey Report No. 114 (F.R.L. Report No. 35-R.I.C.S. No. 225): Holt seam, Highwood area, Highwood Coal Mines, Ltd.
- F.R.L. No. 33-R.I.C.S. No. 223: Interim Report on the Washing Characteristics of Coal from the Minto Coalfield, New Brunswick, conducted for the Province of New Brunswick.
- F.R.L. No. 36-R.I.C.S. No. 226: Final Report on the Washing Characteristics of Coal from the Minto Coalfield, New Brunswick, conducted for the Province of New Brunswick.

Interest in briquetting was increased, especially in the beneficiation of the products of degradation produced from low rank coals. In view of the problems arising, a new experimental briquetting press of standard design was installed and a series of batch tests was made on various fuels, in connection with which studies were made of the preparation of smokeless briquetted fuels. This work necessitated the design and construction of special carbonizing equipment. Experimental work was also done in briquetting fluorspar and chromite ore; and F.R.L. No. 12 (R.I.C.S. No. 209), "Report on the Briquetting of Fluorspar Flotation Concentrates", was issued.

The study and separation of petrographic constituents of various Canadian coals was continued, especially of certain western coals that appear to lend themselves to separation by size and gravity. The purpose of this study is to determine which coals are amenable to such treatment, and whether such beneficiation will enable two or more products to be made from the same coal, with characteristics sufficiently divergent to make them more suitable for certain specific industrial applications, such as coking, hydrogenation, and for use in domestic stokers.

Processes for beneficiation of Canadian coals were investigated, including the study of a relatively new process of heavy-medium washing for the cleaning of coals ranging in size from 4 inches down to probably 48 mesh. This apparently allows for fairly accurate control of the gravity separation and was studied because of its possible application to various Canadian coals high in so-called "bone", or in which the coal is somewhat intimately mixed with the mineral matter. In either case they present a natural product difficult to clean economically by most processes. This preliminary study was reported in F.R.L. No. 8 (R.I.C.S. No. 205), "Field Report on the Heavy-Media Separation Process".

The upgrading of various low rank non-caking coals by carbonization in special equipment was also studied to see whether certain newly developed processes are suitable technically and economically for the production of a satisfactory char from either lignite or sub-bituminous coal. Two reports on this work were prepared:

F.R.L. No. 8 (R.I.C.S. No. 205), Field Report on the National Fuel Carbonizing Process.

F.R.L. No. 27 (R.I.C.S. No. 217), Report on Carbonization Tests on a Saskatchewan Lignite and Drumheller Coal Conducted in the Travelling Grate Coking Plant of the Shawinigan Chemicals, Ltd.

The washing study of Minto coals for New Brunswick, referred to above, resulted in an extensive laboratory investigation of the coking properties of the fractions separated from the several coals.

The preparation of processed buckwheat anthracite for use in blower-operated furnaces was also investigated. Some of the results were presented in Report F.R.L. No. 18 (C.S.M. No. 3)—"Method and Equipment for the Chemical Treatment of Blower Coal at Coal Yards of Small Dealers".

The results of a study of the literature on underground gasification of coal were reported in F.R.L. No. 19 (C.S.M. No. 31), "Underground Gasification for the Joggins-River Hebert Coal District".

#### ROUTINE CHEMICAL LABORATORY WORK

As shown below, 1,755 samples of solid, liquid, and gaseous fuels were analysed, the examination of which involved, roughly, 11,000 separate chemical and physical determinations, mostly in duplicate, of the different items of analysis. The total included 291 samples of mine air from British Columbia and Alberta, and 400 coals and oils from the Department of National Defence. During the year, 1,176 samples of drill core from the bituminous sand deposits in Alberta were also analysed, but are not included in the tabulated data that follow.

NOTE: F.R.L., as above, is the abbreviation for Fuel Research Laboratories; R.I.C.S., for Report of Investigation of Carbonization Section; and C.S.M., for Carbonization Section Memorandum.

	Number of samples	Per cent of total
1. Samples pertaining to investigations of Fuels Division—		
<i>Solid Fuels</i> .....	740	42.1
Coals.....	739	
Cokes, peat, briquettes, and miscellaneous.....	1	
<i>Liquid Fuels</i> .....	43	2.5
Crude oils, gasoline, lubricating oils and hydrogenated oil products.....		
<i>Gases</i> .....	22	1.3
Natural gas, manufactured gas and gas from hydrogenation tests.....		
2. Samples from other divisions of Department of Mines and Resources (coals and oils).....	15	0.85
3. Samples from other Government departments—		
Department of National Defence—Army, Air, and Navy....	400	22.8
Coals, cokes, briquettes, etc.....	147	
Gasoline, fuel oils and lubricating oils.....	253	
Department of Veterans Affairs.....	31	1.7
Coals.....		
Department of Justice (Penitentiaries' Branch).....	108	6.2
Coals.....		
Department of Munitions and Supply.....	15	0.85
Coals from Coal Controller's Office—Gasoline and miscellaneous from Oil Controller's Office.....	15	
Other Government departments (including samples of aviation fuels and lubricating oils from National Research Council).....	54	3.1
Provincial governments—mostly mine air from Alberta and British Columbia.....	291	16.6
Commercial firms, private individuals, etc.....	36	2.0
Totals.....	1,755	100.0

### EXPLOSIVES DIVISION

With the end of the war, production of military explosives ceased, resulting in the necessity of desensitizing buildings and equipment, and of disposing of surplus explosives. A committee, of which the Chief Inspector of Explosives was a member, was formed to arrange and supervise this work, and officers of the Division assisted in inspecting plants prior to their being turned over to the War Assets Corporation for disposal. By the end of the year nearly all plants, with the exception of those to be retained on a stand-by basis, had passed as explosives-free.

No changes have been made in the Explosives Act since it was proclaimed in 1920, and with the coming repeal of war-time regulations it was thought that a revision of the Act should be made to bring it into line with present-day requirements and to remedy defects revealed by experience in its administration. Accordingly, a proposed revision was drawn up and received first reading in the Senate on March 20, 1946.

Copies of an educational film, "Blasting Cap", were purchased and were being shown across the country through the facilities of the National Film Board, the purpose being to warn children of the dangers of playing with explosives, particularly detonators.

Many requests were received from licensees for relaxations in the guarding of magazines, and where other means of protection were considered adequate these requests were granted.

An interesting experiment was conducted in Alberta where a large quantity of nitroglycerine was used in an attempt to "rejuvenate" an oil well. The nitroglycerine was transported by truck from a plant in Manitoba, under patrol of Deputy Inspectors of Explosives of the Police, and the operation was without incident.

#### STAFF CHANGES

W. P. Campbell, who had been Acting Chief Inspector since the retirement on superannuation of F. E. Leach, was appointed Chief Inspector on April 24, 1945.

Douglas Sharpé, on loan from Canadian Industries, Limited, since June 15, 1942, as Wartime Inspector, returned to that company on March 31, 1946.

#### LABORATORY

Under an agreement with the National Research Council, a laboratory equipped to test all classes of explosives is maintained on the Montreal Road, under the supervision of M. C. Fletcher, Chief Explosives Chemist.

During the fiscal year, 176 samples were received and examined. These are classified as follows:

Commercial dynamites .....	17
Military explosives .....	125
Initiators .....	7
Propellants and ammunition .....	3
Pyrotechnics .....	15
Enemy explosives .....	3
General .....	6

The samples were submitted by or on behalf of the Inspection Board of the United Kingdom and Canada; Department of National Defence; Defence Industries, Limited; Canadian universities; Canadian Industries, Limited; Royal Canadian Mounted Police; and the Inspection Service of the Explosives Division.

Special reports were issued covering projects and investigations that were of a secret or confidential nature.

Members of the laboratory staff attended meetings and conferences in Canada, the United States, and Great Britain, in connection with changes and developments in the testing of explosives.

#### MAGAZINES

At the end of the fiscal year 359 permanent licences were in force, about the same as in the previous year; and there was an increase in temporary licences from 379 to 438. The Royal Canadian Mounted Police gave valuable assistance in the administration of the Explosives Act and Regulations, particularly P.C. 2903 (July 4, 1940), which regulates the possession, use, and sale of explosives under the War Measures Act. Police officers of the provinces and municipalities and inspectors of provincial departments of mines gave very helpful co-operation.

During the year, 21,271 explosives purchase permits were issued by the police. Mining inspectors issued 799 annual explosives purchase permits to mining companies.

#### INSPECTIONS

	Factories	Magazines	Unlicensed premises
Explosives Division Inspectors.....	57	315	586
Royal Canadian Mounted Police.....		324	3,862
Ontario Provincial Police.....		11	3

## IMPORTATION PERMITS

The importation of explosives is controlled by permits issued by the Division under Orders in Council Nos. 363 (March 1, 1920), 2864 (August 13, 1921), and 110 (January 23, 1925). Most of the imports consisted of nitro-cotton for use in the manufacture of lacquers, over 2,000,000 pounds of which was received by Canadian manufacturers. Other commercial imports comprised nitroglycerine, detonators, Christmas snappers, distress signals, and lachrymatory cartridges. In all, 409 permits and 19 special permits were issued.

## ACCIDENTS

A serious accident occurred in a commercial factory on August 29, when a gelatin cartridge house blew up, killing three men. The explosion took place during the clean-up after cartridging operations had been completed. Two operators were in the building and a trucker was approaching the cartridge house. Some 200 pounds of gelatin was involved. From a study of the evidence the accident appears to have been caused either by an inadvertent act on the part of one of the operators, or by a defective "worm" gear in the cartridging machine that permitted the accumulation of nitroglycerine in small pockets in the metal. Several changes were recommended to prevent a recurrence.

Three other accidents in commercial explosives plants resulted in material damage, but no injury to personnel. A black powder "glaze mill" was struck by lightning shortly after midnight on April 17 and 6,000 pounds of powder exploded. The building was destroyed.

On December 31, a small magazine containing about 100 pounds of laboratory stock samples was destroyed by an explosion, damage being estimated at \$575. Overheating of the magazine from the steam line was considered to be the most likely cause of the accident.

At a detonator plant on January 15, 1946, about 3 pounds of primer composition exploded during mixing operations. Damage to building and equipment was estimated at \$3,000. As evidence brought out at the investigation indicated that the operation was being conducted in a normal manner, static discharge was considered to be the most probable cause. Several changes in the design of the building were recommended.

Investigations were conducted into circumstances attending accidents in war plants and storage depots and special confidential reports with recommendations were forwarded to the parties concerned.

Efforts were made to find and correct the causes of unusual incidents and minor explosions reported by explosives factories.

Reports were received of 117 accidents in the use and handling of explosives, resulting in 19 deaths and 139 injuries. Nearly half of these were the results of playing with detonators and other explosives, and children were the chief victims. Many of the accidents were due to military explosives found near former camp sites, or to live souvenirs brought back from overseas.

	Accidents	Killed	Injured
Mines and quarries.....	41	3	46
Elsewhere in industry.....	20	6	15
Playing with detonators.....	13	2	18
Playing with other explosives.....	35	8	44
Miscellaneous.....	8	0	16
Total.....	117	19	139

## PROSECUTIONS

Proceedings were entered in five cases under the Explosives Act, one of which was later dropped. A construction firm was fined \$25 and costs for improper storage of explosives; an individual was fined \$10 and costs for improper storage; a truck driver was fined \$5 and costs for not displaying a red flag on a truck carrying explosives; and nine persons were each fined \$25 and costs for breaking down explosives that their employer had contracted to dispose of by dumping at sea.

Twelve of the fourteen persons charged under P.C. 2903 (July 4, 1940) drew fines ranging from \$10 to \$50 plus costs, and two of the charges were withdrawn.

For infractions of P.C. 3561 (April 30, 1942), which covers the possession of matches and smoking in prohibited areas, 128 persons were fined amounts ranging from \$50 to \$100, and three persons were each sentenced to 3 months in jail. Two charges were withdrawn, and a number were still pending at the end of the fiscal year.

Seven persons were charged under the Criminal Code of Canada with theft or illegal use of explosives, and sentences up to 6 years were imposed.

One man was sentenced to 30 days in jail under Section 160 of the Ontario Mining Act for committing a careless act with explosives.

## DESTRUCTION

During the year, 101,087 pounds of deteriorated dynamite, 2,811 detonators, and 275 pounds of black powder were destroyed by inspectors or deputy inspectors. Part of this had been intended for use on the development of the Canol oil project in the Northwest Territories, and the remainder was abandoned by mining and construction companies, or condemned in licensed magazines.

## PUBLICATIONS

Following is a list of publications issued during the year.

## MINES AND GEOLOGY BRANCH

*English Publication*

*Separate of Annual Report for the Fiscal year Ended March 31, 1944.*

*French Translation*

*Separate of Annual Report for the Fiscal year Ended March 31, 1944.*

## GEOLOGICAL SURVEY

*English Publications*

Report No.

- G.S. Bulletin No. 1. *A Day in the Arctic*—by J. D. Bateman.  
 G.S. Bulletin No. 2. *The Magnetometer As an Aid in Geological Mapping*—by J. W. Ambrose.
- 2472 Memoir 239. *Mesozoic Stratigraphy of The Eastern Plains, Manitoba and Saskatchewan*—by R. T. D. Wickenden.
- 2473 Memoir 240. *Palæozoic Geology of The Windsor-Sarnia Area, Ontario*—by J. F. Caley.
- 45-1 *St. George, New Brunswick*—by F. J. Alcock and S. C. Perry. (Map only.)  
 45-2 *Musquash, New Brunswick*—by F. J. Alcock. (Map only.)  
 45-3 *Kindersley, Saskatchewan*—by R. T. D. Wickenden. (Map only.)  
 45-4 *Prosperous Lake, Northwest Territories*—by A. W. Jolliffe. (Map only.)  
 45-5 *Princeton, British Columbia*—by H. M. A. Rice. (Map only.)  
 \*45-7 *Snow Lake, Manitoba*—by J. M. Harrison.  
 \*45-8 *Orford, Eastern Townships, Quebec*—by Y. O. Fortier. (Map only.)  
 \*45-9 *Manson Creek Map-area, British Columbia*—by J. E. Armstrong and J. B. Thurber.  
 45-10 *Louvicourt, Abitibi County, Quebec*—by G. W. H. Norman. (Map only, four sheets.)  
 \*45-11 *Entrance Map-area, Alberta*—by A. H. Lang.



- \*45-12 *Gold Deposits East of Flin Flon, Manitoba*—by J. D. Bateman.  
 \*45-13 *Pedley Map-area, Alberta*—by E. J. W. Irish.  
 \*45-14 *McVeigh Lake Area, Manitoba*—by J. D. Bateman.  
 \*45-15 *Sherridon, Manitoba*—by J. D. Bateman and J. M. Harrison.  
 45-16 *Canol Geological Investigations in the Mackenzie River Area, Northwest Territories and Yukon*—by G. S. Hume and T. A. Link.  
 \*45-17 *Geology and Mining Properties of Part of West Half of Beauchastel Township, Témiscamingue County, Quebec*—by J. W. Ambrose and S. A. Ferguson.  
 45-18 *Owen Sound, Ontario*—by J. F. Caley. (Map only, two sheets.)  
 \*45-19 *Fall Creek Map-area, Alberta*—by J. F. Henderson.  
 \*45-20 *Greenwood-Phoenix Area, British Columbia*—by D. A. McNaughton.  
 \*45-21 *Geological Reconnaissance Along the Canol Road from Teslin River to Macmillan Pass, Yukon*—by E. D. Kindle.  
 \*45-22 *Geological Reconnaissance Along Lower Liard River, Northwest Territories, Yukon and British Columbia*—by C. O. Hage.  
 45-23 *Alexo, Alberta*—by G. P. Crombie and O. A. Erdman. (Map only.)  
 \*45-24 *Saunders Map-area, Alberta*—by O. A. Erdman.  
 45-25 *Londonderry, Colchester and Hants Counties, Nova Scotia*—by L. J. Weeks. (Map only.)  
 \*45-26 *Bass River, Colchester and Hants Counties, Nova Scotia*—by L. J. Weeks. (Map only.)  
 \*45-27 *The Upper Cretaceous, Dunvegan Formation of Northwest Alberta and Northeast British Columbia*—by F. H. McLearn.  
 \*45-28 *The Lower Triassic of Liard River, British Columbia*—by F. H. McLearn.  
 \*45-29 *Recent Exploratory Deep Well Drilling in Mackenzie River Valley, Northwest Territories*—by J. S. Stewart.  
 45-30 *Taku River, Cassiar District, British Columbia*—by F. A. Kerr. (Map only.)

#### French Translation

- 45-8 *Région d'Orford (Quebec)*—par Y. O. Fortier.

#### NATIONAL MUSEUM OF CANADA

##### English Publications

- Bulletin 99. *Mammal Investigations on the Canol Road, Yukon and Northwest Territories, 1944*—by A. L. Rand.  
 Bulletin 100. *Mammals of Yukon Territory*—by A. L. Rand.  
 Bulletin 101. *The Alpine Flora of the East Slope of Mackenzie Mountains, Northwest Territories*—by A. E. Forsild.

#### BUREAU OF MINES

##### English Publications

- 814 *Petroleum Fuels in Canada—Deliveries for Consumption, Calendar Years 1940-44*—by J. M. Casey.  
 815 *The Canadian Mineral Industry in 1944*—by the staff, Bureau of Mines.  
*Separates of The Canadian Mineral Industry in 1944*—by the staff, Bureau of Mines.  
 Folder: *Petroleum Fuels—Deliveries for Consumption, Calendar Year 1944*—by J. M. Casey.  
 List No. 1-1. *Metallurgical Works in Canada, Part I, Iron and Steel.*  
 List No. 1-1. *Metallurgical Works in Canada, Part II, Non-ferrous and Precious Metals.*  
 List No. 1-2. *Part I. Milling Plants in Canada.*  
 List No. 4-1. *Coal Mines in Canada.*

\* Indicates that the report was mimeographed.

## LANDS, PARKS AND FORESTS BRANCH

R. A. GIBSON, DIRECTOR

During the past year much thought has been devoted to planning and organization. The ending of the war and the subsequent Dominion-Provincial conferences on reconstruction made it appear for some time that it would be possible for both Dominion and Provincial Governments, in collaboration with industry, to undertake immediately greater activities for the safeguarding, fuller development, and more complete utilization of the natural resources in which this Branch is particularly interested. While these hopes have not been fully realized, some increase in appropriation has been granted and it may be said that studies and discussions have made the relative responsibility clearer to all concerned.

Funds have been provided for basic surveys which are essential to sound budgeting. Steadily increasing interest in the Northwest Territories and Yukon has resulted in additional funds being made available to all government departments for scientific services in the northland. It has been possible to undertake desirable public works for the improvement of transportation in Mackenzie District. For the first time a substantial vote for the organization of a service to protect the forests and to initiate game management policies in Mackenzie District of the Northwest Territories has been obtained. A start has also been made with the organization of forest protection in Yukon Territory.

A more adequate staff has been provided for local government administration and for the administration of the resources of Mackenzie District. Mining activity in the Yellowknife district has greatly increased and the revenue from this source is growing. To meet the demand for more commercial and residential building sites, it was necessary to survey an additional townsite area at Yellowknife. Plans are now under way for its development, including the provision of modern water and sewer services. A modern airport is being constructed at Yellowknife, and one landing strip suitable for use by large aircraft has been completed already.

Plans have been drawn for the construction of new government buildings at Fort Smith, Yellowknife, and other places, which will house administrative and other personnel. These structures include an administrative building and staff quarters at Fort Smith; an administrative building, liquor dispensary, and staff quarters at Yellowknife, and a number of cabins for members of the warden service in Wood Buffalo Park. Arrangements are also under way for the erection of a modern hospital at Yellowknife, to the cost of which the Government is prepared to contribute one-third.

Mining activity in Mackenzie District has been particularly active in the Yellowknife area, where the production of gold was resumed at the Negus mine during the late summer of 1945. Development work was continued at other important properties where production was suspended temporarily, and their re-opening has been forecast for the coming year. Exploration and staking have been extended for a distance of 125 miles beyond the settlement of Yellowknife, and a number of important gold discoveries were reported during the year. The decision of the Dominion Government to develop hydro-electric power on the Snare River is expected to assist in the reduction of mining costs in the Yellowknife region, and stimulate the mining industry as a whole.

The increased importance of radio-active minerals in the Great Bear Lake area, including uranium and radium-bearing ores, has led to an expanded program of exploration and geological mapping. The mine and mill of Eldorado Mining and Refining (1944) Limited at LaBine Point on Great Bear Lake continued to operate at capacity.

An important development during the year was the transfer to the Department of National Health and Welfare of the control and supervision of medical care and hospitalization of the native population of the Territories. For almost two decades the Northwest Territories Administration had extended medical service to the Eskimos of the Northwest Territories to the maximum extent possible within the limits of funds made available. Hospitals, owned and operated by church missions, were established at strategic points where native and indigent patients were admitted and maintained on a per diem basis by the Administration. Industrial homes were also operated in conjunction with some hospitals to care for convalescent or infirm patients. Medical kits and drugs were provided by the Administration at Arctic and other posts where there were no hospitals. Special medical surveys were made from time to time to investigate and alleviate diseases to which the native population is susceptible.

In Yukon Territory, mining continued to be the principal industry, and gold production from placer operations showed a substantial increase over the preceding year. The resumption of lode mining on a larger scale was forecast by the acquisition of claims in the Mayo District, formerly owned by Treadwell-Yukon Corporation, by a newly incorporated company backed by eastern capital.

Arrangements were made prior to the end of the fiscal year for the taking over and maintenance of the Alaska Highway by the Department of National Defence (Army). This action will result in the resumption of administration of the natural resources along the route by the various services of this Branch.

In the development of the Yukon and Northwest Territories, it is desired to acknowledge the assistance which has been received from many other departments of the Dominion Government which also have responsibilities in providing essential public services.

The end of the war and the easing of travel restrictions has had an immediate effect on the number of visitors to the National Parks during the year under review. This increase amounted to nearly 25 per cent, and with the provision of additional tourist accommodation, the volume of travel may be expected to swell to much greater proportions.

It is planned to afford returned service personnel an opportunity to obtain concessions to provide accommodation for visitors, but there is little hope that the amount of building material available for the construction of necessary seasonal buildings will meet the demand. Consequently, a fuller use of campgrounds is being promoted, and returned service personnel concessionaires are being established on these camping areas to provide the amenities which campers usually require. The organization of community activities on campgrounds to promote recreation is also being arranged.

It is expected that alternative service workers who have been relied upon to perform a considerable amount of maintenance work in National Parks will be released, and returned men will be provided with an opportunity of obtaining employment at prevailing wage rates. Steps are being taken to replace as rapidly as possible worn-out and obsolete maintenance equipment.

During the year the Dominion's responsibility in forestry was outlined in the House of Commons by the Minister. The forest resources of Canada are immense in size and diversified in character. If Canadians are to reap the full value of this great national heritage, the forest lands of the nation must be

brought into a state of continuous production. Administration and protection of the Crown forests lying within provincial boundaries is, and will continue to be, a responsibility of the provincial authorities. The Dominion Government, however, can properly assist in the orderly development of national forest resources in two ways: first, by expanding activities for which it admits responsibility, and, second, by assisting, through the provision of funds, to raise provincial standards respecting the conservation, protection, and development of the provincial forest resources.

The Dominion Forest Service is already engaged in the broad fields of research in silviculture, forest protection, utilization of forest products, and forest economics, and has demonstrated the feasibility of ideas and the development of products which have since been adopted by industry to the benefit of all concerned. It is hoped to be able to expand activities of the Dominion Forest Service to the extent necessary for the post-war years.

The Branch welcomes the return to civil duty of a number of those who have been in the Armed Services or who have been seconded to war departments.

## BUREAU OF NORTHWEST TERRITORIES AND YUKON AFFAIRS

### NORTHWEST TERRITORIES

The Northwest Territories comprise that part of the mainland of Canada lying north of the Provinces of Manitoba, Saskatchewan, Alberta, and British Columbia and east of Yukon Territory, the islands in Hudson and James Bays and in Hudson Strait including Ungava Bay, and the vast Arctic Archipelago. The estimated total of land and fresh-water areas of the Northwest Territories is 1,309,682 square miles. According to the 1941 census, the population of the Territories was 12,028, including 2,284 whites, 4,334 Indians, 5,404 Eskimos, and 6 others, chiefly Asiatics. The total has since been increased by about 3,000 owing to increased mining activity in Mackenzie District.

The Commissioner of the Northwest Territories in Council has power to make ordinances for the government of the Northwest Territories in relation to such subjects as are designated by the Governor in Council under the authority of the Northwest Territories Act. The seat of government is in Ottawa.

#### *Council*

<i>Commissioner</i>	Charles Camsell,
<i>Deputy Commissioner</i>	R. A. Gibson,
<i>Members of Council</i>	A. L. Cumming, K. R. Daly, R. A. Hoey, S. T. Wood.
<i>Secretary (Acting)</i>	J. F. Doyle.

#### WORK OF COUNCIL

Five regular and seven special sessions of Council were held during the year. Assent was given to the following ordinances and amendments: Insane Persons Ordinance; Armed Forces Moratorium Ordinance; Local Administrative District Ordinance; Businesses, Callings, Trades and Occupations Licence Ordinance; Judicature Ordinance; Vital Statistics Ordinance; Local Administrative District Ordinance; Dog Ordinance and Regulations, Bulk Sales Ordinance and Assignment of Book Debts Ordinance.

In addition, matters of policy were discussed in connection with the Eastern Arctic Patrol; Eskimo affairs; medical services in the Eastern Arctic; health and welfare; education; hospital and medical services; Northwest Game Act and Regulations; establishment of forest and game protection service; assistance

to mining companies in the construction of trunk roads; radio services; supervision of payment of family allowances; public buildings; agricultural, fish, geological, water-power and hydrographic, geodetic, legal, forest and wild life surveys, and appointment of Territorial officers and commissioners.

R. A. Hoey, Director, Indian Affairs Branch, was appointed member of the Northwest Territories Council as of August 21, 1945, to replace Dr. H. W. McGill, who retired on superannuation March 21, 1945.

Major D. L. McKeand, Superintendent of the Eastern Arctic and Secretary of the Northwest Territories Council, retired from the Government service on superannuation as of June 13, 1945. The duties of Acting Superintendent of the Eastern Arctic were assumed by James G. Wright, and the duties of Secretary of the Council were carried on to the end of the fiscal year by John F. Doyle.

#### ADMINISTRATION

The Lands, Parks and Forests Branch is responsible for the administration of the various acts, ordinances and regulations pertaining to the Northwest Territories. To facilitate departmental administration there is a Superintendent for the Eastern Arctic and one for the Mackenzie District. A departmental agent is stationed at Fort Smith, N.W.T., and this officer is also Superintendent of Wood Buffalo National Park, Agent of Dominion Lands, Crown Timber Agent, Mining Recorder, Stipendiary Magistrate, and Marriage Commissioner. The Sheriff of the Northwest Territories is also stationed at Fort Smith. The Mining Recorder, Agent of Dominion Lands, and Crown Timber Agent for the Yellowknife Mining District, which includes what was formerly known as the Great Bear Lake Mining District, is stationed at Yellowknife. The Mining Recorder for unorganized districts is located at Ottawa, and Sub-Mining Recorders are also located at Ottawa, Edmonton, Fort Simpson, Fort Norman, Aklavik, Coppermine, and Port Radium.

#### MEDICAL OFFICERS

For a number of years the Northwest Territories have been divided into seven medical districts and two sub-districts, over which medical officers of the Department of Mines and Resources had jurisdiction. These officials had their headquarters at Fort Smith, Fort Resolution, Fort Simpson, Fort Norman, Aklavik, Port Radium, Yellowknife, Chesterfield, and Pangnirtung, and on the vessel carrying the annual Eastern Arctic Patrol. In addition, doctors were employed at various points throughout the Territories to look after the general health of those engaged in joint defence projects and in mining and other industries.

Under the provisions of Order in Council (P.C. 6495) of October 12, 1945, the control and supervision of that part of the public service administering the medical care and hospitalization of Indians, including Eskimos, together with the staff employed, equipment, and other physical assets used in connection therewith, were transferred from the Department of Mines and Resources to the Department of National Health and Welfare as from November 1, 1945.

As the Department of National Health and Welfare had made no financial provision for the medical services and hospitalization of Eskimos, all accounts were paid by the Northwest Territories Administration up to and including March 31, 1946.

Although the medical staff of the Department of Mines and Resources was absorbed by the Department of National Health and Welfare, the medical officers in the Territories continue to represent the Department of Mines and Resources in the administration of the Public Health and other related ordinances and also in connection with the health of all residents of the Territories other

than Indians and Eskimos. All doctors have been appointed coroners and medical health officers under the Public Health Ordinance. Some of the doctors make patrols to outlying areas and all make use of the radio-telegraphic service in prescribing for those who are unable to obtain treatment at the medical centres.

#### HOSPITALS

Twelve hospitals were operated in the Territories during the year, nine by missions of the Roman Catholic Church and the Church of England in Canada, two by mining companies at Yellowknife and Port Radium, and one by the Indian Affairs Branch at Fort Norman until November 1, 1945, when its administration was taken over by the Department of National Health and Welfare. The last-named hospital was destroyed by fire on February 22, 1946. Hospital facilities were also provided by private enterprise at Norman Wells for those engaged on the Canol Project and related activities.

The mission hospitals are situated at Fort Smith, Fort Resolution, Hay River (sick bay), Fort Simpson, Aklavik (2), Rae, Chesterfield, and Pangnirtung. By special arrangement, the Northwest Territories Administration paid the mission hospitals \$2.50 per diem for the care of indigent whites, Eskimos, and half-breeds who were admitted on the recommendation of the resident medical officer. In the case of patients suffering from venereal disease, \$3 was paid for in-patients, and \$1 per diem for out-patients. The aged and infirm are cared for in industrial homes operated in conjunction with the mission hospitals at Aklavik, Chesterfield, and Pangnirtung. These inmates are also admitted on the recommendation of the Government medical officers, and the missions receive \$200 per person per annum for their care and maintenance. During the year, the sum of \$39,368.76 was expended for the care of destitute patients in the hospitals, representing approximately 15,750 days of treatment. Thirty-five patients were accommodated in the industrial homes at a total cost of \$6,012.37, and 17 insane patients together with a number of indigents were treated in provincial institutions at a cost of \$17,431.80. The above figures do not include the amounts paid by the Indian Affairs Branch for services to Indians only.

#### SCHOOLS

Residential and day schools are operated by the Church of England and the Roman Catholic missions. The residential schools are located at Fort Resolution, Fort Providence, and Aklavik (2), and the mission day schools are located in the principal settlements. Owing to the nomadic tendencies of the natives some of the day schools in the outlying areas are only operated during certain periods of the year when the natives are in the vicinity. During the year 132 children attended the residential schools and 361 pupils attended the day schools. The public schools were operated at Fort Smith and Yellowknife, and were attended by a total of 108 pupils.

Grants totalling \$30,190.17 were paid to the various schools and for the maintenance of indigent children in the residential schools. Quantities of school supplies were also furnished.

As the Northwest Territories Administration is responsible for the welfare of all Eskimos, arrangements have been made for the maintenance of a number of destitute children in the residential schools at Fort George, Que. School supplies are also furnished to a number of mission day schools operated within Eskimo territory of the Province of Quebec.

The above figures do not include amounts paid by the Indian Affairs Branch for the maintenance and education of Indian children.

During the year steps were taken to provide for the appointment of a school inspector in the Northwest Territories with headquarters at Yellowknife, whose duties will entail the co-ordination of all educational services in the Territories.

#### LAW AND ORDER

Law and order in the Territories are maintained by the Royal Canadian Mounted Police. Detachments have been established at the more important settlements and extensive patrols are made to outlying areas. To facilitate the administration of justice, four Stipendiary Magistrates have been appointed.

#### EASTERN ARCTIC PATROL

The annual Eastern Arctic Patrol sailed on the R.M.S. *Nascopie* from Montreal on July 7. The vessel reached Churchill, Manitoba, on August 2, where passengers were exchanged and coal, freight, and supplies loaded for the northern part of the voyage. The vessel made 21 calls and covered a distance of 10,250 geographical miles before returning to Montreal on September 26. J. G. Wright, of the Bureau of Northwest Territories and Yukon Affairs, was the Officer in Charge of the Patrol.

Dr. George MacCarthy and Dr. Campbell Laidlaw, both of Ottawa, served as medical officers on the Patrol as far as Churchill. They rendered valuable service in the examination and treatment of Eskimos as well as white residents at all ports of call on the first half of the voyage. This work was continued from Churchill onward by Dr. Dennis Jordan, of Toronto, and an assisting technician. Together they collected useful research material on blood groupings among the Eskimos. An eye group consisting of Dr. Walter Crewson, ophthalmologist of Hamilton, and two assistants supplied by arrangement with the Canadian National Institute for the Blind, accompanied the northern half of the Patrol from Churchill. They were able to improve the vision of many natives and to conduct a study of eye conditions for future guidance. The dispensary with which the *Nascopie* was fitted in 1944 was used frequently as an operating room by the various medical officers.

The *Nascopie* and auxiliary schooners carried mail and medical and other supplies for all ports in the Eastern Arctic. Royal Canadian Mounted Police detachments were reopened at Port Harrison, Quebec, and Dundas Harbour on Devon Island. A post office was opened at the latter point and thus became the most northerly post office in the British Empire. Building materials were carried for a new radio-sonde station at Port Harrison and for improvements at the meteorological station at Arctic Bay and at several Royal Canadian Mounted Police detachments. Weather and radio station facilities at Southampton Island and the ionospheric station at River Clyde, which until recently were operated by United States interests, were taken over by the Department of Transport. These new activities added considerably to the number of passengers and amount of freight carried on the Patrol.

The health of the Eskimo population was found to be generally good in all regions with the exception of Cape Dorset, where a number of deaths had occurred from a disease which was ultimately diagnosed as typhoid fever. A campaign of immunization was started by the medical officers on the Patrol to prevent the spread of the disease. This work was continued by Dr. N. Rawson, Government Medical Officer at Chesterfield, who early in October was flown to Cape Dorset, where he remained until picked up by an R.C.A.F. plane early in February. Dr. Rawson travelled up and down the coast by boat and later by dog sled, inoculating the natives against typhoid. So far as is known, the disease was completely controlled, and no further deaths have been reported from that cause.

Two unusual incidents occurred on the Patrol. At Lake Harbour a medal awarded by the Royal Canadian Humane Association was presented to Eskimo Tommy (1452) for saving the life of the wife of the Hudson's Bay Company post manager in 1943 when the small boat in which they were travelling was upset by a tide-rip in the icy waters of the outer harbour and all other passengers were drowned. The presentation, the first of its kind to an Eskimo, was made by the Officer in Charge of the Patrol in the presence of some 200 Eskimo and white residents.

When the Patrol was in Lancaster Sound the opportunity was taken to hold a brief ceremony in commemoration of the Franklin Expedition which in 1845, 100 years before, sailed westward through the sound and ultimately perished with no survivors. The *Nascopie* was stopped for fifteen minutes while an appropriate ceremony was held, at the conclusion of which a wreath provided by the Northwest Territories Administration was dropped overboard.

#### LIQUOR PERMITS

The Saskatchewan Liquor Board, as Territorial Liquor Agent, continued the operation of the stores at Yellowknife and Fort Smith under the direction of the Northwest Territories Administration. The restrictions governing supply under Wartime Alcoholic Beverages Order 1942 were removed in 1944 as they applied to beer, and the restrictions on spirits and wine were lifted in 1945. However, only a moderate increase was possible in the available supply for the Territorial liquor stores during the fiscal year. A small increase in the hard liquor ration was made in December, 1945. The liquor sales at the Fort Smith store declined following the termination of activities associated with the Canal Project, but sales at Yellowknife store increased substantially with renewed interest in mining activity in that area.

Net profits from the operation of the liquor stores during the fiscal year amounted to \$125,485.01 as compared to \$89,392.79 in 1944-45. Profits from the Yellowknife store were \$86,530.59 and from the Fort Smith store \$38,594.42. Profits from liquor sales and permit fees in the Mackenzie District, together with \$1,989.52 derived from fines under the Territorial Liquor Ordinance, were placed in the special liquor account for territorial purposes. The balance in this account as of March 31, 1946, was \$419,251.77. The sum of \$104 was obtained from the sale of liquor permits issued at Ottawa.

During the fiscal year, 5,205 Class "A" annual permits were issued in the Northwest Territories. Liquor permits issued at Ottawa were 2 Class "B" permits covering sacramental wine and 57 Class "C" permits authorizing the importation of limited quantities of spirits, wine, and beer. Sales at the Territorial liquor stores during the fiscal year were approximately 5,112 gallons of spirits, 1,273 gallons of wine, 2,756 gallons of ale and stout, and 27,150 gallons of beer. Importation permits covered 115 gallons of spirits, 212 gallons of wine, and 120 barrels of beer.

#### LANDS AND TIMBER

*Surveyed Lands.*—Two settlement lots were sold and patented as follows: Coppermine, 1; Hay River, 1. At Port Radium Settlement, 7 surface leases have been issued. These leases are issued at present for five-year periods.

*Unsurveyed Lands.*—Small parcels of unsurveyed land suitable for agricultural and fur-farming purposes, as well as tracts with water frontage suitable for transportation and shipping interests, are leased under the provisions of Chapter 113, R.S.C. 1927. The issuing of each lease is authorized by an Order in Council and the number of such leases in force is 35.



Forty-seven permits to occupy Dominion lands during the pleasure of the Department have been granted. There are 3 grazing leases in force, and 5 hay permits were issued under which 69 tons of hay were cut.

During the year 53 assignments affecting lands were registered in the Department.

*Timber.*—Seventy-eight (78) timber permits, exclusive of those granted in connection with timber berths, were issued, authorizing the cutting of 8,554 linear feet of timber, 150 roof poles, and 3,678 cords of wood. Of these permits, 26 were issued free of dues to educational, religious, and charitable institutions; to settlers for domestic use, and to government departments. Twenty-one timber berth permits were granted under which 1,090,549 feet board measure of lumber were manufactured.

Total revenue derived from lands, timber, grazing, and hay was \$27,936.82.

#### FOREST AND WILDLIFE PROTECTION

An important development during the year was the establishment of a service to protect forests and wildlife in Mackenzie District, with local headquarters at Fort Smith. For many years the Mackenzie River Valley has been ravaged by fires, most of them of unknown origin, and owing to lack of adequate preventative measures these fires have often developed into serious conflagrations. For the first time a substantial appropriation has been granted for the organization of forest protection on a more adequate basis.

The new protection service is headed by E. G. Oldham, with the title of Superintendent of Forest and Wildlife Management. Mr. Oldham is a forestry engineer formerly employed by the Forest Service of the Province of British Columbia, and a veteran of World War II. He will be assisted by a technical staff and a warden service. Members of the latter will be assigned definite areas to patrol, including Wood Buffalo Park, and they will assist in the investigation of forest areas and wildlife conditions. Orders were placed for considerable fire-fighting equipment, including three new forest patrol boats. Early in 1946 the new Superintendent completed a trip by aeroplane to all important settlements along Mackenzie River, and conferred with government officers, traders, and trappers at the places visited.

During the year, a number of very large forest fires occurred in the area south of Great Slave Lake and east of Slave River. Other serious fires raged through the northern part of Wood Buffalo Park. A patrol by aeroplane of the latter area in March, 1946, confirmed reports that fires were still burning in moss and underbrush in sections of the park, and necessary action was taken to deal with the situation.

Because of prevailing employment conditions, it was not possible to engage a qualified forester to take charge of forest fire suppression work in Mackenzie District during the summer of 1945. Arrangements were made, however, for the loan of the services of H. L. Holman, District Forest Service Officer at Calgary, Alberta. Mr. Holman proceeded to Fort Smith in April, and under his direction considerable fire-fighting equipment, including pumps, and boats, was purchased, and delivered to officers of the Royal Canadian Mounted Police, who acted as forest and game officers at the various settlements. Mr. Holman was also authorized to use aircraft as an aid in spotting fires and for the transportation of men and equipment where required. The serious fire condition required almost continuous attention, and effective action in combating a number of fires which threatened some of the settlements was taken.

It is hoped that the new protective organization, with the assistance of the R.C.M.P. and other Government officers, will be able to institute effective action in preventing further serious loss of valuable forest resources by fire, and that

the necessary field investigations will be conducted at an early date in order to determine the action required to restore to normal the wildlife in Mackenzie District.

### NORTHWEST GAME ACT AND REGULATIONS

No person except a native-born Indian (or half-breed leading the life of an Indian) or an Eskimo (or half-breed leading the life of an Eskimo) shall engage in hunting or trapping any game protected under the Regulations without first securing a licence to do so.

The following are eligible for hunting and trapping licences:—

- (1) Residents of the Northwest Territories, as defined by these Regulations, who on May 3, 1938, held hunting and trapping licences and who continue to reside in the Northwest Territories.
- (2) The children of those who have had their domicile in the Northwest Territories for the past four years, provided such children continue to reside in the Northwest Territories.
- (3) Such other persons as the Commissioner of the Northwest Territories may decide are equally entitled to licences under these Regulations.

Only British subjects with four years' residence in the Northwest Territories are eligible for licences under Clause 2. A minor under the age of fourteen years shall not be eligible for a licence. A minor assisting his parents or guardians in connection with hunting or trapping operations will not require a licence.

### FUR PRODUCTION

Fur production during the year was below average. This was attributed in part to forest fires which destroyed much of the cover providing the habitat of wildlife and to the lack of precipitation which resulted in lowering of the water levels, thereby affecting aquatic animals, particularly beaver and muskrats. Investigations indicated that it was desirable to continue full protection for marten throughout Wood Buffalo Park and the Northwest Territories. Beaver also were reported very scarce in many districts and a close season for these animals was established throughout Wood Buffalo Park and the greater part of Mackenzie District. The trapping of beaver, with a bag limit of ten animals to native and resident trappers, was permitted in that part of the Mackenzie District to the north and west of the Liard River and in Yellowknife Game Preserve, where beaver were reported to be fairly plentiful. Muskrat conditions in the delta of Mackenzie River were reported favourable and an average yield was expected. This was in contrast with the situation in the deltas of the Athabaska and Slave Rivers, where conditions were much below average. Another contributing factor to the general fur shortage was the fact that the low ebb of the life cycle for several fur-bearers was reached.

Some of the natives in the Providence and Simpson Districts complained of inability to secure sufficient fur to allow them to purchase needed supplies. Cases of this nature were investigated by the local Indian Agent and the R.C.M.P. and relief supplies were issued where necessary. Surveys were planned by field officers to ascertain the present status of beaver and marten and to determine whether any modification of the trapping restrictions should be authorized for the ensuing season. Fur conservation activities are under consideration for areas which lend themselves to such developments.

## WOOD BUFFALO PARK

Investigations made by J. D. Soper early in 1945 confirmed reports of severe damage to the forests in Wood Buffalo Park by fires and of the depletion of the beaver, marten, and muskrats. The appointment of a number of new wardens to the staff was made in order to give more supervision to the forest fire situation and to take prompt action in suppressing fires. A tractor and other mechanical equipment, including dump trucks and general purpose vehicles, were ordered for delivery in 1946 for use in constructing roads and trails into the remote areas to facilitate patrolling of the park, and to assist in suppressing forest fires. The continued low water conditions in the delta of the Athabaska River reduced the muskrat population in this part of the park to the smallest on record. As opportunity permits, surveys of conditions which affect the delta will be carried out.

Buffalo were reported to be thriving and many calves were observed. Available grazing areas were estimated to be greatly in excess of present requirements. Fifty-seven old male buffalo were slaughtered to provide meat for distribution to hospitals, missions and Indian Agents, providing treatment and facilities to natives in needy circumstances.

## GENERAL

Seven fur farms were licensed to operate in the Northwest Territories during the fiscal year.

Comparative figures of the number of big game animals and birds taken during the licence years ended June 30, 1944, and 1945, and the average for the 5 years ended June 30, 1944, follow:—

	Year ended June 30		5-year Average 1940-1944
	1945 <sup>2</sup>	1944 <sup>1</sup>	
<i>Big Game—</i>			
Caribou.....	28,704	22,763	21,006
Deer.....	44	82	69
Moose.....	790	693	1,062
Sheep.....	44	7	48
Goat.....	5	0	10
<i>Game Birds—</i>			
Ducks.....	11,850	9,525	11,705
Geese.....	656	227	804
Grouse.....	198	532	821
Partridge.....	489	571	2,065
Prairie Chicken.....	696	640	1,691
Ptarmigan.....	5,945	4,872	8,070

*Licences, Permits and Revenue.*—Comparative statement of licences and permits issued and revenue derived under the Northwest Game Act.

	Licences Year ended June 30		5-year Average 1941-45
	1946 <sup>2</sup>	1945	
<i>Hunting and Trapping—</i>			
Resident.....	449	506	524
Non-Resident Bird Licence.....	33	30	23
<i>Trading and Trafficking—</i>			
Resident.....	124	110	115
Non-resident.....	3	3	6
Non-resident—non-British.....	1		

	Permits Year ended June 30		5-year Average 1941-1945
	1946 <sup>2</sup>	1945 <sup>1</sup>	
To establish trading posts.....	8	8	16
To take mammals.....	2	3	3
To hunt and trap in Wood Buffalo Park.....	246	302	335
To take migratory birds.....	5	3	8
To take scientific specimens.....	3	5	5
To take quota (10) beaver.....	476	1,367	1,442

<sup>1</sup> These figures may differ slightly from those recorded in the Annual Report for 1944-45 because of additional returns received after that report was printed.

<sup>2</sup> Subject to revision as additional returns are received.

**Revenue.**—Revenue under Northwest Game Act for fiscal years ended March 31, 1945 and 1946, and average for 5 years 1941-45 are shown hereunder:—

	Fiscal Year		5-year Average 1941-45			
	1945-46	1944-45				
	\$	cts.	\$	cts.	\$	cts.
Hunting licences.....	994	00	980	00	1,069	95
Trading licences.....	1,388	90	1,065	00	1,784	44
Bird licences.....	78	00	111	00	164	20
Fur farm licences.....	15	00	20	00	19	40
Trading post permits.....	6	00	12	00	13	80
Sale of furs.....	3,341	50	3,192	28	1,433	62
Fur export tax.....	56,834	64	62,751	18	92,370	68
Permit to export live furbearers.....	100	30				
Fines and forfeitures.....	90	00	326	78	528	55
Sub-total.....	62,846	34	68,458	24		
Revenue under the Businesses, Callings, Trades and Occupations Ordinance, fiscal year ended March 31, 1946....	5,875	50	6,366	50		
	68,721	84	74,824	74		

**Infraction of Game Laws.**—There was one prosecution and conviction for infraction of the game laws.

#### REINDEER

The reindeer herd on the Government reserve immediately east of the Mackenzie Delta was maintained in good condition. The problem of corralling the deer at the summer round-up has become more difficult in recent years. The reindeer were brought together in July, 1945, but the count and classification of the animals was not completed. Measures have been initiated to secure expert advice on handling the herd and improving the fencing and corralling arrangements. Reductions in the herd reported during the fiscal year were normal and included 403 deer taken for meat. The usual donation of 100 carcasses was made to mission hospitals and residential schools. Revenue from the sale of reindeer products amounted to \$4,106.

Some of the reindeer contained in two herds under native management near Anderson River were brought together after the proprietors of these herds lost their lives in the wreck of the native schooner *Cally* in September, 1944. These animals, now under Government management as the "Anderson River Herd", totalled about 2,000 head in the summer of 1945.

The abundant fur yield and high prices which have prevailed in the Mackenzie Delta area for a number of years tend to attract the young natives to trapping rather than to reindeer herding. This situation makes it difficult to maintain a sufficient number of qualified herders and apprentices to keep effective control over the herds and to extend the industry as the reindeer increase in number. However, it is the policy of the Administration to continue with such developments and improvements as may be possible with a view to carrying out the objects of this enterprise in the interests of the natives.

### Mining

Yellowknife continued to be the centre of mineral development in the Northwest Territories. Although mining activity, including underground development, was greatest in the vicinity of Yellowknife Bay and River, exploration and staking have extended northward to the Indin Lake area, about 135 miles north of Yellowknife Settlement, northeastward to the treeless barrens in the vicinity of Courageous Lake, and eastward along the Hearne Channel of Great Slave Lake. Considerable mining activity has also occurred in the Thompson Lake, Gordon Lake, and Beaulieu River areas within a 75-mile radius of Yellowknife Settlement.

Interest in the Yellowknife mining district was accentuated by several developments. Among these were the decision of the Dominion Government to make available additional hydro-electric power in the region by development of power sites on Snare River. Details of the proposed development will be found in the report of the Director of Surveys and Engineering. An agreement reached between the Dominion Government and the Province of Alberta for construction of an all-weather road linking railhead at Grimshaw, Alberta, with Hay River Settlement, N.W.T., on Great Slave Lake, is expected to result in improved facilities for transportation of mining equipment and supplies. Gratifying reports which followed diamond drilling and exploration on properties of Giant, Negus, and other mines, an improvement in labour conditions, and an easing of essential supplies have all contributed to a continued expansion of the mining industry.

More than 200 companies have been incorporated for operation in the Northwest Territories, the greater number having interests in the Yellowknife field. As additional groups of claims become available for exploratory work, the total may be expected to increase. The expansion in mining activity is reflected in the revenue derived from fees collected under the Quartz Mining Regulations. For the year ended March 31, 1946, revenue from that source amounted to \$184,019, or approximately double that collected during the previous year.

Gold production was resumed in the Territories during the year. Negus Mines, Limited, which suspended milling in October, 1944, resumed operations in July, 1945, and production of 12,243 ounces of gold and 3,096 ounces of silver was reported for the period ended March 31, 1946. Development work was continued at the Con and Rycon mines, and a resumption of gold production at these properties, as well as at Thompson Lundmark Gold Mines, Limited, has been forecast for the year 1946-47.

Of the properties under development that of Giant-Yellowknife Gold Mines Limited in the Yellowknife River area has shown considerable progress. At the end of the fiscal year, one shaft had been completed to a depth of 500 feet, and the sinking of a second shaft was under way. The sinking of a shaft at the property of Crestaurum Mines Limited has also been commenced. Construction of roads connecting the Giant and Crestaurum properties with Yellowknife Settlement were also undertaken.

Prospecting was carried farther afield. In addition to that carried on in new territory, intensive prospecting of older claims was also undertaken. This type of work should tend to promote faster and more rapid growth of the mining industry. Yellowknife mining district comprises an immense area, and many localities have as yet received only casual examination. Although thousands of claims have been staked, a great many await geological examination. The seven principal mining areas under investigation and development in the Yellowknife District are as follows: Yellowknife Bay and River; Gordon Lake; Beaulieu River; Indin Lake; MacKay-Courageous Lakes, Russell-Slemon Lakes and Hearne Channel (Great Slave Lake).

In the Great Bear Lake area, the mill and mine of Eldorado Mining and Refining (1944) Limited at Labine Point continued operations at capacity during the year, with about 200 persons employed. The development of atomic research with the aid of uranium, one of the principal products of the mine, has made the property one of the most valuable on the continent. It has been operated as a Crown company since 1944, and for security reasons, production figures are treated as confidential.

The value of mineral production in the Northwest Territories for the past three years, together with the total value of production to date, is indicated by the following figures which have been released by the Dominion Bureau of Statistics:—

<i>Mineral</i>	Production for 1943	Production for 1944	Production for 1945	Total Production to End of 1945 <sup>1</sup>
Gold .....	\$2,272,732	\$ 799,838	\$333,218	\$14,343,619
Silver .....	5,996	5,881	956	837,523
Lead .....	..	..	..	490
Copper .....	..	1,428	..	24,102
Tungsten .....	729	..	..	37,674
Pitchblende Products .....	..	..	..	5,805,423*
Petroleum .....	400,201	632,587	136,303	1,645,104
Natural Gas .....	335	335	335	3,260
	\$2,679,993	\$1,440,069	\$470,812	\$22,697,195

\*Total to end of 1941. The value of pitchblende products, including radium and uranium, for 1942, 1943, 1944 and 1945, is not available for publication.

During the fiscal year, 1,432 miner's licences and 1,516 renewals of miner's licences were sold; 8,625 quartz grants were issued and 5,508 assignments of mineral claims were recorded. In addition to the above, 15 leases comprising 749.29 acres were issued under the Quartz Mining Regulations.

*Coal.*—At present there are no coal mining leases in force in the Northwest Territories but there are three Domestic Coal Mining Permits in force in the Unorganized Districts.

*Petroleum and Natural Gas.*—The agreement between the Crown and Imperial Oil Limited, covering the "proven area" (7,939 acres) at Norman Wells, came into effect on May 3, 1945. This agreement is essentially a lease and comprises the only area in the Northwest Territories under which oil has been found and produced. One permit (255,633 acres) issued under the regulations, approved June 3, 1945, has been abandoned and two new permits have been issued under the same regulations, one in the Norman area (256,000 acres) and one on the Hay River (646 acres). The total area at present under permit is 2,242,284 acres. Six leases comprising an area of 3,279.23 acres and the above-mentioned "proven area" are in good standing. With the disuse of the Canol Pipe Line many wells were capped and during the fiscal year, on a monthly average, seven wells were operated to supply the Territorial market only. The Canol Project was terminated on March 8, 1945. During the period of its existence, April, 1942, to March 8, 1945, a total of 1,858,447 barrels was produced from the Norman field. Oil production during the fiscal year 1945-46 was 69,434 barrels.

*Dredging.*—Two five-mile stretches under lease on Grizzly and Bennett Creeks produced a combined revenue of \$106.75.

#### YELLOWKNIFE ADMINISTRATIVE DISTRICT

The Local Trustee Board of Yellowknife, which has functioned since January 1, 1940, was increased in number from 5 to 7 members, effective January 1, 1946. During the year the Board held 21 meetings and passed several by-laws including those covering the assessment of property and the rate of taxation. Many other matters of interest to the community were also discussed and passed upon by the Board.

#### TOWNSITE DEVELOPMENT

Increased mining activity in the Yellowknife District with a corresponding increase in population made necessary an extension of the settlement of Yellowknife. During the year many lots suitable for business and residential purposes were surveyed on a suitable area about a mile southwest of the original townsite. Most of the lots made available had been leased at the close of the fiscal year, when plans were being made for an additional survey.

A scarcity of materials delayed the construction of buildings to be erected both by Government agency and by private enterprise, but plans were completed for a number of new structures including an administration building, staff quarters, and a new store for the sale of liquor. A campaign for funds to meet the cost of erecting a modern hospital, with Government assistance, was also undertaken in the settlement.

#### PUBLIC IMPROVEMENTS

Public roads in the principal settlements of Mackenzie District and roads leading to adjacent aerodromes were maintained during the year by the Department of Transport from funds provided by the Northwest Territories Administration. The two portage motor roads connecting Fort Fitzgerald, Alberta, with Fort Smith, Northwest Territories, were kept in serviceable condition by Northern Freighters, Limited, and Northern Transportation Co., Limited. The latter company also maintained the road connecting Fort Smith with Bell Rock, where the company's warehouse and wharf are located.

Progress was made by the Department of Transport in the development of an airport at Long Lake, about four miles from Yellowknife, and one landing strip, 5,000 by 500 feet, was completed. Preliminary work was also carried out on a second strip which will measure 5,000 by 500 feet when completed. The Department of Transport also constructed an access road connecting the airport with the settlement of Yellowknife. The airport was used during the winter of 1946 by the R.C.A.F. as a base for aircraft services provided in connection with "Operation Musk-Ox". The development of the airport also facilitated the movement of personnel and supplies required by the mining industry in the Yellowknife district. It will continue to be an important adjunct to the community as the mining industry expands farther afield.

Giant-Yellowknife Gold Mines, Ltd., built a road connecting the mine with the new townsite addition to Yellowknife, and an extension of this road to the property of Crestaurum Mines, Ltd., was commenced by the latter company. Financial contributions towards this work were made by the Northwest Territories Administration. A winter tractor road was opened from Slemon Lake to the Indin Lake area north of Great Slave Lake which permitted mining companies to transport supplies to their properties.

The section of the Grimshaw-Hay River winter road within the Territories was maintained by one of the transportation companies using the route, with financial aid from the Northwest Territories Administration. Four companies operated tractor trains from the terminus of the road, at the mouth of Hay

River, across Great Slave Lake to Yellowknife. During the year an agreement was reached between the Dominion Government and the Government of Alberta providing for the construction of an all-weather highway linking Grimshaw and Hay River. The Dominion Government will share the cost of the section of the highway situated within the Province and the cost of constructing the section within the Northwest Territories will be borne entirely by the Dominion Government. The agreement provided that work on the highway will commence not later than May 1946, and be completed by the end of 1947.

An area situated about a mile southwest of the original settlement of Yellowknife was sub-divided into building lots during the year to meet the requirements of a greatly increased population. Surveys and other necessary investigations were made to provide for future installation of power, water, and sewer services in the new townsite area.

Landing fields for aircraft along the Mackenzie River Route in the Mackenzie District as far north as Norman Wells were maintained for use by wheel-equipped aircraft by the Department of Transport, which also provided meteorological services and facilities for refuelling. Radio communication services were maintained at a number of these stations by the Royal Canadian Corps of Signals, Department of National Defence. One permanent landing strip was constructed at the Long Lake aerodrome near Yellowknife to replace the temporary strip previously used.

The Department of Transport continued the maintenance of aids to navigation along portions of the Mackenzie River waterway including points on Slave River, Great Slave Lake, Mackenzie River, and Great Bear Lake. Such aids now include 5 sets of range lights, 19 beacon lights, and 4 light buoys. Buoyage or channel marks suitable to available depths are also provided at various points along the waterway.

The Royal Canadian Corps of Signals also maintained a system of wireless communication in the Northwest Territories and Yukon which now consists of 19 radio stations extending through from Alberta to the Arctic Ocean. This system provides an outlet for approximately 32 additional stations owned and operated by commercial organizations such as mining, transportation, and trading companies. Connections were also maintained with Department of Transport stations, the Alaska Communications System, and with Canadian commercial telegraph companies at Edmonton.

#### SCIENTIFIC SURVEYS

During the year the Surveys and Engineering Branch, through its Dominion Water and Power Bureau, continued stream measurement and investigation of possible water power development in the Northwest Territories. Field investigations were undertaken in the Yellowknife area as a result of increased mining activity there. Reconnaissance engineers inspected the Lockhart River power site as well as power sites on Snare River. Hydrographic surveys were made by the Department of Public Works and the Hydrographic Service of the Department of Mines and Resources at the western end of Great Slave Lake and down Mackenzie River to Fort Simpson. A new channel through Green Island Rapids on Mackenzie River above Fort Simpson was examined and charted.

Engineers of the Department of Public Works carried out a complete harbourage survey at Fort Smith which was extended along the west shore of Slave River to Bell Rock. Surveys were also completed at Fort Resolution, Deadman's Island, Buffalo River, and Yellowknife.

During the 1945 season, surveys of the section of the 7th Meridian and the 36th Base Line in the Northwest Territories were made by the Legal Surveys and Map Service of the Department. These surveys give map control and assist in the location of mining claims and other areas.



The Geological Survey of Canada had four parties in the field during the year. Three of these were engaged in detailed mapping in the vicinity of Great Bear Lake and the fourth was engaged in completing geological mapping of the Ross Lake area some 30 miles northeast of Yellowknife. The detailed work was designed to aid the discovery of pitchblende or other uranium-bearing minerals and was carried on in close co-operation with Eldorado Mining and Refining, a Crown company.

Biological investigations of waters in the Northwest Territories including Great Slave and Great Bear Lakes were continued by the Fisheries Research Board of Canada. The summer's investigations supplemented those inaugurated in 1944, and provided much additional information about the available supply of fish. Gill-net sampling in Great Slave Lake resulted in an average catch comparable to that obtained in 1944.

During the year an Alberta fish company operated on Great Slave Lake under a commercial licence and obtained a catch of approximately 1,300,000 pounds—chiefly trout, with smaller quantities of whitefish and inconnu. The greater part of the catch was processed as fillets at the lake with the aid of mechanical quick freezing equipment and was transported on refrigerator barges to railhead at Waterways for shipment to markets in Eastern Canada and the United States.

#### AERIAL MAPPING

Considerable aerial photography was carried out by the Royal Canadian Air Force during the year. In Yellowknife mining district an area of 14,054 square miles was covered by vertical photography for mapping purposes. These aerial photographs are essential in unsurveyed territory for the graphical representation of mining claims.

In the Great Bear Lake region, an area of 672 square miles was photographed to permit the study of mining possibilities of the region, particularly with reference to the location of bodies of uranium and radium-bearing ores.

An area of 18,096 square miles straddling the Mackenzie River Valley was photographed to permit the study of potential oil-producing territory. Wood Buffalo Park, comprising an area of 17,300 square miles, together with an additional 412 square miles around its borders, was also photographed for forest and wildlife management purposes.

In addition to the specific purposes mentioned, the photographs so obtained will be utilized for general mapping purposes, and for use in connection with the national forest inventory being undertaken by the Dominion Forest Service of the Branch.

#### AGRICULTURE

During the summer exploratory soil surveys, inaugurated in 1944, were continued by Dr. A. Leahey, of the Experimental Farms Service, Department of Agriculture, along Mackenzie River from Fort Simpson to Aklavik. More comprehensive investigations were also made of soil conditions on Salt River plains near Fort Smith, in Yellowknife Settlement and vicinity, and in the Fort Simpson area.

In an endeavour to improve gardening and other forms of horticulture in Mackenzie District, a selected group of 34 residents of various settlements along the Mackenzie River system between Fort Fitzgerald, in Alberta, and Aklavik, N.W.T., received free parcels of selected garden seeds, plants, roots, fertilizer, and insecticides from the Experimental Farms Service. This distribution was followed up by visits made by F. V. Hutton, horticulturist of the Experimental Farms Service, who furnished personal advisory services and inspected results. In connection with this horticultural effort, experimental garden and grass plots

were laid out at Yellowknife Settlement on suitable land. The results of the season's work, which was tentative in scope, were satisfactory, and served as a basis for more intensive plans in 1946.

At a meeting of the Interdepartmental Committee on Agriculture, composed of officers of the Departments of Agriculture and Mines and Resources, the establishment of an agricultural substation at Fort Simpson during 1946 was discussed and approved, and the necessary preliminary arrangements were made.

#### GEOGRAPHIC AND ECONOMIC RESEARCH

Research studies dealing with the geography, natural resources, and peoples of the Northwest Territories were continued by the Bureau's geographer. The compilation and analysis of information obtained from official records and files was supplemented by field work carried out in Mackenzie River Valley during the summer. Studies in the field entailed investigations of several days' duration at each of the settlements in Mackenzie Valley. Such visits were made in the course of travel by air and boat through the district as far north as Aklavik and east to Reliance.

As a result of field studies, much additional information was obtained for the records of the Bureau. Particular attention was devoted to matters connected with water transportation, fur production and the cycle of fur-bearing animals, settlement growth and mapping, location of Indian camp-sites, climatic conditions including those associated with the opening and closing of water transportation, population, and the general distribution of natural resources.

A research assistant was engaged to assist in assembling more rapidly information about Yukon and the Northwest Territories. Much of the data compiled was later published in a series of articles in the *Canadian Geographical Journal*. Reprints of the articles were purchased for distribution.

#### PUBLICITY AND INFORMATION

Request for general and special information on Northern Canada continued to be heavy, and to meet the demand reprints of the multilithed booklets *The Northwest Territories*, *The Yukon Territory*, and *An Outline of the Canadian Eastern Arctic* were printed. In addition, reprints of articles in the *Canadian Geographical Journal* which described in detail the geography, peoples, natural resources, and facilities for transportation in Mackenzie District of the Northwest Territories, and in the Yukon Territory, were issued in co-operation with the Canadian Geographical Society. A special article, *Physical Geography of the Canadian Eastern Arctic*, was prepared for inclusion in the 1945 Canada Year Book, and a number of reprints in English and French were obtained for selected distribution.

A list of the publications printed during the year for general distribution follows:

- The Northwest Territories—Administration, Resources, Development.*
- The Yukon Territory—Administration, Resources, Development.*
- An Outline of the Canadian Eastern Arctic—Its Geography, Peoples and Problems.*
- Physical Geography of the Canadian Eastern Arctic.*
- Agriculture and Forests in Yukon Territory.*
- Land Use Possibilities in Mackenzie District, N.W.T.*
- Fur Production in the Northwest Territories.*
- Water Transportation in the Canadian Northwest.*

Numerous requests for special information were dealt with by correspondence, and writers, editors, publishers, and others were supplied with articles, photographs, half-tones, and maps. Considerable effort was also expended in the revision of sections of encyclopedias and other works of reference describing the Yukon and Northwest Territories.

### YUKON TERRITORY

Yukon Territory has an area of 207,076 square miles. It is bounded on the south by British Columbia and Alaska; on the west by Alaska (longitude 141 degrees west); on the north by the Arctic Ocean, and on the east by the Northwest Territories. Most of the Yukon's present population is found in three areas; the northern or Dawson District, the southern or Whitehorse District, and the Upper Stewart River or Mayo District. According to the 1941 census, the population of Yukon Territory was 4,914. This figure, however, has been increased by new developments including a revival of the mining industry. The population of the Territory, as of December 31, 1945, was approximately 7,000.

The Yukon was created a separate territory in June, 1898. Provision is made for a local government composed of a chief executive, called the Controller, also an Elective Legislative Council of three members, with a three-year tenure of office. The Controller administers Government measures and works under instructions from the Governor in Council or the Minister of Mines and Resources. The Controller in Council has power to make ordinances dealing with the imposition of local taxes, sale of liquor, preservation of game, establishment of territorial offices, maintenance of prisons and municipal institutions, issue of licences, incorporation of companies, solemnization of marriages, property and civil rights, administration of justice, and generally all matters of a local and private nature in the Territory. The seat of government is at Dawson, Y.T.

#### TERRITORIAL COUNCIL

The Yukon Territorial Council, elected for a three-year term on February 9, 1944, is composed as follows: Dawson District, John R. Fraser, Dawson; Mayo District, Ernest J. Corp, Keno Hill; Whitehorse District, Alexander A. Smith, Whitehorse. The Controller of Yukon Territory is G. A. Jeckell, Dawson.

#### WORK OF COUNCIL

The Yukon Council met on April 16, and was prorogued on April 30, 1945. The annual supply bill was passed, and new ordinances passed as follows: to Provide for the Protection of Children; Respecting the Protection and Care of Archaeological Sites; Respecting the Practice of Optometry; Governing the Storage, etc., of Inflammable Petroleum Products; for the Incorporation of Co-operative Associations and to Provide for their Regulation; for Granting Supply. In addition, the following ordinances were amended: Medical, Dental, Assessment, Motor Vehicle, Legal Profession, Game, Respecting Benevolent and other Societies, Succession Duty, Bills of Sale, Hire Receipts and Conditional Sale of Goods, Adoption of Infants, Bounties on Wolves and Coyotes, the Woodmen's Lien, Liquor, to Regulate the Hours of Labour and the Minimum Wage to be paid in Mining Operations, the Sidewalks Ordinance, and the Fire Prevention Ordinance.

#### ADMINISTRATION

The Lands, Parks and Forests Branch of the Department at Ottawa is responsible for the transaction of business arising from the general administration of the Territory under the Yukon Act and ordinances passed by the Territorial Council; for the disposal of lands under the Dominion Lands Act; for the administration of the Yukon Placer and Quartz Mining Act, and for the collection of revenue.

The revenue collected under Territorial Government ordinances during the year was \$92,984.97. The amount transferred from the liquor account to general account was \$320,000. Expenditures from the Yukon Consolidated Revenue Fund were \$417,340.85. The Territorial Government received no grant from the Dominion Government during the year.

### MINING

A substantial increase in gold production, continuation of prospecting, and a remarkable expansion in staking featured the mining industry in Yukon Territory during the 1945 season. This activity was almost wholly on land administered under the Placer Mining Act. Several large corporations investigated lode properties during the year, and it is anticipated that, with an expected increase in supply of both labour and material, operations will be extended to lands administered under the Quartz Mining Act.

Gold production for the year was 40,049.97 ounces, the value of which, at \$35 an ounce, is \$1,401,749, or an increase of \$372,387 over the preceding year.

Entries were granted for 138 placer and 299 quartz mining claims and 3,135 such claims were renewed for another year. Twenty-one quartz mining leases were renewed. Seven new leases were issued and two leases expired. The area held under such leases is 5,154.57 acres.

A total of 522 miles of river and creek beds has been conveyed by prospecting leases issued under the Placer Mining Act.

About 100 tons of high grade silver-lead ore were shipped out of the Territory for treatment but no new mines were brought into production during the year.

*Gold Royalty.*—The total amount collected for royalty on gold obtained from placer deposits up to March 31, 1946, was \$5,352,121.64, of which \$1,501.84 was collected during the fiscal year.

*Dredging Leases.*—Six leases permitting the lessee to dredge for minerals in the beds of rivers in the Territory were in force and comprise a total length of 34½ miles. The rental received from these leases up to March 31, 1946, amounted to \$213,621.97, of which \$1,574.30 was collected during the fiscal year. One new lease was issued covering 10 miles of the Finlayson River.

*Hydraulic Mining Locations.*—Four hydraulic mining locations are still held under leases issued under the old regulations which were withdrawn by Order in Council dated February 2, 1904. These leases comprise a total stretch of 16 linear miles. Rentals amounting to \$220,638 have been collected to date on account of such locations. The amount received during the past year was \$2,390.

*Coal Mining Leases.*—Two coal mining leases comprising an area of 77 acres are in good standing. The revenue for the year from this source amounted to \$2.60.

### PLACER MINING

On March 31, 1946, 2,734 placer claims were in good standing in the Dawson District. The majority of the claims are held by the Yukon Consolidated Gold Corporation, which operated three dredges, expended a total of \$413,319 on salaries and wages, and employed an average of 112 men during each month of the year. No. 3 dredge operated in the Klondike Valley, digging ground buried under the Jackson Gulch hydraulic tailings. No. 7 dredge operated on Quartz Creek and No. 11 dredge worked on Middle Hunker Creek digging ground of which part had been previously worked. Stripping and thawing operations were restricted owing to the prevailing scarcity of labour.

Clear Creek Placers Limited continued work with one dredge on the left fork of Clear Creek with satisfactory results. In the Mayo District the only producer was Ole Lunde, who operated on Dublin Gulch.

In the Whitehorse District, Barker and Ray continued operations with the aid of a bulldozer and shovel on Shorty Creek. George Murray worked on Bates and Iron Creeks, and Frome on Burwash Creek. These operators, together with a few individuals in Kluane and Big Salmon areas, produced the 981.74 ounces of gold presented for royalty tax in this district.

The royalty export tax collected was contributed as follows:

Dawson—\$14,536.69; Whitehorse—\$368.24; Mayo—\$113.91.

#### LODE MINING

*Dawson District.*—Entries were granted for 185 quartz claims staked during the year, and 209 claims previously staked were renewed.

*Mayo District.*—Entries were granted for 77 new quartz claims, and 284 claims were renewed.

*Whitehorse.*—Entries were granted for 36 new quartz claims, and 64 claims were renewed.

Order in Council P.C. 4574 of June 4, 1943, which provided for the suspension of representation work required by the Yukon Quartz and Placer Mining Acts, was in force throughout the year. By this suspension, the owners of mining rights were encouraged to retain possession of their holdings until supplies and labour are available.

*Territorial Assay Office.*—The Assay Office at Keno Hill was maintained by the Territorial Government. Nine hundred and ninety-eight rock samples drawn from the Territory in general were received and 1,309 quantitative analyses were made. In addition, analyses and chemical tests were made in connection with identification and classification of various rocks and minerals. The assays made were—gold and silver, 998; lead, 287; copper, 10; zinc, 13; and nickel, 1.

#### PROSPECTING

As stated above, several new companies have entered the Territorial field. The Yukon Alluvial Golds Limited, a company allied to Clear Creek Placers Limited, carried out a drilling program on Thistle and Barker Creeks. The work on Barker Creek was discontinued but the company intends to operate one dredge on each of Thistle and Henderson Creeks.

The Sunshine Mining Company of Idaho drilled on Big Gold, Glacier, and Forty Mile Creeks and have mapped out a development program.

New locations were confined mainly to the Nansen Creek area east of Teslin, where a notable discovery was made, and also to the Mayo District.

The Yukon Northwest Exploration Company acquired claims on Keno Hill and intends to start development in 1946. The properties of the Treadwell Yukon Corporation were acquired by a newly-incorporated company, Keno Hill Mining Company, Limited, which also expects to commence operations during 1946.

#### LANDS AND TIMBER

*Lands.*—During the year 4 lots were sold and patented. There are now in force 10 agricultural leases, 1 grazing lease, 18 permits to occupy Dominion lands, 22 waterfront leases, 2 miscellaneous leases, and 23 homestead entries.

The revenue from lands was \$7,075.33.

*Timber.*—The number of permits issued was 130, authorizing the cutting of 953,657 feet board measure of saw-timber and 11,008 cords of wood. Fourteen licence timber berths were in force. There were 4 timber seizures.

The total revenue amounted to \$6,388.63.

## FOREST PROTECTION

The development of the Forest Protective Service in Yukon Territory, which was inaugurated in 1943, was continued. The organization, headed by a qualified forest engineer, includes a warden staff with headquarters at Whitehorse. Considerable fire-fighting equipment was obtained and distributed during the year at strategic areas in the southern part of the Territory. To date, forest protection has been confined to the main arteries of travel including the Alaska Highway, Haines Cut-off, and Lewes-Yukon River systems. The Officer in Charge assisted the Crown Timber and Lands Agent at Whitehorse in the administration of timber and public lands in southern Yukon. He also served as liaison officer for the Department in matters affecting United States Army authorities who were responsible for the maintenance of the Alaska Highway and access roads in Yukon Territory.

## THE ALASKA HIGHWAY

Maintenance of the Alaska Highway which links Dawson Creek, B.C., with Fairbanks, Alaska, and traverses approximately 600 miles of Yukon Territory, was continued by the United States Army during the year. The work was carried on from eighteen maintenance camps in Canada, of which eight were located in the Yukon. Major construction was limited to two permanent steel and concrete bridges, one of which crossed Beaver Creek at Mile 1,200 and the other Snag Creek at Mile 1,208. Telephone and telegraph lines along the highway were also maintained together with flight strips which were constructed for use in contact flying. Airports and intermediate aerodromes along the Northwest Staging Route, some of which were improved by the United States authorities with expenditures reimbursed by Canada, together with access roads leading to airports and aerodromes, were maintained by the Royal Canadian Air Force.

The Joint Traffic Control Board, with headquarters at Edmonton, continued to supervise travel on the highway, which was restricted to persons on official business and to bona fide prospectors.

In the early autumn the operation of bus services on the Alaska Highway was arranged by the United States Army to replace services previously operated by the latter, and was provided chiefly for the benefit of United States Army personnel and civilian employees. The section from Fairbanks to Whitehorse was operated under contract by the O'Harra Bus Company of Fairbanks, and the section from Whitehorse to Dawson Creek under contract by the British Yukon Navigation Company. Policing of the highway was taken over from the United States Military Police by the Royal Canadian Mounted Police on July 1. The operation of gasoline stations at points along the highway in British Columbia was assumed during the year by the Imperial Oil, Limited.

The Haines Cut-off, which connects Haines, Alaska, with the highway at a point approximately 100 miles west of Whitehorse, was opened for traffic on July 1 and closed during the latter part of September.

During the latter part of the fiscal year, arrangements were completed for the transfer of control of the highway and access roads, from United States authority to the Department of National Defence (Army) on April 1, 1946.

Inspecting engineers of the Engineering and Construction Service of the Department of Mines and Resources were located at Whitehorse, Y.T., and Fort Nelson, B.C., in connection with the maintenance of the highway by the United States authorities. Regular and detailed reports describing the condition of the highway were furnished by these engineers for the information of the Department.

## THE CANOL PROJECT

Although activities associated with the Canol Project at Norman Wells, Northwest Territories, and elsewhere were ordered discontinued on March 8 1945, by the United States Government, operation of the oil refinery at Whitehorse was continued into April 1945, in order to process crude oil stocks on hand. Supplementary fuel pipelines, including those from Skagway to Whitehorse, Carcross to Watson Lake, and Whitehorse to Fairbanks, were used for the transmission of gasoline supplies. Use of the service road paralleling the Canol pipeline from Johnson's Corners, Yukon Territory, to Norman Wells was discontinued, following the destruction by flood waters of a number of bridges along the route. This road has since been officially closed to traffic.

## ROADS AND BRIDGES

In addition to the work carried out on the Alaska Highway and access roads by United States authority, other roads in Yukon Territory were improved and maintained by the Territorial Government. This work was confined to roads in use, and a total of \$72,867.23 was expended. The construction of a mining road to link the Clear Creek mining area with Dawson was commenced, but work was hampered by a lack of suitable labour and a shortage of equipment.

## AIRCRAFT LANDING FACILITIES

Complementing the maintenance of airports and aerodromes along the Northwest Staging Route by the Royal Canadian Air Force was an expenditure of \$3,425.85 by the Territorial Government on maintenance of and repairs to landing fields under its supervision. In addition the sum of \$5,000 was used to purchase an area of cleared land required to lengthen the landing field at Dawson. Landing fields at Dawson and Mayo were maintained in good condition during the winter months by the Territorial Government.

## AGRICULTURE

A wet season resulted in poor field crops in the Territory. The growth of grasses was good, but poor weather prevented successful harvesting. Excellent garden crops, however, were grown in the Dawson area, and good yields were obtained.

Progress was made by the Experimental Farms Service of the Department of Agriculture in the establishment of an agricultural experiment substation at Pine Creek on the Alaska Highway about 100 miles west of Whitehorse. About fifteen acres of land were cleared with the aid of a bulldozer and later most of this area was plowed. Buildings erected during the year included workmen's cottages, a residence for the superintendent, and a garage. The Superintendent, J. W. Abbott, visited most of the settlements along the Lewes and Yukon Rivers, and furnished valuable advice to farmers and market gardeners in the region.

## FUR AND GAME

Collections made under the Fur Export Tax Ordinance amounted to \$10,618.49, an increase of \$3,018.62 over the previous year. An increase in the number of fisher, cross and red fox, lynx, marten, mink, otter, weasel, and wolverine pelts was reported. The number of coyote pelts presented for tax was 37 and the number of wolf pelts, 63. Revenue from Game Ordinance licences was \$5,410, an increase of \$71 from the previous year. Bounty payments for wolves and coyotes totalled \$10,065, payments being made on 400 wolves and 272 coyotes.

## PUBLIC WELFARE

The health of the white population in the Territory was reported as generally good, but an increase in tuberculosis among Indians was noted. The incidence of venereal disease in the Whitehorse area and southern Yukon also increased, the source of infection in the majority of cases being of Indian parentage. A close check was made of all cases reported and the Venereal Disease Ordinance was enforced as far as possible. Preventative inoculations were continued during the year for diphtheria, smallpox, and other diseases by Medical Health Officers and the travelling nurse of the Indian Affairs Branch.

Registrations under the Vital Statistics Ordinance during the year were 196 births, 78 marriages, and 94 deaths. The Government hospital at Whitehorse and St. Mary's Hospital at Dawson were operated throughout the year, and grants toward their maintenance were provided by Council. Hospital days for patients during the year were: Whitehorse 7,865; Dawson 16,450. A public nurse was employed in Mayo District for three months, but for the remainder of the year no nurse was available.

The sum of \$36,004.84 was expended for relief. A total of \$3,747.29 was paid to St. Paul's Hostel, Dawson, for the care of all indigent half-breed and white children who attended the Dawson School.

## EDUCATION

Seven schools were maintained in the Territory during the year, including two at Dawson and one each at Whitehorse, Mayo, Carcross, Teslin, and Destruction Bay. The total number of pupils enrolled during the school year ended June 30, 1945, was 441, and the total number of pupils enrolled as of March 31, 1946, was 332. The number of teachers employed was 14. The total amount expended on education was \$61,671.82.

## LAW AND ORDER

Law and order were well maintained throughout the Territory by the Royal Canadian Mounted Police.

## SCIENTIFIC SURVEYS

During the 1945 season engineers of the Surveys and Engineering Branch of the Department carried out aerial and ground reconnaissance of roads to be located between Whitehorse and Dawson and between a point on the Alaska Highway near Jakes Corner, Y.T. and Atlin, B.C.

Engineers of the Geodetic Service, Surveys and Engineering Branch, undertook considerable work in Yukon Territory related to horizontal and vertical control for mapping purposes. Precise level lines for vertical control were continued during the year. Approximately 218 miles of levelling was carried out along the British Columbia section and about 237 miles along the Yukon Territory section of the Alaska Highway. An inspection of bench marks established by the United States Geodetic Survey between Whitehorse and the Alaska-Yukon boundary was also made.

The survey of the British Columbia-Yukon Territory boundary in the vicinity of the Alaska Highway was continued by the Legal Survey and Map Service, and several additional points established along the boundary line.

Work was also continued on a legal survey of the Alaska Highway in the Yukon Territory. During the season 187 miles of highway were surveyed, bringing the work to Whitehorse. A settlement survey was also made at Teslin, and other legal surveys were made. A traverse survey of the Alaska Highway in British Columbia was completed by a land surveyor of the Lands, Parks and Forests Branch.



Two parties from the Geological Survey of Canada, Mines and Geology Branch, completed reconnaissance work along the Alaska Highway and Canol Road respectively. The survey along the highway extended west and northwest from Whitehorse and included areas north and northwest of Kluane Lake and southwest of Dezadeash Lake.

During July and August, 1945, a biological investigation of the waters in Yukon Territory was carried out by Professor V. C. Wynne-Edwards and Dr. Ronald Grant for the Fisheries Research Board of Canada. The party flew from Whitehorse to Porcupine and Peel Rivers in the northern part of the Territory, and also travelled the Yukon River from Whitehorse to Dawson by flat-bottomed boat. An examination of the main rivers and lakes in the southern part of the Territory was also made during the course of a trip by truck, which entailed more than 1,000 miles of travel. The investigation revealed that although commercial fisheries in the Territory are relatively poor, the sport fishery is capable of considerable development and is potentially a valuable asset in connection with future tourist traffic.

## LAND REGISTRY

The Land Registry maintains a Central Office of Record for lands owned or otherwise controlled by the Dominion; it administers certain Ordnance and Admiralty lands, Dominion public lands, Soldier Settlement lands on which advances have been made, and Dominion lands reserved to Canada under the Transfer of Natural Resources Agreements. The Land Registry also, in conjunction with the western provinces, considers applications for apportionment or adjustment of seed grain, fodder, and relief indebtedness, whether advanced solely by the Dominion or jointly by the Dominion and provinces; issues Letters Patent; and administers matters in connection with the purchase of lands acquired for the Alaska Highway, and with mineral rights reserved by virtue of Section 57 of the Soldier Settlement Act.

### CENTRAL OFFICE OF RECORD

The Central Office of Record is a convenient inventory of all lands owned or otherwise controlled by the Dominion, and the general public and other departments have found it a ready source of information. A complete list of properties controlled by the other departments had not been received at the outbreak of war, and owing to the pressure of war work and the great number of new properties acquired during the war, the records are not entirely up-to-date. It is hoped, however, that this situation will be remedied in the near future. There are 6,439 parcels listed.

### ORDNANCE AND ADMIRALTY LANDS

Ordnance and Admiralty lands are those areas in the Maritime Provinces, Quebec, Ontario, and British Columbia which were at one time, because of their strategic situation, reserved or acquired by purchase or otherwise by the Crown. When no longer required for such purposes they are transferred to this Department to administer. It is the policy of this division to make these lands revenue-producing wherever possible, by placing them under occupation in the manner to which they are best suited. The work of administration comprises appraisals, surveys, searches of titles, the preparation of plans, leases, and reports, and the collection of rentals.

During the year there were 13 investigations and 5 surveys carried out, covering parcels of land in Nova Scotia, New Brunswick, Quebec, Ontario, and British Columbia. The Port McNeil Government Reserve was transferred from

the Department to the Province of British Columbia. No lands were transferred to the Department. One hundred and one leases and 3 permits were issued and 17 sales were completed. The net revenue from Ordnance and Admiralty lands for the year was \$26,670.07.

#### PUBLIC LANDS

Lands of other departments no longer required for the purpose for which they were obtained are transferred to the Department as public lands, and put on a revenue producing basis where possible.

During the year 10 investigations were made, no lands were transferred to the Department and 5 parcels were sold. The net revenue for the year from public lands amounted to \$88,594.

#### SOLDIER SETTLEMENT CHARGED LANDS

The unpatented lands in the four western provinces, against which charges are registered under the Soldier Settlement Act, remain vested in the Dominion. There are 104 quarter-sections comprising approximately 16,640 acres thus administered. They are divided among the four western provinces as follows: Manitoba, 10 parcels; Saskatchewan, 42 parcels; Alberta, 32 parcels; and British Columbia, 4 parcels.

Letters Patent are issued to entrants who complete the required duties in accordance with the terms of the Dominion Lands Act, if their indebtedness to the Soldier Settlement has been liquidated. If their duties are complete but this indebtedness still unpaid, Letters Patent are issued in the name of the Director, Soldier Settlement of Canada, under the authority of the provisions of Section 27 of the Soldier Settlement Act, and the amendment of 1931. During the fiscal year 7 Letters Patent were issued, 2 in the name of the Director, Soldier Settlement of Canada, and 5 in the name of the entrants.

#### TIMBER AND GRAZING WITHIN THE PROVINCES

*Timber.*—There are 11 licensed timber berths covering a total of 61·212 square miles within the boundaries of the National Parks. Two of these berths are in the Province of Manitoba and 9 are in British Columbia. During the year licences, in duplicate, were issued for each berth—the revenue amounted to \$3,721.15.

On the Dominion Government Coal Block, near Hosmer, B.C., there is one timber berth permit in force.

Timber cutting operations continued active on Ordnance Reserve No. 1 and Naval Reserve A on St. Joseph Island in Lake Huron and the revenue collected was \$149.54.

*Grazing.*—During the year 10,054·9 acres were covered by 6 annual grazing permits on Dominion lands along the southern boundary of Saskatchewan and Alberta and sworn returns by the permittees indicated that for the grazing season 1945, there were 497 cattle, 173 horses, and 400 sheep maintained on the lands. The revenue, consisting of ground rental, amounted to \$179.20.

#### SEED GRAIN, FODDER, AND RELIEF INDEBTEDNESS

During the year, recommendations relating to the adjustment or apportionment of outstanding seed grain, fodder, and relief indebtedness were submitted in 1,641 cases by the Alberta, Saskatchewan, and Manitoba Adjustment Boards. These recommendations were ratified by Orders in Council and 2,116 discharges and releases of liens were issued. As a result, indebtedness amounting to \$187,043.97 was written off. There were 2,862 inquiries from the provinces for

statements of outstanding indebtedness relative to the issue of land grants, and 221 certificates of indebtedness were issued. In addition, 5,743 inquiries were received from different Debt Adjustment Boards in the western provinces. Gross collections for the fiscal year amount to \$115,358.67 and the sum of \$3,165.60 was refunded, leaving a net revenue of \$112,193.07.

As the staff engaged on this work has other responsibilities as well, it is impossible to give a definite figure for the cost of administration but the total amount including office expenses and field investigations is approximately \$7,000.

The following summary shows the financial operations for the year ended March 31, 1946:

	Principal	Interest	Total
<i>Debits</i>			
Balance outstanding March 31, 1945.....	\$2,525,263 99	\$3,613,841 15	\$6,139,105 14
Accrued interest April 1, 1945 to March 31, 1946.....		144,378 86	144,378 86
Total debits.....	<u>\$2,525,263 99</u>	<u>\$3,758,220 01</u>	<u>\$6,283,484 00</u>
<i>Credits</i>			
Net revenue April 1, 1945 to March 31, 1946.....	\$ 72,916 74	\$ 39,276 33	\$ 112,193 07
Amount written off as loss by Orders in Council (Sec. 1, Chap. 51, 17 George V)	45,435 70	141,608 27	187,043 97
Total credits.....	<u>\$ 118,352 44</u>	<u>\$ 180,884 60</u>	<u>\$ 299,237 04</u>
Amount outstanding March 31, 1946.....	<u>\$2,406,911 55</u>	<u>\$3,577,335 41</u>	<u>\$5,984,246 96</u>

## SUMMARY

## PROVINCE OF MANITOBA

	Principal	Interest	Total
<i>Debits</i>			
Amount outstanding March 31, 1945.....	\$ 11,059 24	\$ 17,099 03	\$ 28,158 27
Accrued interest April 1, 1945 to March 31, 1946.....		583 10	583 10
Total debits.....	<u>\$ 11,059 24</u>	<u>\$ 17,682 13</u>	<u>\$ 28,741 37</u>
<i>Credits</i>			
Net revenue April 1, 1945 to March 31, 1946	\$ 448 71	\$ 285 21	\$ 733 92
Amount written off as loss by Orders in Council.....	51 00	352 62	403 62
Total credits.....	<u>\$ 499 71</u>	<u>\$ 637 83</u>	<u>\$ 1,137 54</u>
Amount outstanding March 31, 1946.....	<u>\$ 10,559 53</u>	<u>\$ 17,044 30</u>	<u>\$ 27,603 83</u>

## PROVINCE OF SASKATCHEWAN

	Principal	Interest	Total
<i>Debits</i>			
Amount outstanding March 31, 1945.....	\$1,633,945 72	\$2,282,109 42	\$3,916,055 14
Accrued interest April 1, 1945 to March 31, 1946.....		92,555 42	92,555 42
Total debits.....	<u>\$1,633,945 72</u>	<u>\$2,374,664 84</u>	<u>\$4,008,610 56</u>

**Credits**

Net revenue April 1, 1945 to March 31, 1946 .....	\$ 56,998 77	\$ 34,727 15	\$ 91,725 92
Amount written off as loss by Orders in Council .....	14,241 69	66,112 80	80,354 49
Total credits.....	\$ 71,240 46	\$ 100,839 95	\$ 172,080 41
Amount outstanding March 31, 1946.....	\$1,562,705 26	\$2,273,824 89	\$3,836,530 15

**PROVINCE OF ALBERTA**

	Principal	Interest	Total
<b>Debits</b>			
Amount outstanding March 31, 1945.....	\$ 880,234 03	\$1,314,595 20	\$2,194,829 23
Accrued interest April 1, 1945 to March 31, 1946 .....		51,239 09	51,239 09
Total debits.....	\$ 880,234 03	\$1,365,834 29	\$2,246,068 32

**Credits**

Net revenue April 1, 1945 to March 31, 1946 .....	\$ 15,469 26	\$ 4,263 97	\$ 19,733 23
Amount written off as loss by Order in Council .....	31,143 01	75,142 85	106,285 86
Total credits.....	\$ 46,612 27	\$ 79,406 82	\$ 126,019 09
Amount outstanding March 31, 1946.....	\$ 833,621 76	\$1,286,427 47	\$2,120,049 23

**PROVINCE OF BRITISH COLUMBIA**

	Principal	Interest	Total
Amount outstanding March 31, 1946.....	\$ 25 00	\$ 38 75	\$ 63 75

**LETTERS PATENT**

During the fiscal year there were 12 Letters Patent issued covering a total of 1,026 acres, divided according to provinces as follows:—

	Patents	Acres
Saskatchewan .....	6	863
Alberta .....	2	161
Northwest Territories.....	2	2
Yukon Territory.....	2	0
	<u>12</u>	<u>1,026</u>

The various kinds of grants are dealt with in the following Table:

	Homesteads*	Soldier*	Special †	Sales
	Patents-Acres	Patents-Acres	Patents-Acres	Patents-Acres
Saskatchewan .....	1 160	4 639	1 64	
Alberta .....	.. ..	.. ..	1 160	1 1
Northwest Territories .....	.. ..	.. ..	.. ..	2 2
Yukon Territory .....	.. ..	.. ..	.. ..	2 0
Total .....	<u>1 160</u>	<u>4 639</u>	<u>2 224</u>	<u>5 3</u>

\* Under this heading are included lands entered for by returned soldiers, affected by loans from the Director of Soldier Settlement of Canada, said loans having been repaid in full. Patents were issued direct to the settlers.

† Under this heading are included lands entered for by returned soldiers affected by loans from the Director of Soldier Settlement of Canada, which loans were patented to the said Director either at the request of the entrants or pursuant to salvage proceedings under the Soldier Settlement Act.

There were 237 certified copies of Letters Patent issued during the fiscal year, for which the Department received \$740.

## ALASKA HIGHWAY LAND ACQUISITION

The survey of the right of way of the Alaska Highway in British Columbia was completed during 1945, and draughting of the plans is now under way.

There were 10 parcels of land purchased during the year, comprising approximately 279.18 acres. One new lease was entered into, covering 14.5 acres for nuisance ground at Dawson Creek, and 6 leases were terminated. One hundred and thirty-one easements were acquired, covering a waterline to Fort St. John aerodrome, another to Dawson Creek campsite, and telephone and telegraph lines in Alberta and British Columbia. The title on three quarter-sections of land on the Dawson Creek flight strip, one lease at Dawson Creek, and one at Fort St. John were transferred to the Department of Transport.

Eighteen parcels of land comprising 325.27 acres have yet to be purchased, but owing to the difficulty of locating the respective owners there may be some delay in accomplishing this.

## NATIONAL PARKS BUREAU

Mention of World War II is inevitable because both its continuance during part of the year under review and its victorious conclusion had a significant effect upon National Parks operations. While travel restrictions in the United States during the war, as well as the shortage of tires and gasoline, severely curtailed the number of American tourists, the percentage of Canadian visitors to the parks was greater than ever. Such a trend in the recreational habits of Canadians is worth noting now, as its development may be more evident in the years ahead.

War conditions and their aftermath also curtailed expenditures for park maintenance and improvements. Because of the shortages of man-power and equipment, and the pressing need for both men and materials, particularly in house-building projects, expenditures on both maintenance and improvements were kept down to a level consistent with the protection of the National Parks in which the people of Canada have already invested some forty-five million dollars. Nevertheless, plans for greater development, in keeping with the growing use of these parks, were advanced to the point where they can be readily carried out when men and materials are available.

The dramatic ending of the war had an almost immediate effect upon the attendance figures at the National Parks. From the previous year's total of 457,392 visitors the figures climbed to 602,409. It is worthy of note that more than 93 per cent of the 1945-46 visitors to the National Parks were Canadians.

## NATIONAL PARKS

	1945-46	1944-45
Banff .....	148,113	119,065
Cape Breton Highlands .....	18,863	11,940
Elk Island .....	24,939	14,881
Georgian Bay Islands .....	3,842	4,200
Glacier .....	330	345
Jasper .....	16,127	12,497
Kootenay .....	28,326	17,113
Mount Revelstoke .....	6,474	3,745
Nemiskam .....	.....	17
Point Pelee .....	59,948	38,745
Prince Albert .....	18,858	13,059
Prince Edward Island .....	48,068	33,365
Riding Mountain .....	108,060	88,096
St. Lawrence Islands .....	10,809	10,547
Waterton Lakes .....	46,744	37,278
Yoho .....	10,868	6,663

## NATIONAL HISTORIC PARKS

Fort Anne .....	5,544	7,369
Fort Beausejour .....	5,343	3,344
Fort Chambly .....	16,203	14,674
Fort Lennox .....	655	....
Fortress of Louisbourg .....	3,126	2,617
Fort Malden .....	15,279	12,978
Fort Wellington .....	2,594	2,568
Port Royal Habitation .....	3,296	2,196
Totals .....	602,409	457,392

## ADMINISTRATION

The parks are administered by the National Parks Bureau at Ottawa under the authority and provisions of the National Parks Act. The Act also covers the National Historic Parks, places set aside to commemorate historic events or to preserve national sites and monuments. Besides the administrative staff at Ottawa, a resident Superintendent is located in each of the principal parks. In addition to the protection and management of wildlife within the park areas the National Parks Bureau at Ottawa administers the Migratory Birds Convention Act.

## EVENTS OF INTEREST

Principal events of interest in the parks during the fiscal year 1945-46 are noted briefly hereunder:

April was the peak month for skiers, who came from all parts of the continent to the lodges in Banff National Park. There was a greater snowfall in April than in any month during the winter, and skiers visited Mount Norquay as late as the last Sunday in the month. Annual ski camp of the Alpine Club of Canada was held in the Little Yoho Valley.

Delegates to the Navy League of Canada convention, held in Calgary, spent April 27 at Banff, and a Dominion convention of Compensation Board officials was held in Banff from May 21 to 24, as well as the district conference of Kinsmen Clubs from May 25 to 27.

About one hundred naturalists and bird lovers spent a week-end in Point Pelee National Park studying birds.

His Excellency the Earl of Athlone and Her Royal Highness Princess Alice spent five days, May 5 to 9, in Jasper National Park visiting many points of interest.

The Order of the Eastern Star convention was held in Banff National Park on June 5. Later June events at Banff included a visit by a group of Belgian journalists and a Lions Club convention June 13, and a meeting of the Canadian Youth Hostels Association on June 18.

A group of forty-four convalescent sailors and staff members from the Farragut Naval Hospital near Sandpoint, Idaho, spent two nights at Radium Hot Springs en route to Banff and Lake Louise.

The Trail Riders of the Canadian Rockies held their annual outings in Banff National Park during July, and on July 31 the French Ambassador to Canada, Comte de Hauteclouque, visited Banff.

The Wasagaming Golf Club's annual tournament was held in Riding Mountain National Park.

Prince Albert National Park was the scene of the Saskatchewan Tennis Championships on July 1 and 2.

The Alpine Club of Canada held camp in the Eremite Valley, Jasper National Park.

"The Mazamas", a mountaineers' club with headquarters in Portland, Oregon, held their annual encampment at Lake O'Hara, Yoho National Park, between July 16 and July 29, and the following month the Skyline Trail Hike was held in the same park, August 3 to 6.

Thirty-two patients of a United States Army hospital in Spokane, Washington, came to Banff as guests of the local Rotary Club.

Point Pelee National Park was visited on August 26 by a delegation from the Point Pelee Nature Laboratory, Detroit, Michigan.

Golf Tournament Week was held in Prince Albert National Park, Saskatchewan, from August 12 to August 18.

The Prince Edward Island Golf Association held the finals of the Provincial Tournament at the Green Gables links on August 22. Sixty-two players participated in the tourney.

Hon. Ray Atherton, United States Ambassador to Canada, spent the period between August 3 and August 19 visiting points of interest in Jasper National Park with a party of friends.

Held on August 5-6, the annual golf tournament sponsored by the Lions Club drew 220 entries to Waterton Lakes National Park. On V-J Day War Correspondent Matthew Halton, formerly of Pincher Creek, Alberta, was guest of honour at a gathering sponsored by the Waterton Park Lions Club.

The Banff School of Fine Arts completed its thirteenth intensive summer session in August. Four hundred and twenty-seven students were registered.

A 26-inch snowfall during the last week of October resulted in a record early opening of the ski season at Mount Norquay in Banff National Park. The famous Banff Winter Carnival opened on December 26 and continued with a series of week-end events until March, being concluded with the crowning of the "Carnival Queen". A marked increase in entries for the annual Banff Bonspiel during the week beginning February 11 was noted, and the Ski Runners championships at Mount Norquay drew at least 1,500 spectators. Three hundred and twenty-five skiers from Edmonton visited Banff on March 17.

## PUBLIC RELATIONS

Publicity, during the war years, was directed toward making the people of Canada more aware of the wonderful heritage they possess in their National Parks, to create a greater pride in the possession of these nationally-owned playgrounds, and to acquaint the public with the recreational and inspirational values of the parks from the standpoint of health and morale. The results indicate a fair measure of success.

The principal channels through which the public was approached were: (a) public addresses at conventions and other gatherings, (b) the distribution of articles, mats, photographs, and engravings to newspapers and magazines, and (c) the distribution of booklets, folders, slides, and films.

Addresses were delivered during the year to several organizations interested in travel in Canada, and special articles descriptive of the scenic attractions, wildlife, and recreational facilities in the National Parks were regularly supplied to newspapers and to magazines desiring them. Forty-seven articles, many of them written in editorial style, were released to the press. More than 600 press clippings attest to the wide coverage which these articles received, due largely to the favourable attitude of editors to the National Parks idea. To illustrate these articles 211 mats and 188 cuts were sent out. A total of 1,138 photographs were also supplied, as well as 154 enlargements of National Parks scenes. Text material was supplied for use in annual publications and encyclopedias and by writers, publicists, and lecturers. Twenty-five copies of each article in English and ten in French were forwarded to the Canadian

Information Service for distribution to Canadian offices abroad. Where practicable, articles are translated into the French language for use in the French press in Canada and the United States. A feature of this year's newspaper publicity has been the increase in the number of articles used editorially.

Distribution of National Parks literature totalled 132,240 pieces as follows:

Canada's Mountain Playgrounds .....	9,625
Fort Anne Guide .....	9,000
Jasper Park folder .....	20,945
Kootenay-Yoho folder .....	6,995
Playgrounds of Eastern Canada .....	5,260
Playgrounds of the Prairies .....	11,075
Waterton Lakes folder .....	7,195
Banff folder .....	17,745
National Parks folder .....	10,120
Cape Breton Highlands folder .....	5,000
Riding Mountain booklet .....	5,500
Riding Mountain folder .....	10,445
Prince Albert folder .....	4,125
Fort Wellington Guide .....	1,000
Elk Island booklet .....	2,850
Prince Edward Island folder .....	1,000
Geology of National Parks .....	575
Birds of Banff Park .....	75
Elk Island folder .....	3,710

Motion pictures from the Bureau library, covering a variety of recreational and nature-study subjects, were lent to many organizations requesting them. In this manner 2,441 films were distributed and at the 9,506 showings at least 804,070 persons were reported as having seen them. In addition, 2,183 lantern slides were provided for a similar service.

The announcement by the Prime Minister that the name of Castle Mountain had been changed to Mount Eisenhower, in honour of General Dwight D. Eisenhower, gave added publicity to the National Parks and resulted in many requests for articles and photographs relating to this famous mountain.

While the value of Canada's National Parks as wildlife museums and conservation areas has been constantly stressed, the importance of the parks to the tourist industry of Canada has also been emphasized. The average inquirer appears to be more interested in the facilities for recreation and accommodation, the condition of the roads to and in the parks, and the quality of the catering service than in the part which the parks are playing in conserving the natural phenomena, the flora and fauna, and the superb scenery in these areas. Any new development for the comfort and convenience of park visitors is, therefore, publicized in a matter-of-fact manner without exaggerated claims or extravagant comparisons. A series of articles calling attention to the camping facilities which are provided in the parks was released during the latter part of the year in order to increase the use of these camp-grounds and relieve the pressure on existing accommodation. It is expected that the results of this publicity campaign will be apparent during the 1946 tourist season.

#### DIRECT REVENUE

Gross revenues from the National Parks and from the administration of the Migratory Birds Convention Act for the fiscal year 1945-46 amounted to \$302,725.89 and \$462.46 respectively, a total of \$303,188.35. Compared with the figures for the previous year, which were \$288,537.31 and \$228.84 respectively, an increase of \$14,422.20 is indicated.



## MAINTENANCE AND IMPROVEMENTS

Maintenance was carried out as economically as possible on all facilities, including highways, roads, trails, bridges, and buildings. Within the townsites, municipal services were continued on a repayment basis.

## ROADS AND BRIDGES

The only construction under this classification was a new concrete bridge over Sinclair Creek at Mile 5.2 in Kootenay Park. Steel girders were placed at the Kicking Horse River bridge in Yoho on concrete abutments already in place. A new culvert was built on the Trans-Canada Highway west of Banff, and a cable guard-rail, 3,400 feet in length, was erected along the road over the dam at Lake Minnewanka.

Practically all road work carried out was for maintenance and improvement of existing facilities, and consisted of widening, grading, and surfacing, together with extensive repairs to bridges and culverts.

## TRAILS

Extensions totalling 8.75 miles were carried out on trails in Banff Park, but elsewhere the work consisted of maintenance only.

## COMMUNICATION SYSTEMS

No construction work was done on telephone lines except in Jasper Park, where a right-of-way was cut to the Palisades and the line completed to the lookout. Maintenance work on communication systems was carried out generally in all the parks, and in several of them radio-telephone sets are in use.

The following table indicates the existing mileage of roads, trails, and telephone lines within the National Parks as at March 31, 1946:

National Parks	Roads				Trails miles	Telephone Lines miles
	Motor miles	Secondary miles	Fire miles	Total miles		
Banff.....	182.4	10.5	94.5	287.4	743.55	273.0
Cape Breton Highlands.....	50.8	1.6	.....	52.4	21.0	.....
Elk Island.....	16.0	.....	.....	16.0	14.0	16.0
Glacier.....	.....	.....	20.5	20.5	91.0	1.5
Jasper.....	144.0	18.5	34.7	197.2	590.1	414.2
Kootenay.....	61.1	.....	9.5	70.6	155.2	60.0
Mount Revelstoke.....	18.0	.....	.....	18.0	33.5	10.7
Point Pelee.....	6.5	2.8	.....	9.3	.....	.....
Prince Albert.....	68.0	43.0	163.0	274.0	236.5	134.0
Prince Edward Island.....	7.1	2.5	.....	9.6	.....	.....
Riding Mountain.....	51.6	52.9	.....	104.5	113.0	149.0
Waterton Lakes.....	47.8	13.5	12.0	73.3	159.4	60.2
Yoho.....	46.0	6.5	25.0	77.5	191.0	69.5
Total.....	699.3	151.8	359.2	1,210.3	2,348.25	1,188.1

## BUILDINGS

New construction consisted mainly of repairs, improvements or extensions to existing buildings, but a few minor buildings and structures were erected. Building permits were issued as follows: Banff Park 91, Jasper Park 15, Riding Mountain Park 23, and Waterton Lakes Park 15.

Construction work included an equipment depot, Minnewanka Lake wharf; a milk depot for Tunnel Mountain camp-ground; two water-storage tanks at Sulphur Mountain and Cascade River respectively; and a warden's cabin at Bryant Creek, all in Banff Park. In addition, a warden's cabin at Goat Creek was started, and one at Stoney Creek was 50 per cent completed. In Jasper Park construction was in progress on a log building at Ranger Creek camp; in Glacier Park a new warden's cabin was erected in Flat Creek district; and in Kootenay Park alterations and repairs were made to the Administration

buildings. New ice and meat houses were built at Radium Hot Springs, and a gravity water supply was installed for Hay cabin. An implement shed at Mile One was completed, and a water storage tank erected at Mile Two. In Yoho Park a warden's cabin with gravity water supply was built at Wapta Lake, and a frame building was erected at Misko camp. In all other park building operations were confined to repairs and maintenance, although at Cape Breton Highlands Park the Provincial Government erected an addition to Keltic Lodge as well as eight separate staff buildings in connection with the lodge.

## TOWNSITES

At Banff, municipal services and maintenance were carried out. At Jasper, in addition to the above, a new water supply intake was installed at Cabin Lake, and sewer services were laid to three new houses. The water supply at Jasper serves both the townsite and the Canadian National Railways, and average daily consumption amounted to 631,433 gallons. At Kootenay, in addition to maintenance and repairs, the Radium Hot Springs water system was extended 1,500 feet to McKay Creek in order to obtain a purer supply. At Waterton, a new electric generating plant of 60 kva. was installed and has been working satisfactorily. At all other parks maintenance and repairs were the only activities carried on.

## FOREST PROTECTION

The fire season of 1945 was one of the most favourable that has been experienced in the National Parks in the last ten years. Only 19 forest fires occurred, burning over an area of approximately 153 acres. The nearest approach to this was in 1943, when 23 fires were reported with a burned area of 5,492 acres.

One notable feature of the past season was the small number of fires in the "prairie" parks—only two in Prince Albert Park, and none in Riding Mountain Park. These parks are located in areas of high hazard, and were responsible for most of the larger fires during the dry years of 1939 and 1940.

An analysis of the causes of these fires shows that lightning was responsible for 47.3 per cent; campers and smokers, 21 per cent each, and miscellaneous known causes 10.7 per cent. Classified according to size, 47.3 per cent were less than  $\frac{1}{4}$  acre; 47.3 per cent,  $\frac{1}{4}$  to 10 acres; and 5.4 per cent, 10 to 500 acres. The value of timber burned, which was estimated at \$188.40, was extremely low.

## FIRE LOSSES IN NATIONAL PARKS

Park	Number of Fires		Area Burned—Acres		Cost of Suppression	
	1945	1944	1945	1944	1945	1944
					\$ cts.	\$ cts.
Banff.....	4	5	2 $\frac{1}{2}$	3 $\frac{1}{2}$	69 52	20 38
Cape Breton Highlands.....	1	0	4	0	142 77	0 00
Elk Island.....	1	0	spot	0	5 00	0 00
Glacier.....	2	0	131	0	351 92	0 00
Georgian Bay Islands.....	0	0	0	0	0 00	0 00
Jasper.....	1	0	9 $\frac{1}{2}$	0	4 25	0 00
Kootenay.....	3	2	4 $\frac{1}{2}$	5	132 67	36 12
Mount Revelstoke.....	3	0	1 $\frac{3}{4}$	0	483 28	0 00
Point Pelee.....	0	7	0	102	0 00	18 58
Prince Albert.....	2	8	$\frac{1}{2}$	1,215 $\frac{1}{2}$	70 00	1,278 68
Prince Edward Island.....	0	0	0	0	0 00	0 00
Riding Mountain.....	0	5	0	1,937	66 63	264 54
St. Lawrence Islands.....	0	2	0	$\frac{1}{2}$	0 00	0 00
Waterton Lakes.....	2	0	spot	0	2 50	0 00
Yoho.....	0	0	0	0	0 00	0 00
Totals.....	19	29	153 $\frac{1}{2}$	3,263 $\frac{1}{2}$	1,328 54	1,618 30

## IMPROVEMENT IN FIRE-FIGHTING EQUIPMENT

The only new forest fire lookout completed during the year was the Palisades cabin in Jasper Park. The total number of primary lookouts in the mountain parks is now twelve.

Purchases of new equipment were limited almost entirely to replacements and repair parts necessary to maintain the efficiency of the fire-fighting organization. One new 1,000-gallon tank truck was constructed by the warden service in Banff and proved very successful in the control of fires along the highways.

## FIRE WEATHER FORECASTING

Fire weather recording stations were in operation throughout the fire season in Banff, Jasper, Yoho, Waterton Lakes, Prince Albert, and Riding Mountain Parks. Although weather conditions were generally favourable, short periods of extreme hazard occurred in May and June and again in September and October. No new weather stations were established during the year.

## INSECT CONTROL

Measures to control the mountain pine bark-beetle (*Dendroctonus monticolae*) were limited to salvage operations in Kootenay Park and treatment of an area of active infestation near Leancoil in Yoho Park. In the latter, fifteen men were employed from early in January until the end of March, 1946. During this period an area of some 280 acres was blocked out, and infested trees were marked and destroyed by burning. Because of labour difficulties and an unusually heavy snowfall, the work was not completed and will have to be continued next autumn.

In Kootenay Park, salvage operations in beetle-killed lodgepole pine were conducted on both sides of the Banff-Windermere Highway near Miles 16 and 21. Alternative service workers carried on logging and milling operations which produced approximately 280,000 feet board measure of lumber and 9,302 linear feet of mine props.

## DISPOSAL OF TIMBER UNDER ANNUAL CUTTING BUDGET

Cutting of saw-timber, fuel-wood, and other forest products for the use of local settlers under the annual budget plan was continued in Riding Mountain Park. During the period from April 1, 1945, to March 31, 1946, 2,090 permits were issued for 3,074,755 feet board measure of saw-timber, 20,541 cords of fuel-wood, 65,860 posts, and 7,290 trees. Permits issued during the current year showed a marked decrease from the year 1944-45 when the number was unusually high as a result of the large quantity of windfalls caused by severe storms.

## USE OF ALTERNATIVE SERVICE WORKERS

In the spring of 1941, under the authority of the National War Services Regulations, Mennonites and other conscientious objectors exempted from military training were required to perform alternative service. On December 1, 1942, administration of alternative service, which up to that time had come under the Department of National War Services, was transferred to the Department of Labour.

Camps, which were first established in Banff, Jasper, Kootenay, and Riding Mountain National Parks in 1941, continued to operate throughout the past fiscal year. Early in May, twenty-four men were transferred from Kootenay Park to Yoho Park, where they operated as a separate unit until the end of September. As in former years accommodation was provided by the use of permanent camp buildings, portable huts, and tents. Supervisory personnel

and skilled labour were hired by the Superintendent as required, and were paid at prevailing rates. Ordinary workers were paid at the rate of 50 cents a day, which could be increased to 75 cents for those promoted to sub-foremen, and \$1.00 for foremen. In addition board, lodging, clothing, and medical and dental care were provided free. Workers were also entitled to receive benefits under the Government Employees Compensation Act.

During the 12-month period ended March 31, 1946, 456 conscientious objectors were employed in these camps. Of these 258 were transferred to agriculture and industry, 15 were discharged as medically unfit, and 5 deserted.

Work projects upon which these men were employed consisted mainly of forest protection, forest fire suppression, construction and maintenance of fire trails, buildings, telephone lines, roads, bridges, and culverts, general improvement to park property, and salvage of insect-killed, fire-killed, and wind-thrown timber. Products from these operations included 570,000 board feet of sawn lumber, 9,302 linear feet of mine props, 9,655 board feet of sawlogs, 439 cords of fuel-wood, 100 telephone poles, 260 hub rails, and 2,000 fence-posts. In addition, 3,112 cubic yards of gravel was hauled and spread, and 1,400 feet of secondary road, 175 feet of hub rail, and 17 culverts were constructed.

Fewer men were employed than last year, and as a result of transfers to agriculture and industry the total strength in all camps was reduced to about 100 by the middle of January, 1946. Although there were some exceptionally good workers, the majority of the men were of inferior quality who had been brought to camp under escort for refusing to accept work elsewhere. Although this combination of circumstances tended to slow up the return per man-day, much useful work was completed which would not have been possible under the regular appropriations available.

## NATIONAL HISTORIC PARKS AND SITES

The functions of the National Parks Bureau include the restoration, preservation, marking, and administration of National Historic Parks and Sites and the commemoration of the public services of outstanding personages connected with the civil and military history of the Dominion. In this phase of its work the Bureau is advised by the Historic Sites and Monuments Boards of Canada, an honorary body of recognized historians representing the various parts of the country.

The personnel of the Board is as follows: Chairman, Dr. J. Clarence Webster, Shediac, New Brunswick; Professor Fred Landon, London, Ontario; Professor D. C. Harvey, Halifax, Nova Scotia; Hon. E. Fabre-Surveyer, Montreal, Quebec; J. A. Gregory, North Battleford, Saskatchewan; Rev. Antoine d'Eschambault, St. Boniface, Manitoba; Major G. Lanctot, Dominion Archivist, Ottawa, Ontario; Professor M. H. Long, Edmonton, Alberta; Professor Walter N. Sage, Vancouver, British Columbia; W. D. Cromarty, National Parks Bureau, Ottawa, Ontario.

A general meeting of the Board was held in Ottawa, May 16-18, 1945, when many subjects relating to the historic background of the Dominion were reviewed and an additional number of sites selected to be marked by the Bureau at a later date. Of the many sites already considered by the Board, 352 have now been marked or acquired and 202 recommended for attention at a later date.

### NATIONAL HISTORIC PARKS

*Fort Anne National Historic Park, Annapolis Royal, Nova Scotia.*—The museum building, bandstand, cannon, flagpole, benches, and chain fence were painted, the roads and lawns properly maintained and the edges trimmed and a number of the electric light posts in the park were moved to other locations in

order to improve the lighting conditions. An underground drain was laid from the west side of the museum building to the moat. Many additional articles of historical interest were acquired.

A total of 5,544 persons signed the museum register during the year.

*Port Royal National Historic Park, Lower Granville, Nova Scotia.*—Several pieces of furniture were made and placed in the Governor's Chambers; preserving fluid was applied to the outer walls of the Habitation; the Coat-of-Arms over the main entrance was cleaned and varnished; the doors were painted and all iron work cleaned and oiled; the bridges were repaired; fresh gravel was placed in the powder magazines and the lawns were rolled, fertilized and maintained.

The Minister of Game and Fisheries for the Province of Quebec kindly arranged for four wolf skins to be sent to the park and these are now on display at the Habitation.

Visitors registered in the park during the year numbered 3,296.

*Fortress of Louisbourg National Historic Park, Louisburg, Cape Breton Island, Nova Scotia.*—The damage to the entrance road caused by a tidal wave was repaired; a new woven wire fence was erected along the western boundary of the park; the lawns and paths were kept in good condition; bridges within the park area were repaired; the iron fence enclosing the Society of Colonial Wars memorial was scaled and painted; the entrance gates, field signs, and all storm doors and windows were painted and several of the rooms in the basement re-decorated.

A memorial erected by the Congregation of Notre Dame on the site of the convent to the members of the Order who served at the fortress during the period it was occupied by the French was unveiled on August 25.

A total of 3,126 persons signed the visitors' register.

*Fort Beausejour National Historic Park, Sackville, New Brunswick.*—New signs were made and erected throughout the park to mark points of interest, the larger ones being placed on heavy posts set in concrete; the roads and paths were cleaned and trimmed; the walls of the furnace room were treated with a special cement preparation and the guns and gun carriages painted. The Coat-of-Arms of H.M.C.S. *Whitby* and *Moncton* were obtained from the Department of National Defence (Navy) and are on display in the museum.

Visitors registered during the year numbered 5,343.

*Fort Chambly National Historic Park, twenty miles southeast of Montreal, on the Richelieu River.*—The walls of the fort were repointed; the memorials within the fort grounds were cleaned; the caretaker's residence and the interior of the museum were redecorated, the flagpole, picnic tables and storm doors were painted, and the trees, shrubs, and paths trimmed.

During the year 16,203 persons signed the museum register.

*Fort Lennox National Historic Park, Ile-aux-Noix, thirteen miles south of St. Johns, Quebec.*—Permission was granted for the fort buildings to be used during the summer as a training centre for the Canadian Youth Association, sponsored by the Physical Fitness Division of the Department of National Health and Welfare. Two temporary buildings erected on the island during the period it was used as a refugee camp were disposed of by the War Assets Corporation and the water tank, also erected at that time, was taken down. The roofs of the guard house and officers' quarters were scraped and painted; the main entrance bridge was repaired; a new fire-pump was installed, and general maintenance work carried out on the fort buildings.

Visitors registered in the park during the year numbered 655.

*Fort Wellington National Historic Park, Prescott, Ontario.*—The wire fence enclosing the park property was removed; electric lights were installed in the underground passage leading to the caponniere; repairs were made to the palisades and to the drain from the septic tank; rubberized flooring was laid in the museum; a porch was constructed on the front of the officers' quarters now used as the caretaker's residence; the guard house was whitewashed, and the grounds were maintained in good condition. Additional articles of historical interest were obtained for the museum and a four-page leaflet was published containing a condensed version of the history of the fort.

A total of 2,594 persons signed the museum register during the year.

*Fort Malden National Historic Park, Amherstburg, Ontario.*—The boundary of the park has been extended to include an area immediately to the south on which a large residence known as "The Fort", and a smaller dwelling, known as "The Cottage", are situated. The latter is the only remaining building of the original Fort Malden. Many additional articles of interest relating to the early history of the district were received and are on display in the museum. The flag-pole was painted and the lawns and paths were kept in good condition.

*Fort Prince of Wales National Historic Park, Churchill, Manitoba.*—General supervision was continued throughout the year.

#### NATIONAL HISTORIC SITES

During the year all the sites marked on the advice of the Board were suitably maintained. These include Indian earthworks, forts, and villages; French forts, trading posts, and mission enterprises; sites connected with British exploration and naval and military operations in the long struggle for the possession of Canada; posts of the Hudson's Bay Company and sites related to the social, economic, and industrial development of the country.

### CONSERVATION SERVICES

#### WILDLIFE MANAGEMENT

The wildlife of the National Parks appeared to be generally in good condition after the average winter conditions of 1945-46. Dr. Ian McTaggart Cowan, Professor of Zoology, University of British Columbia, continued his scientific studies of the animal populations and range conditions of the mountain National Parks. In spite of the planned reduction in the number of elk during the previous winter, Dr. Cowan reported that the ranges of Banff and Jasper National Parks still showed signs of serious overgrazing. He recommended that the population of elk in these parks be further decreased next year. Plans have been laid for the reduction of elk in these parks, and the disposal of the dressed meat and hides to Indian reservations.

During the year marten and beaver were live-trapped in Banff National Park and given to the Indian Affairs Branch to restock areas that had been depleted. In order to maintain the high standard of our game stock by the weeding out of diseased animals, a close watch was maintained on the status of predators in the National Parks. It is necessary that the predators remain in balance with the hooved game mammals. In some cases it was found necessary to exercise some control on predators, especially on park borders in the vicinity of cultivated and stock-raising areas.

#### WILD ANIMAL PARKS

It was considered advisable to slaughter 400 buffalo in Elk Island Park during the year and the meat and hides were disposed of by tender. Eleven buffalo were slaughtered in Banff Park. The meat, with the exception of six carcasses, was given to the Indian Affairs Branch for use by the Indians. The

hides were sold by tender. Fifty-one buffalo were slaughtered in Riding Mountain Park, the meat and hides being sold by tender. Three buffalo were slaughtered in Prince Albert Park, one carcass being sold by tender and the remainder given to the Indian Affairs Branch. The hides were sold by tender. In order to protect the range from over-use, 352 surplus elk were slaughtered in Banff Park and 197 in Jasper Park. The meat and hides were given to the Indian Affairs Branch.

A census of wild animals in fenced enclosures in the National Parks as of March 31, 1946, is as follows:

## ANIMALS IN FENCED AREAS

Species	Banff Park Paddock	Elk Island Park	Prince Albert Park Paddock	Riding Mountain Park Paddock	Total
Buffalo.....	6	896	7	25	934
Elk.....		717		168	885
Moose.....		184			184
Mule deer.....		72		1	73
White-tailed deer.....				14	14
Rocky mountain goat.....	1				1
Total.....	7	1,869	7	208	2,091

## FISHING AND FISH CULTURE

In general, fishing conditions in the National Parks of Canada continued to be satisfactory, judging by the many good catches reported to the park authorities. The use of Creel Census Cards in the mountain parks and in Prince Albert Park was continued, and 1,487 cards showing 2,970 efforts were returned. A new Creel Census Card was prepared, and every effort is being made to induce anglers to make the proper returns. A limnologist, appointed to the Bureau during the year, carried out preliminary investigations in some of the western parks in the autumn.

Fishing in Banff Park generally was considered to be only fair. Test netting was carried out at Lake Minnewanka to determine if the rainbow trout had become established in any reasonable numbers.

In Cape Breton Highlands Park some fairly good catches of trout were made in park waters. Extreme dry weather and low water during the fishing season did much to keep the catches down.

Stream fishing in Glacier Park was poor throughout the season, with a slight improvement noted during September.

The unusual weather conditions in Jasper Park affected the fishing throughout the season. The levels of the lakes were below those of the previous year. The long, cold spring weather affected both the spawning and the fishing. Fish cultural investigations were continued in many of the lakes in this park. The collection of trout eggs from park waters was carried out. During the year 82,000 speckled trout eggs were shipped to Banff Park.

Fishing generally throughout Kootenay Park, particularly in the Kootenay, Vermilion, and Simpson Rivers, was much better than it had been for some years.

In Mount Revelstoke Park fishing was good during the season, and some good catches were made, particularly in Lake of Jade.

Fishing in Prince Albert Park was not as good as in previous years, owing mainly to inclement weather. There were several long periods of bad weather when fishing was not possible. However, good catches of pickerel and pike were obtained from Wasquesiu Lake. Commercial fishing for whitefish was again permitted to a limited extent in Wasquesiu Lake during the summer.

A small number of excellent trout were taken from the Lake of Shining Waters and Long Pond, Prince Edward Island Park.

Fishing in Riding Mountain Park showed some improvement over past years, no doubt due to higher lake levels. During the autumn another shipment of approximately 318 mature lake trout was made to Clear Lake by rail and truck.

In Waterton Lakes Park pike fishing maintained its usual standard of attraction for the early fisherman, and reports indicate that returns were about the same as in other years. On the whole fishing conditions were satisfactory in this park.

Conditions in Yoho Park were fair and some good catches were reported.

The following statement shows the number of fry, fingerlings, and adult fish distributed in park waters during the year:

Park	Rainbow Trout	Cutthroat Trout	Speckled Trout	Lake Trout (adult)	Total
Banff.....	455,000	120,000	143,000		718,000
Jasper.....	110,015	63,962			173,977
Kootenay.....	35,000	60,000			95,000
Waterton Lakes.....	80,900	32,000			162,900
Yoho.....	30,000				30,000
Riding Mountain.....				318	318
Total.....	710,915	325,962	143,000	318	1,180,195

#### MIGRATORY BIRDS CONVENTION ACT

The Migratory Birds Treaty, which was signed in Washington, D.C., on August 16, 1916, and made effective by Act of Parliament of Canada, 1917 (Chapter 130, Revised Statutes of Canada, 1927, and Amendments), was designed for the better protection of certain birds that migrate between Canada and the United States. In this conservation measure the Dominion and the provinces co-operate. Regulations in accordance with the Statute are agreed upon and are made effective by both the Dominion and the provinces.

The responsibility for the police work in connection with the enforcement of the provisions of the Migratory Birds Convention Act and Regulations thereunder throughout Canada was transferred to the Royal Canadian Mounted Police in 1932.

In 1945, the waterfowl situation in British Columbia remained practically unchanged. In the great duck-producing area of the Prairie Provinces, effects of serious drought conditions were noticed along the Alberta-Saskatchewan boundary and in the Athabaska Delta. These conditions contributed to a considerable reduction of the continental duck population. The ubiquitous and important mallard is the most numerous species. Mallards continued to concentrate locally in southern Alberta, causing trouble for agriculturists in some areas. In the East, the population of game ducks remained generally the same. For the first time in many years, the wood duck was legal game in Ontario. A considerable increase in the hunting of geese in the James Bay region was noted. No increase was evident in the population of greater snow geese. A cold summer apparently resulted in the production of very few young. In the Maritimes the spring migration of brant was encouraging, but the autumn flight was poor.

Only minor changes in seasons and bag limits were made in the Migratory Bird Regulations for the hunting of waterfowl and other migratory game birds. Close co-operation was continued with provincial governments, game conservation societies, and other organizations interested in bird conservation.



In the entire Dominion there are 754 honorary game officers, of whom 14 are officers of the Forest Service, 102 are officers of the Department of Fisheries, and 105 are Canadian Pacific Railway Police. The game and fishery officers of the Provinces of New Brunswick, Quebec, Ontario, Manitoba, and British Columbia and the members of the New Brunswick Provincial Police are ex-officio game officers under the Migratory Birds Convention Act.

Field administration of the Act was continued under the supervision of four District Migratory Bird Officers. The Chief Federal Migratory Bird Officer for British Columbia carried out an investigation of wildlife and other natural resources in central British Columbia. The Chief Federal Migratory Bird Officer for the Prairie Provinces made an intensive investigation of wildlife conditions in Wood Buffalo Park and other parks, and also made inspections of certain bird sanctuaries and public shooting grounds. The Chief Federal Migratory Bird Officer for Ontario and Quebec conducted a patrol and quinquennial census of eider ducks and other sea birds on ten sanctuaries in the Gulf of St. Lawrence. A motion picture film on the birds of the Gulf was produced. Wildlife investigations were carried on in other parts of Quebec, and in southwestern Ontario. The Chief Federal Migratory Bird Officer for the Maritime Provinces studied the unusually heavy invasion of snowy owls and continued his research on woodcock populations. Officers of the Bureau disseminated, by lectures and otherwise, information about migratory birds and their conservation, and lecture material, including motion pictures and lantern slides, was lent to voluntary assistants.

In order to proceed advantageously with adequate conservation of native wild birds as a natural resource of great economic value, it is indispensable that certain precise data be available for study by various officials and organizations charged with this responsibility. The only possible way in which much of the exact information required on the migration and general life histories of wild birds in their natural habitat may be obtained is by marking the birds with official numbered bands, bearing a return address, whereby each bird so marked may be clearly identified as an individual if it is later recaptured, killed, or found dead.

The importance and practical usefulness of this method of systematic investigation of wild bird life has been demonstrated and emphasized repeatedly for many years in most important international wildlife conservation discussions. Current ornithological and conservation literature contains much of the new and useful information made available through studies of data obtained as a result of bird-banding activities.

Bird banding in North America is international in scope and is being conducted, under the provisions of the Migratory Birds Convention Act and regulations thereunder, in full co-operation between the Wildlife Division of Canada's National Parks Bureau and the Fish and Wildlife Service of the United States Department of the Interior at Washington, D.C. Close co-operation with various provincial and state game authorities, as well as with game officials for Newfoundland and other North and South American countries, is also involved from time to time.

In Canada, where practically all banding activities are conducted voluntarily, and free of expense to this Department, by conservation-minded citizens, the National Parks Bureau has had jurisdiction over all banding investigations since 1923. During recent years, the number of voluntary co-operators in Canada has averaged about 200 per annum, all of whom furnish the National Parks Bureau with detailed records of all their banding operations. Wild birds may, of course, be banded only under authority of official permits, which are issued only to persons possessing certain ornithological ability, and none but the regular official bands, furnished free of charge to banding co-operators, may be used.

Bird banding in Canada continued to progress favourably during the period covered by this report. As of December 31, 1945, the Official Canadian Bird-Banding Records contained 478,232 records of birds that have been banded, together with a total of 32,874 detailed records of banded birds that have been recovered.

The National Parks Bureau appreciates the co-operation of all who have helped further the success of the bird-banding effort by reporting the recovery of banded birds, and urges all persons to report any banded birds which may come to their attention. Persons who report banded birds perform an act of direct benefit to the public at large in that they help advance scientific knowledge of wild birds as an important and very essential natural resource. No postage is required on reports relating to banded birds if they are directed to the Controller, National Parks Bureau, Ottawa, Ontario.

Sixty-five bird sanctuaries, comprising an area of approximately 1,291.08 square miles, are now reserved under the Migratory Birds Convention Act in Canada. One new sanctuary, Rockhill, in Quebec, was established during the period under review.

On some parts of the Atlantic Coast the eel-grass situation showed slight improvement, especially in Nova Scotia. However, normal conditions have not been restored anywhere on the Coast.

During the year 912 permits and licences were issued. Printed material distributed comprised 5,990 copies of the Migratory Birds Convention Act and Regulations, 14,802 Abstracts of the Regulations, 41,173 posters, and 7,789 educational pamphlets.

The Bureau was represented at the largely attended Eleventh North American Wildlife Conference in New York, March 11-13, 1946. A paper on the management of Canada's wildlife resources was presented and was well received.

### DOMINION FOREST SERVICE

The year 1945 was notable for the cessation of nearly six years of war. In the Dominion Forest Service that event was marked by the gradual return of some 33 per cent of the professional and technical officers of the staff who had enlisted in the Armed Services. Considerable anxiety was felt with regard to the retention of forest engineers with long training and experience in the Forest Service. This situation developed as a result of the acute shortage of trained foresters in Canada and the consequent demand for their services by governments and industry. There is no doubt that this shortage will continue for some years and the supply of experienced and trained foresters will fall far short of satisfying increased demands throughout Canada. Fortunately, however, this difficulty was relieved in the Dominion Forest Service by a salary reclassification which, with a few exceptions, enabled the retention of the valuable technical forestry staff and also permitted the recruitment of additional experienced foresters.

In May, 1945, the Dominion Forester was loaned to the Department of Reconstruction as Deputy Co-ordinator, and subsequently as Acting Co-ordinator of Resources Development. The Assistant Dominion Forester was appointed Acting Dominion Forester.

The impact of the war on Canada's forests has been great. War needs made a tremendous demand on the forest resources of this country with the result that overcutting has occurred in many sections and serious depletion has taken place in the accessible stands of saw-timber, particularly in those producing the higher grades of lumber. Post-war needs will place an added burden on our forests to supply both the domestic and foreign requirements in the reconstruction period.

In addition to the past and future drain on timber supplies through cutting, other forms of forest depletion, such as fires, insects, and disease, leave little cause for comfort. Forest fire losses were considerably less than average for the past ten years but the fire season of 1944 was one of the worst on record. This clearly indicates that the forest fire protection situation in Canada to-day is unsatisfactory since the toll of loss and damage through this agency varies mainly with the weather conditions.

Losses due to forest insect epidemics and tree diseases are on the increase. In particular, the present epidemic of spruce budworm, if not controlled, threatens the loss of raw materials on a scale approaching national disaster. To combat this immediate menace the Forest Insect Control Board was set up in September, 1945, with representation from the Departments of Mines and Resources, Agriculture, and Reconstruction and Supply, and from British Columbia, Ontario, Quebec, and the Maritime Provinces. Through the actions of this Board increased funds have been made available by the Federal Government and plans have been drawn with a view to finding measures to control the spruce budworm and other forest insects, particularly in the endemic stage.

The forest resources of Canada are immense in size and diversified in character but they are not inexhaustible. If Canadians are to attain the full benefit of this great natural heritage our forest land must be brought into a state of continuous production. Liability to destruction by fire, insects, and disease must be controlled and forests managed as perpetually renewable crops.

To the problem of improving the protection and management of our forests must be added problems concerning the more efficient use of wood that is cut and there must be constant effort to improve the efficiency of the forest products industries themselves. The Forest Products Laboratories of this Department have made and are continuing to make a substantial contribution in this effort.

The key to forestry progress in Canada lies in co-operation among the parties most immediately interested, namely, industry, the provincial governments, and the Dominion Government. Each of these agencies must be prepared to assume definite responsibility if our forests are to yield all the economic benefits of which they are capable. The more clearly these responsibilities are understood and defined, the greater will be the rate of progress. The chief Dominion interest in the forest resources of this country lies in their contribution to our national economy.

With few exceptions the forest areas belong to the provinces. Their protection and management is, and will continue to be, a function of provincial governments. However, the Federal Government has a definite responsibility and can, as it has in the past, assist in the orderly development of the national forest resources. Such assistance takes the form of research in silviculture, forest fire protection, photogrammetry and forest products, as well as economic studies and special investigations. The Dominion Forest Service has made valuable contributions in this field for the past 29 years. This effort has met with the approval of provincial governments and the forest industry. The results of its work have also been of value to the various departments of Federal Government.

At this time it seems opportune to re-state the contribution which the Federal Government can make in the application of scientific forestry in the Dominion of Canada.

The Dominion Forest Service is concerned with the advancement of forest conservation in Canada generally, and with scientific research and investigation of problems affecting the forests. The Dominion Forest Service is the authoritative source of information in Canada on forest economics and research in silviculture, forest fire protection, forest products and aerial forest mapping. Besides these fields of effort it carries out miscellaneous technical investigations

and also advises the Government on forestry matters of national importance; all leading to the orderly development and optimum use of Canada's forest resources on the basis of permanent management.

For the performance of these functions the Forest Service operates in three divisions, as follows:

1. Head Office at Ottawa with sections for forest protection, forest economics, silvicultural research, surveys, aerial mapping, publicity, and administration.
2. Forest Products Laboratories at Ottawa with branches at Montreal and Vancouver.
3. Five Forest Experiment Stations established in representative forest regions throughout Canada for scientific research and investigations in field problems. (Valcartier and Riding Mountain Stations were closed in 1941 for the duration of the war.)

The regular work of the Forest Service has, of course, been greatly curtailed and in part suspended during the war, but under normal conditions is concerned with the following phases on an expanding basis under the various divisions:

#### FOREST ECONOMICS

The function of this division is to assemble in co-operation with the provinces and industry all available information relative to the extent and character of the forest resources of the Dominion; to compile data in regard to the depletion of these resources due to cutting, fire, and other causes; and to estimate the extent to which depletion is being replaced by growth, and to compile information in regard to the forest industries and the trade in forest products.

#### SILVICULTURAL RESEARCH

*General.*—The work of the staff at Ottawa is largely directional, covering project plans, studies, and co-ordination of field operations. Field data are analysed and reported on, field reports are reviewed, and research notes published for the information of other scientific bodies or for industry.

Co-operative planning with outside agencies is conducted. Assistance in an advisory capacity has been given to provincial forest services and to pulp-wood operators in planning investigations, more especially in studies of conditions on cut-over lands.

*Research.*—To determine through research, and to apply on demonstration areas, measures necessary for the handling of forest lands on silvicultural principles and for economical forest management, to obtain sustained yield and to help control depletion. Methods of improving production of second-growth stands are of primary interest. Field studies of timber types and age-classes are conducted at outside areas in co-operation with provincial services and the forest industries. There are over 230 projects in the classifications of botany, ecology, silviculture, mensuration, protection, administration, and economics.

Studies in tree breeding, botany, ecology, and protection are carried on, some in collaboration with the National Research Council and the Department of Agriculture.

*Surveys.*—Periodical rate of growth surveys are made in selected areas throughout Canada for the purpose of determining the rate of growth for increment in representative types of timber under different silvicultural conditions. These surveys are also for the purpose of determining the rate of mortality and reproduction of the different species.

## FOREST FIRE PROTECTION

*Fire-Hazard Research.*—Studies on the basic principles underlying different stages of forest inflammability, to determine the degree of fire hazard present at any time in the different climatic and forest-cover divisions of Canada, as an aid to protection forces. This requires continual field studies and office research and also involves the improvement or development of special instruments for use in fire-hazard measurements.

*Fire Detection.*—Surveys are being conducted to determine the most effective and economical locations for lookout stations on the National Parks. This involves visible area mapping for all lookout points.

*Fire-Fighting Equipment.*—Experimental work is carried on to improve the quality and design of fire-fighting equipment in order to increase the efficiency of the protection forces.

## AERIAL FOREST MAPPING

The use of aerial photographs adapted to the classification and volumetric estimation of forest cover, from studies and research, has resulted in a considerable reduction of ground surveys necessary to produce reliable forest-cover maps and site classification for forest inventory. Experiments are also conducted in ways and means of applying aerial photographs for forestry purposes.

## FOREST PRODUCTS LABORATORIES

The primary purpose of the Laboratories is to promote the more efficient use of forest resources by finding means of curtailing waste; by developing use for species now used to only a limited extent; by improving manufacturing technique so as to extend markets at home and abroad; by improving grading practice; by developing better engineering standards in timber design; by improving specifications for timber structures in building codes; by increasing the life of timber by chemical treatment and in many other ways

The Laboratories have assembled considerable information from researches in their own and similar laboratories throughout the world, and have served as a public bureau of information and consultation for the forest products industries as a whole, as well as for provincial governments, railways, public utility organizations, and municipal authorities.

The main Laboratories are located in Ottawa: the Vancouver Laboratories deal with problems pertaining particularly to British Columbia timbers. The Pulp and Paper Division, conducted in co-operation with the Canadian Pulp and Paper Association and McGill University, is in Montreal.

Work at the Ottawa Laboratories falls chiefly under the headings of timber mechanics, timber pathology, timber physics, wood chemistry, wood preservation, wood utilization, and lumber seasoning, while that at Vancouver deals with like problems with particular reference to British Columbia conditions.

The activities of the Pulp and Paper Division may be broadly divided into fundamental and applied research: under the first heading come such matters as studies of the chemistry of lignin and cellulose, and of materials of potential economic importance derived from them; problems of applied research include such items as studies of chemical and mechanical pulping, developing instruments for measuring printing smoothness of paper, studies of air- and oil-permeability of newsprint, examination of methods of analysing waste sulphite liquor, studies of alkaline pulping and, generally, any special problems arising out of the operation of pulp and paper plants.

## FOREST EXPERIMENT STATIONS

Research work is conducted on five Forest Experiment Stations situated at strategic locations throughout Canada as follows: Acadia in New Brunswick, area 35 square miles; Valcartier in Quebec, area 7½ square miles (this station has been closed for the duration); Petawawa in Ontario, area 97 square miles; Riding Mountain, area 25½ square miles, within the Riding Mountain National Park, Manitoba, and Kananaskis in Alberta, area 63 square miles.

## PUBLICITY

The serious depletion of Canada's forest resources by fires, a large percentage of which were started through carelessness and thoughtlessness, indicates a great need for continuity of action to arouse public sentiment regarding the importance of forest conservation. Guidance and assistance are given the Canadian Forestry Association in their educational and publicity work.

## FOREST ECONOMICS DIVISION

Final victory over Germany and Japan in 1945 had very little immediate effect on conditions in the forest industries of Canada because the urgency of demand for their products was in no way reduced. Exports of lumber to the United Kingdom, other Empire countries, and the United States continued at high levels. At home, the reduced need for timber for direct war purposes was more than offset by an intensified demand for lumber for construction of new dwellings. Production of logs, pulpwood, sawn lumber, and mill-work continued to be directed by the Timber Control of the Department of Munitions and Supply, and domestic price ceilings were strictly maintained in spite of the fact that prices in export markets were very much above the Canadian level. In order to retain sufficient lumber in the country, the policy of allocating exports and the system of export permits were maintained.

Control of the pulp and paper industry by administrators of the Wartime Prices and Trade Board was continued. Demands for pulp and paper products continued to be far in excess of the quantities it was possible to supply, partly because labour shortages in the woods restricted the output of pulpwood. This situation was relieved to some extent through the efforts of the National Selective Service organization and by the employment of a considerable number of prisoners of war in pulpwood operations.

The following table shows the average rate of consumption and destruction of merchantable timber during the ten-year period 1934-43. Figures in this table are not directly comparable with estimates of depletion published in earlier reports because a new series of converting factors has been used in their compilation. For many years prior to 1945, the Dominion Forest Service and the Dominion Bureau of Statistics converted estimates originally prepared in commercial units—board feet, cords,—to cubic feet by means of converting factors which purported to show the total volume of the trees consumed, including unused stumps and tops. In order to make Canadian statistics directly comparable with those of foreign countries, a new set of factors has recently been adopted which gives cubic volumes of merchantable wood only, excluding stumps and tops. Consequently, the new estimates are somewhat smaller than formerly.

*Average Annual Depletion, 1934-43*

	Millions of Cubic Feet of Usable Wood
Volume used.....	2,312
Merchantable timber burned.....	338
Destroyed by insects and tree diseases.....	500
	<hr style="width: 100px; margin-left: auto; margin-right: 0;"/> 3,150

About 73 per cent of the total depletion was used and 27 per cent was destroyed by fire and epidemic outbreaks of pests.

Replacement of average annual depletion requires an average growth-rate of about 11 cubic feet of merchantable wood per acre over the whole accessible productive forest area of Canada. This is not a high rate of growth, and results obtained in other countries indicate that a much higher rate could safely be maintained if our forests were managed in accordance with sound forestry principles. The beginnings of forest management have made their appearance in certain parts of Canada, but in others there is no systematic control of logging operations. Until more intensive management is introduced, it is very doubtful if Canada can safely increase her output of forest products. As matters stand to-day, severe overcutting exists in certain localities, while the annual growth on other forest areas is not used because they are too difficult of access.

The relative importance of the principal branches of forest industry in 1943 is indicated in the following table:—

FOREST INDUSTRIES  
*Summary of Principal Statistics, 1943*

—	Capital Invested	Employ- ment	Salaries and Wages	Net Value of Products	Gross Value of Products
	\$	Man-years <sup>(1)</sup>	\$	\$	\$
Woods operations.....	281,000,000	107,790	180,000,000	205,000,000	268,615,283
Lumber industry.....	115,273,788	43,954	49,564,303	91,714,000	195,885,336
Pulp and paper industry...	667,458,143	37,020	71,199,422	164,244,088	344,411,614
Wood-using industries.....	124,701,572	45,650	57,699,745	90,860,922	187,904,552
Paper-using industries <sup>(2)</sup> ..	66,328,954	17,975	23,647,948	51,008,498	116,991,197
Total.....	1,254,762,457	252,389	382,111,418	602,827,508	1,113,807,982

<sup>(1)</sup> 300 working days.

<sup>(2)</sup> Not including printing trades.

The net value of the products of the forest industries in 1943 was 7.6 per cent greater than in 1942, and 12 per cent greater than in 1941.

Normal activities of the Economics Division of the Forest Service were carried on throughout the year and a considerable amount of special work was performed for the Timber Controller of the Department of Munitions and Supply. The Chief of the Division acted as Secretary of the Sub-Committee on Resources Development of the Public Investment Committee for the Dominion-Provincial Conference on Reconstruction. He also attended the first meeting of the Food and Agriculture Organization of the United Nations in Quebec and served on the Technical Committee on Forestry and Forest Products of that body.

#### AIR SURVEY DIVISION

The Air Survey Division owes its existence to the increasing importance of air photographs in the survey of the forest resources of Canada. From the research standpoint a fertile field exists in the development of technique and scientific apparatus and in the obtaining of data on the ground to aid in the interpretation of air photographs in regard to timber quantities and other forest information. An opportunity to couple research with practice has arisen in the forest mapping of federally administered lands such as the Northwest and Yukon Territories, Indian reserves, National Parks, and forest experimental areas, as well as in cases where provincial lands have been mapped in co-operation with the provinces.

During the greater part of the year the work was profoundly affected by the shortage of experienced men, pending the return from the Armed Forces of former members of the air survey staff, three of whom eventually resumed their duties. While overseas these men served in key positions in the use of air photographs and have brought back with them a specialized knowledge of recent photogrammetric development that will be most useful in their work. The training of new men to take the place of former members of the staff and to prepare for an expansion of the work has been an important factor in the year's activities.

Advances were made in the establishment of a procedure for the reproduction of forest map sheets in quantities sufficient for distribution to the public at a small fee, much in the same way as the National Topographic Series. The forest maps will, in fact, be based on the Topographic Series but will, in addition, show the forests in classes according to type, height, and crown density, aided by colour distinctions as obtained in the process of photolithographic reproduction. For the purposes of a thorough trial of the procedure a map sheet comprising about 400 square miles in the vicinity of Harper Lake, Province of Quebec, will be published at a scale of one mile to one inch and to this end the necessary classifying and mapping of the forests of this map sheet from the air photographs was completed.

Following discussions with a representative of Harvard Forest of Harvard University, Petersham, Massachusetts, the Dominion Forest Service co-operated in an experiment conducted by the Royal Canadian Air Force in the use of infra-red photographs in air survey, particularly in reference to the possibility of making use of the pronounced tone distinctions which are brought out in infra-red photographs of the forest. Infra-red photography may be used to distinguish hardwoods from softwoods in midsummer photographs, the former having generally a distinctly lighter tone. However, it is not necessary to rely on infra-red for this purpose, as better results may be obtained by photographing with the ordinary panchromatic film at other seasons of the year, thus taking advantage of the absence of the obscuring deciduous foliage, or, at least, of its distinct spring or autumn tones.

In infra-red photography the shadows are usually dark. On the other hand, the foliage is greatly lightened because of the pronounced effect of the chlorophyll of the green foliage on the infra-red film. The result is a great variety of tones ranging from black shadows to white foliage. As these tones are not necessarily caused by species characteristics it is not yet known whether softwood species can be better identified by means of infra-red.

### SILVICULTURAL RESEARCH DIVISION

During the year a number of foresters who had been absent on military leave returned to duty with the Service. This increase in technical staff made it possible to review many of the projects which had been left in abeyance during the war years and to plan for the resumption of silvicultural research investigations in the post-war period. A number of positions were established but it was found impossible to fill any great number of these owing to the lack of trained personnel.

### SILVICULTURAL RESEARCH BOARD

A Silvicultural Research Board was established, the members of which are the Acting Dominion Forester, the Chief of the Silvicultural Research Division, the Assistant Chief of the Silvicultural Research Division, and other foresters whom they may call upon to serve from time to time. This board undertakes the review of all silvicultural research projects, both old and new, with the object of giving full consideration to the value of the project and the plans for investigation. It also assigns such projects to the forest officer considered to have the best qualifications for the undertaking.



## DISTRICT OFFICES AND FOREST EXPERIMENT STATIONS

The District Office at Winnipeg, which was closed early in 1942, was reopened.

The Valcartier Forest Experiment Station, closed in 1941, was reopened toward the end of the year and the normal functions which this station carries out in the Province of Quebec were resumed.

Roads, buildings, telephone lines, and other physical improvements on the Acadia, Petawawa, and Kananaskis Forest Experiment Stations were kept in good repair.

All permanent sample plots due for remeasurement on the Petawawa, Kananaskis, Acadia, and Riding Mountain Stations were re-examined and notes taken. No additional plots were established as operations on these areas were distinctly on a maintenance basis.

In the management of the Petawawa, Kananaskis, and Acadia Stations, a considerable amount of timber was removed. At Kananaskis this consisted of mine props and fuel-wood cut from the 1936 burn. These mine props went to the Canmore and Drumheller mines and the fuel-wood supplied the requirements of a local lime kiln as well as an internment camp and a number of military camps. Timbers cut from the Petawawa Station went to mills located at Pembroke. The following table gives a summary of the products cut on these three stations:—

	<i>Kananaskis</i>	<i>Petawawa</i>	<i>Acadia</i>	<i>Total</i>
Sawlogs, ft.b.m. ....	.....	2,023,253	..	2,023,253
Fuel-wood, cords .....	3,307	792	99	4,198
Pulpwood, cords .....	.....	101	34	135
Mine props, lin. ft. ....	900,055	....	..	900,055
Bldg. logs, cu. ft. ....	.....	718	..	718
Poles, etc. ....	.....	887	..	887

## SPRUCE BUDWORM

A project was undertaken in the Maritimes District to check the feasibility of controlling the spruce budworm through the practice of planned forest management based on a sustained yield operation. This project was undertaken in co-operation with:—

- (a) The Forest Insect Division of the Science Service Branch, Dominion Department of Agriculture.
- (b) The Forest Service, Department of Lands and Mines, Province of New Brunswick.
- (c) Fraser Companies Limited, pulpwood operators.
- (d) The Forest Insect Control Board.

Briefly stated, this project is based on the assumption that old growth, particularly of balsam fir, is most susceptible to attack by the spruce budworm and least likely to recover from such an attack. Plans call for the early removal of this old growth in the expectation that when an infestation reaches this area comparatively little damage will result, owing to the absence of mature and overmature fir and spruce trees. Investigations have shown that young and vigorous trees of these two species suffer less damage than older trees.

In order to put this plan into operation, it is proposed to make all parts of the experimental area available through the construction of roads and to remove from the area all mature or overmature trees of pulpwood species.

This area in New Brunswick, on the limits of Fraser Companies Limited, was selected for this experiment because it is expected that it will be some years before the budworm reaches this location in its spread eastward. In the interim it is hoped to complete the logging of the mature timber and so make this area immune from budworm attack.

The Silvicultural Research Section has assigned a forester to this project who is working under the direction of our District Forest Officer in Fredericton and a committee of the co-operating agencies known as the Green River Working Committee. This forester is co-operating with entomologists and other specialists who have been assigned to this project.

During the year Research Block No. 1 was selected and the boundaries clearly defined on the ground. This block contains 4,023 acres and within it one-tenth acre plots have been established at six-chain intervals on lines spaced ten chains apart. Complete notes have been taken on each plot showing a record of all trees by species and timber classes, nature and extent of reproduction present, direction of slope and other topographic features, kind and character of ground vegetation, and other data considered relevant. This block is to be logged during 1946. These plots will be re-examined after logging and subsequently re-examined every five years. Other research blocks are to be selected for similar examination within the 400-square mile area selected for management.

#### FARM WOODLOTS

With the co-operation of the Dominion Department of Agriculture, the New Brunswick Forest Service, and the Nova Scotia Forest Service, this division selected a number of woodlots located on Dominion Agricultural Experiment Stations and Illustration Stations in the Maritimes and, after an examination of each, prepared detailed working plans for their management on a sustained yield basis. These particular woodlots were selected because farmers in the adjoining country visit these experimental farms in large numbers each year, and, when doing so, they will have an opportunity to observe for themselves the benefits of planned woodlot management. The statistical information available shows that returns to farmers in the Maritimes region from products cut on their woodlots rank quite high in the economy of the region. Furthermore, there is no doubt that the return from these woodlots can be materially increased through the initiation of certain sound forestry practices.

A trained forester has been assigned to this project in order that he may give advice to woodlot owners on the management of their woodlots and to stimulate interest in woodlot management through addresses and press releases.

#### TREE BREEDING

A tree breeding committee, comprising representatives of the National Research Council, the Department of Agriculture, and the Dominion Forest Service, met several times during the year in order to discuss questions related to the development of new strains. Experimental work was continued during the year in the testing of strains of several species developed from seeds and cuttings. Special efforts are being made to develop suitable material of (a) white pine resistant to weevil and blister rust; (b) spruce of rapid growth and with good pulping fibres; (c) poplar of improved qualities for matchwood and pulpwood; (d) poplar suitable for planting in windbreaks on the Prairies.

#### RATE OF GROWTH

The Ontario Forest Service co-operated with the Dominion Forest Service in relocating one-tenth acre sample plots established in the Goulais River Drainage Basin near Sault Ste. Marie in 1926. About one-third of the area was covered and 95 per cent (180) of the plots were found. The lines between plots were reblazed and the corner stakes marking the boundaries of the plots replaced. This project will be continued next year and the remaining plots will be relocated and all plots remeasured.

## CANADIAN PULP AND PAPER ASSOCIATION

The Woodlands Section of the Canadian Pulp and Paper Association held its annual field meeting at the Petawawa Forest Experiment Station on May 25 and 26. This meeting was devoted to papers and discussions on silviculture and the examination of a number of permanent sample plots established on the area, in the forest types where pulpwood species are dominant. This meeting was attended by representatives of a large number of pulp and paper companies operating in Eastern Canada, representatives from the Faculties of Forestry of the Universities of New Brunswick and Toronto, and representatives from Dominion and provincial forest services. The following three resolutions were passed at this meeting:

I. Whereas it is recognized by the forest industry and Governments that there is an urgent and definite need for fundamental and factual data on the regeneration on cutover areas and rate of growth surveys, and whereas such information is essential to the perpetuation of Canada's forest resources, be it therefore resolved that a Joint Committee be set up, consisting of representatives from the forest industry, Provincial and Dominion Government Forest Services, with a view to finding ways and means of implementing the proposals with respect to surveys as outlined in the papers presented by the Dominion Forest Service at this meeting.

II. Whereas experimental work is necessary in our pulpwood forests to study methods for increasing the growth rate of desirable species, be it resolved that experimental areas be established for such purposes.

III. Whereas it is essential to collect and review all available data pertaining to Canada's forests and tree species, preparatory to further research and application of forest management practices, be it therefore resolved that the Woodlands Section consider recommending to the Dominion Forest Service that the Dominion Forest Service undertake this collection and review of such data, their publication and dissemination.

## PUBLICATIONS

Silvicultural Research Note 74, Succession Cutting in Pine—W. M. Robertson.

Silvicultural Research Note No. 75, Some Observations on Silvicultural Cutting Methods—W. M. Robertson.

Silvicultural Research Note No. 76, Knot-free Red Pine by Debudding—A. Bickerstaff.

Silvicultural Research Note No. 77, Growth of Aspen—G. Tunstell.

Silvicultural Research Note No. 78, Effect of Different Methods of Slash Disposal of Jack Pine Reproduction—J. W. Noakes.

Silvicultural Leaflet No. 21, Outline for a Working Plan.

Silvicultural Leaflet No. 22, Balancing Increment per Tree Against Maximum Increment per Acre—A. Bickerstaff.

Silvicultural Leaflet No. 23, Assessing the Growth of Individual Trees by Radial Increment—A. Bickerstaff.

## FOREST PROTECTION DIVISION

Organized forest fire protection in Canada now covers an area of some 750,000 square miles. This is equal to about 60 per cent of the total forested area of the country. Most of the unprotected forested land is either non-productive or inaccessible for commercial use at the present time.

### FIRE LOSSES

The area burned and damage caused by forest fires in 1945 were considerably less than the average for the previous ten years (see Table 1). Losses in British Columbia were unusually heavy. Nearly half of the area burned and more than half of the total damage for the whole of Canada occurred in that Province. Elsewhere, however, the losses sustained were much below normal.

Although there were 4,761 fires in 1945, or 86 per cent of the average number for the past ten years, the average area burned per fire was only 35 per cent of the previous ten-year figure. The total area burned, 741,531 acres, was the lowest recorded since 1927.

Fire losses for the various provinces and for lands under Dominion administration are shown in Table II.

### CAUSES OF FIRES

More than one-quarter of the forest fires in 1945 were attributed to smokers (Table III)—a marked increase over the average number of fires from this cause in the period 1935-44. Camp-fires and railways were next in importance among the man-made causes, each being responsible for 15 per cent of the total number. The proportion of campers' fires was slightly less than in the preceding 10 years, but the number of railway fires has increased greatly as a result of war-time operating conditions.

Lightning, the only unpreventable cause, was responsible for 18 per cent of the forest fires in 1945.

### LEGAL PROCEEDINGS

The number of prosecutions and convictions under the forest fire laws is shown in Table IV. Legal proceedings were instituted in a much smaller number of cases than during the previous year. No loss of life resulted from forest fires in 1945.

### WEATHER CONDITIONS

Throughout the Province of British Columbia weather conditions resulted in hazards considerably worse than average. Although periodic relief occurred, extremely critical fire danger developed in all forest districts during some part of the fire season.

In the three Prairie Provinces rainfall was generally heavier than normal, and was quite well distributed. Dangerous conditions occurred locally in Alberta and Saskatchewan during the month of May, and a high hazard existed in Manitoba towards the end of August, but these periods were of relatively short duration.

From Ontario eastward the early disappearance of the snow resulted in a larger proportion of April fires than usual. Abundant rainfall in May, however, prevented the widespread development of a critical hazard condition such as commonly occurs in that month. The weather in Ontario during the remainder of the fire season was for the most part favourable, although high hazards were experienced in the eastern districts from the latter part of July until the middle of August.

The average precipitation in Quebec was nearly normal, but the distribution was not uniform throughout the Province. The greatest amount of rain occurred in the southern and central sections, and deficiencies were reported in both eastern and western districts. High hazards developed locally in June and July, and more generally in August.

In the Maritime Provinces a relatively good fire season was experienced. Rainfall in New Brunswick was equal to or greater than normal except in the month of August. There was less rain than usual in Nova Scotia, but the humidity remained sufficiently high to prevent the development of critical danger periods.

Throughout Eastern and Central Canada serious hazard conditions did not occur during the autumn months.

#### FOREST-FIRE RESEARCH

Although work of the Division is still handicapped by a shortage of staff, some progress has been made in the investigation of problems relating to forest-fire protection. A survey of the research requirements of forest protection services in Canada was completed, and from this a long-term program of research projects was prepared.

The Forest Fire Hazard Tables, last issued in 1940, which are used for the daily measurement of forest inflammability, have been revised and considerably simplified for field use. The reliability of both the old and the new tables was verified by a study of the actual occurrence of forest fires during a six-year period, in the National Parks of Western Canada. It is expected that the new tables will be available to forest protection officers early in the 1946 fire season.

Analyses of long-term trends in the Dominion fire statistics were brought up to date. War-time influences on forest fires in Canada, as revealed in these statistics, were examined and published.

Field studies, carried out at the Petawawa Forest Experiment Station, were limited to routine investigations of equipment for the determination of forest-fire hazard, and inflammability tests in poplar and cut-over jack pine stands.

TABLE I

*Forest Fire Losses in Canada, 1945, Compared with 10-Year Average 1935-44*

Item	Annual Averages 1935-44	Year 1945
Fires under 10 acres..... number		3,681
Fires 10 acres and over..... "		1,080
Total number of fires.....	5,533	4,761
Area burned—		
Merchantable timber..... acres	554,723	159,909
Young growth..... "	663,088	161,641
Cut-over lands..... "	370,611	129,361
Non-forested lands..... "	852,434	290,620
Total area burned..... "	2,440,856	741,531
Merchantable timber burned—		
Saw timber..... M. ft. b.m.	720,842	686,200
Small material..... cords	2,491,905	289,153
Estimated values destroyed—		
Merchantable timber..... \$	2,603,603	1,018,679
Young growth..... \$	891,904	399,144
Cut-over lands..... \$	313,096	78,103
Other property burned..... \$	502,835	779,777
Total damage..... \$	4,311,438	2,275,703
Actual cost of fire-fighting..... \$	868,197	993,818
Total damage and cost..... \$	5,179,635	3,269,521

TABLE II

## Statistics of Forest Fires by Regions, 1945

(Averages given are those for 10-year period 1935-44)

	British Columbia		Alberta		Saskatchewan		Manitoba		Ontario	
	Average	1945	Average	1945	Average	1945	Average	1945	Average	1945
Fires—										
Total number.....	1,613	1,838	330	284	263	98	370	168	1,254	966
Caused by lightning..... %	35	29	3	6	6	5	8	15	20	12
Areas burned—										
Merchantable timber..... acres	40,211	92,481	173,193	29,785	59,774	20,387	41,314	1,838	133,283	9,301
Young growth..... "	53,680	79,971	207,407	53,178	247,441	6,180	35,547	2,738	60,097	9,530
Cut-over lands..... "	107,942	92,695	18,045	5,510	19,922	5,854	4,066	279	31,627	5,894
Non-forested lands..... "	111,924	87,745	264,036	128,263	191,826	17,302	158,541	6,580	78,070	23,785
Total..... "	313,757	352,892	662,681	216,736	518,963	49,723	239,468	11,435	303,077	48,510
Damage..... \$	753,972	1,443,053	1,073,462	267,181	229,965	12,269	152,272	11,033	801,863	286,062
Cost of fire-fighting..... \$	213,136	483,928	85,351	64,004	71,696	3,404	29,966	4,189	214,621	230,454
Total damage and cost..... \$	967,108	1,926,981	1,158,813	331,185	301,661	15,673	182,238	15,222	1,016,484	516,516

	Quebec		New Brunswick		Nova Scotia		Dominion Lands					
	Average	1945	Average	1945	Average	1945	National Parks		Indian Lands		For. Expt. Stations	
							Average	1945	Average	1945	Average	1945
Fires—												
Total number.....	1,062	996	236	168	278	169	65	19	56	45	6	10
Caused by lightning..... %	6	13	7	10	0	1	12	47	11	7	0	0
Areas burned—												
Merchantable timber... acres	89,326	4,357	6,000	386	1,212	48	6,577	9	3,428	1,316	405	1
Young growth..... "	22,521	2,200	6,732	4,658	5,240	1,050	21,245	16	2,392	2,116	786	4
Cut-over lands..... "	159,128	16,728	23,871	567	1,107	500	4,249	128	612	1,204	42	2
Non-forested lands..... "	20,779	20,403	3,928	1,590	5,390	2,542	10,286	0	7,050	2,370	604	40
Total..... "	291,754	43,688	40,531	7,201	12,949	4,140	42,357	153	13,482	7,006	1,837	47
Damage..... \$	976,340	205,526	219,387	34,700	24,179	10,105	61,552	316	12,841	5,448	5,605	10
Cost of fire-fighting..... \$	190,214	151,109	24,901	37,485	16,732	9,476	16,575	1,329	4,477	8,401	528	39
Total damage and cost \$	1,166,554	356,635	244,288	72,185	40,911	19,581	78,127	1,645	17,318	13,849	6,133	49

TABLE III

*Forest Fires in Canada, 1945, by Causes, Compared with 10-Year Average—  
1935-44*

Cause	Average 1935-44		Year 1945	
	No.	%	No.	%
Camp-fires.....	977	18	710	15
Smokers.....	936	17	1,237	26
Settlers.....	841	15	364	8
Railways.....	315	6	723	15
Lightning.....	972	17	865	18
Industrial operations.....	150	3	173	4
Incendiary.....	330	6	117	3
Public works.....	50	1	14	0
Miscellaneous known.....	464	8	354	7
Unknown.....	498	9	204	4
Totals.....	5,533	100	4,761	100

TABLE IV

*Fire Season, 1945—Comparative Statement by Regions*

Region	Increase or Decrease in Relation to Average for Period 1935-44			Proceedings Under Fire Laws		Deaths
	Number of Fires	Area Burned, Acres	Cost Plus Damage	Prosecutions	Convictions	
			\$			
British Columbia..	+225	+ 39,135	+ 959,873	31	29	0
Alberta.....	- 46	- 445,945	- 827,628	58	49	0
Saskatchewan.....	-165	- 469,240	- 285,988	1	1	0
Manitoba.....	-202	- 228,033	- 167,016	0	0	0
Ontario.....	-288	- 254,567	- 499,968	15	13	0
Quebec.....	- 66	- 248,066	- 809,919	8	7	0
New Brunswick....	- 68	- 33,330	- 172,103	32	29	0
Nova Scotia.....	-109	- 8,809	- 21,330	12	12	0
Dominion Lands...	- 53	- 50,470	- 86,035	2	2	0
Canada.....	-772	-1,699,325	-1,910,114	159	142	0

## FOREST PRODUCTS LABORATORIES

In the early part of the year problems pertaining to the prosecution of the war demanded the greater part of the facilities of the Laboratories. However, with the termination of the war, heavy demands were made for technical assistance in the conversion of industry to a peace-time basis, the rehabilitation of public utilities on which little maintenance had been possible during the war, increased housing and industrial accommodation, and other related problems.

During the war, under the stress of circumstances, many new and unusual techniques were developed and applied in the utilization of timber, plywood, pulp, paper, and other products based on wood. Since the conclusion of the war, keen interest has been shown by industry in the possibilities of commercial application of these techniques to a peace-time economy. This has opened up a very wide and important field in forest products research. Particularly encouraging is the widespread interest among wood-using industries in the possibility of making better use of timber resources by the use of material previously entirely wasted or applied to very low-grade uses. These developments pertain to the fields of engineering, chemistry, and biology. They promise developments of outstanding industrial significance.

Following are brief references to some of the more important fields of research which have engaged the attention of the Laboratories.

## MAIN LABORATORIES—OTTAWA

## DIVISION OF TIMBER MECHANICS

A great deal of research was carried out by the Laboratories during the war with new types of adhesives for use in wooden aircraft, boats, landing barges, and pontoons. The manufacture of components for this equipment was carried out in furniture factories and other wood-working plants, with the result that interest was aroused in their application to peace-time industry. The Laboratories have co-operated with wood-using industries in the technical problems associated with the use of such adhesives, and particularly in investigating the suitability of the different types of adhesives for specific applications.

The Laboratories continued active co-operation with the Canadian Packaging Committee until it completed its work, and participated in conferences with respect to continuation of the work under different auspices, in connection with post-war trade. The Laboratories were made custodians of the codes and specifications prepared by the Committee, pending the setting up of a permanent organization to deal with packaging specifications and research.

Investigations were carried out on impact packaging materials of cellulose, excelsior, wool, hair, fibre, etc. An extensive investigation was carried out on the design of a case for shell eggs for export. Tests were carried out on the significance of moisture content of shooks for boxes, and it was shown that the use of green lumber reduces the strength of the box about 50 per cent.

There is a wide demand for telephone and power-line poles for rural electrification in Canada and the United States and for rehabilitation and extension of existing facilities. The Laboratories, on invitation of the American Standards Association, participated in conferences to establish specifications for



species of timber not previously used for such purpose. The Laboratories also conducted an extensive series of tests on jack pine poles affected with red-stain and red-rot, which greatly assisted in curtailing rejection of such poles and improving the supply situation. Attention was also given to progressive heart-rot in cedar poles in service twenty years.

In view of experience with war-time timber structures, considerable feeling has developed in the timber industry that existing specifications are too conservative with respect to factors of safety in timber construction. Considerable work was carried out on the re-analysis of existing test data in this regard. A conference of representatives of the United States and Canadian Laboratories was held to review data and to endeavour to find a common approach to this matter, since species used and conditions of use are so similar: agreement in this regard will also facilitate grading for export between the two countries.

In view of the present wide demand for railroad ties, careful consideration is being given by the railroad companies to the use of species previously used to a limited extent only, and to the acceptance where practicable of material formerly rejected under existing specifications. A good deal of work was carried out and advice given on request in this connection. Numerous spike-retention and strength tests were carried out on jack pine ties containing red-rot, which yielded results of considerable economic importance.

The extensive use of plywood and other laminated construction during the war has raised a number of technical problems. Laminated construction is found in a wide variety of uses, namely in aircraft, in exterior siding of houses, and in laminated keels for boats. Such construction must be shown by suitable tests to be capable of serving adequately over an extended period. A great deal of time was spent on investigations as a basis for establishing standards and methods of tests for specific uses. A wide variety of adhesives was dealt with under this investigation, for an adhesive suitable for one type of use may be entirely unsuitable in another application.

Work on the effect of temperature and humidity on exposed wooden aircraft, carried out since 1943 at Prince Albert and Ottawa stations, was completed during the year and a comprehensive report prepared. This was part of an integrated investigation carried out by arrangement of the Ministry of Aircraft Production in Great Britain, in the United States, India, Australia, South Africa, and Canada.

Hardwood flooring has been in very short supply for housing and industrial building. The Laboratories carried out considerable work on the practicability of bonding hardwood veneers to softwood backing for flooring strips and also for flooring panels. Some of the assemblies required a sub-flooring and others were of sufficient thickness to withstand full floor loads. Some of these show considerable promise of satisfactory application at reasonable cost. They permit also the possibility of using waste from veneer plants and fairly low-grade lumber. Considerable attention had to be given to the development of a method of testing these floorings which would be suitable and satisfactory to building authorities. This work is continuing.

In co-operation with the British Army Staff and the William Clapp Marine Laboratory of the United States, special panels were prepared on the Laboratories' plywood press, with the object of developing plywood for naval

craft such as wooden boats, scows, tugs and motor-boats, which would be resistant to attack by teredos and other marine organisms. Experiments included special treatment of the veneers and also the addition of certain materials in the glue lines. A good deal of success was attained and further work is planned with a view to simplifying procedure and reducing cost.

The Laboratories co-operated with a group of research workers in the University of Toronto in a study of adhesion. Considerable difference of opinion exists in this connection, and until more is known about adhesion it is difficult in many cases to supply a satisfactory answer as to why bonding fails under specific conditions.

At the request of the Logging Sleigh Committee of the Woodlands Section of the Canadian Pulp and Paper Association, tests were made upon beams and runners of solid and laminated wood to determine their relative strength. A scale model of a Ginsberg single-runner sleigh was built to illustrate the principles and advantages of this type of construction to lumbermen interested in sleigh development.

At the request of the Tool Committee of the Woodlands Section of the Canadian Pulp and Paper Association, tests were made to determine the degree of tension in saw-frames discarded as unusable in comparison with the tension in new frames, also comparative tension tests on steel and aluminum saw-frames. The investigation included also the re-tensioning of discarded frames.

#### DIVISION OF WOOD PRESERVATION

Work was continued on tests of preservatives used to protect wood products from decay and insect attack during shipment and storage overseas. Specifications for the treatment of this material were prepared for the Canadian Packaging Committee.

During the war, work was carried out on development of fire-retardant paints, and this method of protecting wood, particularly in houses, from ignition by small sources of heat and flame should receive more attention in the post-war period. An approval test for fire-retardant paints for use on government buildings was developed. Further use of fire-retardant paints will require general acceptance of an approved test for inclusion in city building codes.

The use of organic types of wood preservatives such as copper naphthenate and chlorinated phenols, with varying degrees of resistance to volatilization and leaching, is increasing. Laboratory tests were developed to provide information on the relative stability of these preservatives under the conditions of the test. The problem is still under study.

Work was continued on recording the service life of treated and untreated timber products in Canada in co-operation with industrial organizations and government departments. A total of 960 tests have been started to date, of which 750 are still active.

Studies of the average service life of groups of small jack pine posts cut at different seasons throughout the year, to determine the effect of time of cutting on durability, were completed. Each group was divided into two lots to determine the durability when: (a) handled with care by prompt removal and kiln-drying immediately after cutting, (b) carelessly handled by leaving the posts for some months in the bush after cutting.

## DIVISION OF WOOD CHEMISTRY

A small wood hydrolysis pilot plant has been installed and experimental work started. Douglas fir chips were first treated according to a standard Scholler procedure. Certain changes in the standard hydrolysis procedure are contemplated, with a view to increasing yields and concentrations of reducing sugars, following which completely different hydrolysis techniques will be tested.

In the hydrolysis of wood by the Scholler process, a lignin residue is obtained for which there is little use except as a fuel. Having in view the use of this residue in plastics, attempts were made to improve its flow properties. Spruce Scholler lignin was treated with nitric acid solutions to produce residues containing carboxyl groups, and these residues were then polymerized with glycerol: another series of experiments was undertaken in which this lignin was treated under pressure with various concentrations of sodium hydroxide, of sodium bisulphite, and of sodium hypochlorite. This problem will require further investigation.

The existing methods of wood hydrolysis make use of either (1) concentrated hydrochloric acid at room temperature, or (2) dilute sulphuric acid at high temperature. The former process (Bergius) has never been considered to be economically feasible in Canada. The dilute sulphuric acid process (Scholler) requires very expensive equipment, such as high-pressure autoclaves, and percolators, and a very large supply of sawdust or other wood waste at one centre.

The idea of hydrolyzing part of the wood in a flue-gas atmosphere under atmospheric pressure has been tried on a small laboratory scale. Further work is required in order to find out more about the economics of the process. The project was initiated with a view to determining the practicability of recovery of part of the theoretical yield of wood sugars with inexpensive equipment at plants where only limited supplies of waste wood are available.

About 10 to 15 per cent of the total volume of pulpwood consists of bark which is now either wasted or used as fuel. A project was undertaken to study the chemical compositions of various barks with a view to better utilization. The first bark investigated was that from Western red cedar. This was separated into inner and outer bark fractions, which were analysed for ash, one per cent alkali-soluble, water-soluble, alcohol-soluble, and for lignin and pentosan. These fractions were also pulped with various reagents in an attempt to determine the lignin and polysaccharide components present. As a preliminary to the laboratory study of bark, a literature review was made on this subject and a report prepared.

Owing to the wide interest shown in the methylolurea treatment of wood, these Laboratories undertook some experiments in this field. Yellow birch heartwood and sapwood samples were treated with dimethylolurea and urea according to a procedure recommended by a manufacturer of these chemicals. It was found that the heartwood absorbed only about 10 per cent of its weight of chemicals and its physical properties remained almost unchanged by the treatment. The sapwood on the other hand absorbed about 30 per cent of its weight of chemicals but only a few of its properties were affected. The hardness and strength in compression perpendicular to the grain were increased considerably, but the Izod impact strength was appreciably reduced.

Efforts to produce a hardboard of reasonable strength from wood waste have been continued. Many binding materials have been tried, some of which show promise. The greatest difficulty in the use of sawdust as a raw material

for this purpose is the high percentage of cut fibres. Shavings are more satisfactory in this respect. On account of the increasing requirements for building materials and the abundance of wood waste, this project will be continued.

Preliminary plans have been made to subject waste sulphite liquor and lignin solutions to the action of electrolysis. After considering the feasibility and potential merits of such an approach to this problem, plans were worked out, cells were designed, and the necessary equipment was ordered. The aim of the investigation is to produce valuable chemicals from lignin by cathodic hydrogenation and anodic oxidation. Other processes such as anodic chlorination and oxidation of sugars which might be present in the solutions will be investigated.

#### DIVISION OF TIMBER PHYSICS

In the investigation of chemical treatment of trees to prolong the period during which bark is readily removable, black spruce and poplar of pulpwood size, and white spruce of sawlog size were treated with various chemicals along the lines of previous experiments. It was noted that the effect of certain chemicals applied late in the natural peeling season (July) was that sawlogs of spruce would stand until felled in November without developing blue-stain and without being attacked by wood-borers.

While the very effective killing action of ammonium sulphamate on all trees tested was confirmed, it is planned to look for chemicals that not only have quick killing action on trees, but also have repellent action on wood-boring insects and prevent fungus stains in the wood of treated trees during the warm summer before felling. Material from trees killed by different chemicals was examined microscopically in order to note the structural characters that affect the ease of peeling. A general summary of work to date was prepared for discussion at the annual meeting of the Canadian Pulp and Paper Association.

In studying coatings of adhesive on wood, samples of glue joints broken in testing were examined microscopically. For joints which broke so near the adhesive layer that it is difficult to distinguish (by ordinary visual appraisal) the failure in the wood from that of the adhesive, it was found that the failures can be classified and measured as required with the aid of the compound microscope. Such classifications and microscopic measurements can be conveniently recorded on low-magnification photomicrographs of the fractured surfaces.

It is believed that the adaptation of microscopic observation to coatings on wood (in studies of adhesives and finishes) brings an important method of appraisal and analysis to the study of factors affecting the deterioration of such coats.

Views of the Canadian Standards Association's Sub-Committee on Loose Wood Fibre Insulation were presented by the Laboratories to the Canadian Electric Code Committee of the Canadian Standards Association with regard to providing standards for thermal insulation used in spaces of buildings in proximity to electric wiring.

New wording was adopted on the lines suggested to clarify the section of the Canadian Electric Code dealing with the subjects, and a committee was appointed to determine suitable standards to govern the use of thermal insulating materials to be used near electric wiring.

In connection with studies of variation in density and in structure of wood of rock elm and white elm, an attempt was made to find a more satisfactory method than is now commonly used for rapid identification of the wood of the true rock elm, *Ulmus Thomasi*, in order to distinguish it from dense wood of other species sometimes sold as rock elm. A method of identifying rock elm by visual examination has been checked against more precise observations with a low-power magnifier and with the microscope and found to be positive for distinguishing wood of rock elm from the common Canadian species of elm, *U. americana*, and *U. fulva*.

Samples of wood or wood materials in the form of manufactured articles, timber specimens, pulpwood chips, paper, sawdust, and wood flour have been examined and identified as to species, on request. In view of growing interest in the use of bark from pulpwood, an address was presented, by request, at a meeting of the Technical Section of the Canadian Pulp and Paper Association, describing the structure and physical properties of bark of various species.

Microscopic preparations of various domestic and foreign woods were added to the files. This includes material from trees killed by various chemicals, and material with special defects such as compression-wood, and, in the case of veneers, the manufacturing defect known as "loose-cutting" or "back-check".

#### DIVISION OF TIMBER PATHOLOGY

A laboratory study based on wood from white and rock elm trees was carried on to test the relative resistance to decay of the two species. A great range of variation was noted in the many samples tested. No correlation, however, was found between resistance to decay and specific gravity in either species, nor under the conditions of test did the material under study reveal any difference in the decay-resistance of the two species. As a field test and a check on the laboratory work, elm pickets were installed in a test plot. Their resistance to decay will be checked periodically over an extended period.

Eight wood-rotting fungi and many moulds and bacteria were isolated from the green elm. Their reactions on elm wood in culture will be studied.

Twenty creosoted jack pine ties containing red-stain were removed from an experimental track in which they had been in service seventeen years. The ties on the whole were in good condition. Analysis showed *Trametes pini* alive in one tie, but there was no evidence of the development of pocket rot in the ties. Secondary rot was present in some of the ties.

Nine fungi isolated from sections of green jack pine poles were inoculated into jack pine blocks in culture jars under aseptic conditions. These cultures are being held under observation to determine the effect of the fungi on the wood.

Fungi causing rot in posts in a test plot were isolated, and some were identified. Fungi were isolated from samples of timbers from a gold mine in northern Ontario, and advice was given as to methods of controlling decay. The rot in samples of wood from folding boats and pontoons sent in from British Columbia was identified. Advice was given in connection with four cases of dry rot which had developed in house timbers. The cause of decay in the ceiling of a cold room used for the storage of fish was determined, and recommendations were made for its eradication. The cause of bio-luminescence in an oak sample submitted was determined.

Three fungi were isolated from a section of brash cedar submitted for examination and their action on cedar is being investigated. A study of air-borne fungi from lumber-seasoning yards is being carried on. Other defects dealt with had to do with rot and stain in spruce, rot in mahogany, yellow stain in birch, mould on lumber and fabrics, and decay in red pine and birch.

Cultures of thirty wood-rotting fungi, representative of twenty-one species, were added to the reference collection.

#### DIVISION OF LUMBER SEASONING

The problem of obtaining properly seasoned lumber for both war-time and peace-time uses was still acute. In a number of instances it was impossible to obtain satisfactory lumber for pressing war-time and other requirements and the semi-commercial dry kilns of the Laboratories were operated on a custom basis.

Birch lumber was conditioned prior to treatment with dimethylolurea and also subsequent to such treatment in order to condition it to a suitable moisture content for physical and mechanical tests.

Plywood was conditioned in the Laboratories' dry kilns in connection with an investigation to determine the effect of high temperature on casein and cold-setting urea resin glues. This conditioning period was of ten weeks' duration.

Box shooks were conditioned to various moisture contents for an investigation to determine the comparative strength of shipping containers manufactured from green and from seasoned lumber. This investigation was requested by the Canadian Packaging Committee.

Moisture range determinations were made in connection with an investigation on the seasoning of large timbers by means of radio-frequency heating.

Assistance was rendered to a large number of small operators who either owned makeshift kilns or who requested information on kilns which might meet their requirements. Often it was not practicable, on account of cost, to suggest modern designs of kilns, but rather some alternative design which would meet requirements reasonably.

Information or service was supplied on the following subjects: dry kiln schedules and kiln operation; storage of veneer logs and the effect of extended periods of seasoning; drying of timber by radio-frequency and infra-red electric heating; the most effective methods of yard seasoning, and the effect of rate of air circulation in dry-kilns on the drying time of lumber.

#### MISCELLANEOUS

During the war, radio frequency dielectric heating was used in the wood-working industries in some countries as a versatile production procedure. Little use of this method of heating has been made in Canada, and it was decided that it warranted investigation. Accordingly, two radio-frequency generators were obtained, the larger of which has an output of 7.5 kilowatts and the smaller an output of 500 watts.

Work has been initiated on the preparation of a radio-frequency setup suitable for laboratory work, and a variety of electrode systems and associated ancillary equipment have been prepared as the necessary material became available.

After the initial installation work was completed, exploratory tests of a very broad nature were made on a number of potential applications relevant to the wood-using industries, including bonding of plywood, laminating of timbers,

lumber seasoning, and paper drying. These experiments suggested lines of investigations and test methods. Based on this work, a program of radio-frequency heating was prepared.

A representative of the Laboratories made an extensive tour of wood products companies in the eastern United States which are employing radio-frequency heating in the manufacture of their products, to obtain information on industrial techniques and research of interest to Canadian wood industries.

#### VANCOUVER LABORATORY

The Vancouver Branch of the Forest Products Laboratories is operated in co-operation with the University of British Columbia to provide local service to British Columbia lumber production and wood utilization industries, and to make available information on new and improved methods for the utilization of British Columbia woods.

#### DIVISION OF TIMBER MECHANICS

Standard testing was carried out on amabilis fir and on mountain hemlock from a logging area adjacent to Vancouver. Changing conditions within the logging and milling industries, the inclusion of second growth and timber from much higher altitudes, and marked variations noted in quality within a single species, indicate the necessity of establishing the basic properties of important commercial species on a more closely defined areal basis. A clearer definition of the range in properties is also desirable so that such values may be more closely related to the specific use to which timber is put. Work in these fields was initiated.

A study was completed to determine the effect of kiln seasoning upon the mechanical strength of Western hemlock of aircraft quality and to establish satisfactory drying schedules which would not damage the wood.

The Laboratory provided service to those who required specific information or tests relating to the glues which they were using and to new glues proposed for use. The work involved examination of glued joints, glued-up laminated construction and the manufacture of plywoods. In the early part of the year a large volume of testing was carried out for the Royal Canadian Air Force and manufacturers of aircraft.

An analysis of the results of tests on Douglas fir and Western hemlock structural timbers in the three merchantable grades defined by Export Grading Rule No. 1 of the British Columbia Lumber and Shingle Manufacturers' Association was well advanced. This investigation was carried out in close co-operation with the British Columbia Lumber and Shingle Manufacturers' Association and the Pacific Lumber Inspection Bureau. A great deal of analytical work was carried out with regard to the practicability of revising permissible design stresses presently incorporated in building codes and in standard specifications.

Tests were made on Western white birch plywood to determine the effect on the mould resistance of casein glues of treating the glue with a preservative toxic to mould organisms.

Assistance was extended to a local manufacturer of "improved wood" in studying the impregnation of local woods with dimethylolurea and its effect on the hardness and other properties of the wood for use in flooring, furniture, and other products.

The Laboratory co-operated with the University of British Columbia in an investigation of the impregnation of several species of wood with synthetic resins and of the effect of compressing the wood after impregnation and setting the resin by radio-frequency dielectric heating.

Several creosoted wood stave pipe sections of diameters from 12" to 60" were tested in accordance with American Society for Testing Materials specification C-13-447, using a sand-box loading.

The International Pacific Salmon Fisheries Commission was given assistance in planning tests to required specifications of all materials for use in the construction of a fish-way at Hell's Gate on the Fraser River.

A large number of mechanical and physical tests were carried out for the Forest Pathology Division of the British Columbia Forest Service.

On request of the Royal Canadian Engineers' Training Centre A-6, an inspection was made of folding wooden boats and wooden bridge pontoons to determine the suitability of conditions of storage and the serviceability of the structures.

#### DIVISION OF TIMBER PRODUCTS

Studies were continued on both hardwood and softwood lumber to determine the comparative moisture pick-up during storage of air-seasoned and kiln-dried stock. An investigation was made of the kiln-drying of broad-leaved maple and of checking during furniture manufacture and in use. The drying of red alder furniture stock in a natural circulation kiln was also studied.

Several hundred Douglas fir indicator sticks for the detection of fire hazard in the forests during the 1946 fire season were prepared, by a new technique developed in California, for the British Columbia Forest Service.

Seasoning with crystal urea of six large Douglas fir discs, approximately four feet in diameter, was undertaken in co-operation with the British Columbia Forest Service in order to provide display specimens for Fouad University, Cairo, Egypt.

A survey was made of all sawmills operating dry kilns in the southern coast area, to determine the extent of corrosion in metal parts so that, if warranted, a study might be carried out in co-operation with the Metals Research Division of the British Columbia Industrial and Scientific Research Council to devise methods for coping with the problem.

An investigation was commenced on the manufacture of sliced aircraft Sitka spruce veneer with a view to reduction of de-grade by finding the best way of conditioning fitches prior to slicing them into veneers.

Calorific determinations were carried out, at the request of Vancouver City and Dominion Government authorities, on certain types of briquetted sawdust and sawdust fuel to establish the heat value of poor quality or wet sawdust sometimes supplied for domestic heating.

Information was assembled for sawmills interested in the use of hydraulic barkers for logs. Samples of bark from floated logs barked by hand and by the hydraulic method were tested to establish the suitability of the waste bark for fuel under mill boilers.

A preliminary survey was made at a number of mills of different outputs to gain an understanding of the different milling practices now employed for logs of different diameters and grades. Two field studies were carried out, one on Engelmann spruce at a mill in the interior of the province, and one on the recovery of sound wood from defective logs milled at a northern Coast mill.



A project was initiated on logging waste with the object of studying, (1) the quality and quantity of material left in the woods after logging, (2) means of logging this material economically and (3) the best methods for manufacturing it into lumber.

For a large creosoting company, microscopic studies were made of sections of Western red cedar poles, in an effort to find the cause of thin and erratic sapwood penetration under full-length creosote treatment.

An investigation was made of Douglas fir lumber containing white-specked heart and intended for house sheathing or concrete forms, in order to advise shippers if this lumber was suitable for the purpose intended and if the decay-producing organism continued to grow in the manufactured product. Assistance was extended to a British Columbia lumber association regarding the extent to which various firm heart-stains such as brown-heart, purple-heart, and red-heart indicate incipient decay and whether firm heart-stain might be acceptable in building grades where strength is not a prime factor.

A study was undertaken on the use of ultra-violet radiation in the detection of incipient decay in Sitka spruce, primarily to determine the possibility of rapid detection in aircraft material of such decay, which might not be visible under ordinary conditions.

A great deal of interest was shown during the year in the possible development of an industry to use waste cedar, hemlock and true fir for the manufacture of insulation blanket and wall-board and information was assembled for several interested firms.

Assistance was extended to officials of the British Columbia Lumber and Shingle Manufacturers' Association in reviewing a proposed revision of popular bulletins on Douglas fir, Western hemlock, and red cedar prepared in 1930 by the Laboratory in co-operation with the British Columbia Forest Service.

#### PULP AND PAPER RESEARCH INSTITUTE OF CANADA, MONTREAL

August 1, 1945, saw the completion of the first five years and the renewal for the next five years of an agreement whereby the re-organized Institute will be operated with the support of the Dominion Government, the Canadian Pulp and Paper Association, and McGill University. The Montreal laboratory of the Forest Products Laboratories is a part of the Institute and is under the General Director who is responsible to the Joint Administrative Committee representing the three partners in the enterprise.

#### FUNDAMENTAL RESEARCH STUDIES

The synthesis of cellulose mono- and dinitrates, in which the nitrate groups were not distributed at random in the cellulose macromolecule, but occupied definitely known positions, was accomplished.

The oxidation of wood lignin by halogen-containing oxidants was studied. Pyrogallol and vanillin, representing different types of chemical structure present in lignins, were first treated. The oxidation of vanillin by sodium chlorite and by chlorine dioxide yielded results which seemed to show that they operate through different mechanisms.

In an attempt to isolate lignin from wood with as little change as possible, a technique was developed whereby extracted spruce wood was oxidized in such a way that the residual substance, named periodate lignin, retains much of the morphological structure of the wood.

Work has begun to determine the arrangement of hydroxyethyl groups in technical hydroxyethyl celluloses, which are finding use as textile finishes, by studying the tosylation-iodination reaction in the cellosolve series with the object of applying the information so gained to the desired research.

In order to fill a gap in the fundamental knowledge of high-pressure hydrogenation, the stepwise hydrogenation of vanillin over a catalyst was studied.

#### APPLIED RESEARCH STUDIES

The new optical instrument for measuring the printing smoothness of paper was found to be of considerable use, fulfilling the assumptions made in designing it and permitting results obtained from it, when expressed on a numerical basis, to be representative.

Considerable time was spent in studying air and oil permeability of newsprint. Oil permeability was not constant but varied with conditions in an anomalous way for which no satisfactory explanation has yet been found.

The critical examination of methods of analysing waste liquor was continued. Some modifications were tested and led to improvements in some of the methods, and further tests give promise of further improvements.

The method of measuring the surface area of a pulp by means of its permeability to water was studied. An apparatus was constructed for making a suitable test sheet of pulp. The water used must be free of air. It was found that permeability decreased with continued flow. This was similar to the effect of oil permeability in newsprint.

A study of alkaline pulping was begun with the idea of ascertaining the effects of varying conditions on the resulting pulp. It was found impossible to duplicate mill conditions, however, so the study was limited to finding the effect of liquor concentration on the yield and quality of the pulp produced. No definite conclusions were arrived at, but some interesting trends were indicated. The work is being continued.

As the result of experience in operating the miniature grinder which was designed at the Laboratory several years ago for the study of the technique of making mechanical pulp, several changes were introduced which increased its flexibility and facilitated the reproducibility of results. It is now better suited for the continuation of studies on grinding.

#### WOODLANDS RESEARCH

A partial study was made of the problem of attaining good restocking of spruce and balsam fir after cutting these trees in the forest. The study of the efficiency of present methods of driving pulpwood in rivers and streams in the spring of each year was completed.

#### TESTING

Testing work was carried out in connection with studies, involving pulp and paper products, being conducted by government departmental agencies and by committees of the Technical Section of the Canadian Pulp and Paper Association.

The usual amount of testing of samples and checking of instruments was done for the industry.

#### MAINTENANCE WORK

An opportunity was afforded during the past year of making a number of desirable changes and improvements in the semi-commercial equipment in the mill at the Institute. Replacements, renovations, and adjustments resulted in improved operation.

## WAR WORK

Until enemy resistance ceased, continued assistance was given to the Government, which involved the use of special equipment or of special qualifications of the staff.

## PUBLICATIONS OF THE LABORATORIES

Circular 61—Cause and prevention of decay in wooden buildings.

*Mimeograph*

- 105—Treated and untreated timbers. Complete service tests to date and notes regarding tests in progress.
- 106—The effect of slant-driving on the holding-power of nails.
- 107—A literature review of the chemical constituents of bark.
- 108—Wood hydrolysis at atmospheric pressure.
- 109—The use of Canadian hardwoods as substitutes for yellow locust for telephone and telegraph top-pins.
- V-100—The rusting of cans in wooden and fibreboard boxes.
- 112—The effect of high temperature on casein and cold-setting urea-formaldehyde glues.

## SURVEYS AND ENGINEERING BRANCH

J. M. WARDLE, DIRECTOR

During the year under review the various services of the Branch resumed the normal activities which had been discontinued or restricted during the war years, and were active in undertaking investigations, surveys, and works relative to the post-war program. The cessation of hostilities in Europe and the south Pacific during the fiscal year naturally affected all the operations of the branch, many of which are directly related to the development under normal conditions of the natural resources of Canada. Surveys and investigations were centred on Canada's northern areas in order that development of resources and orderly settlement might be expedited by accurate maps and improved transportation facilities.

The Dominion Observatory at Ottawa continued its Dominion-wide time service, and determination of accurate time and the transmission of time signals was maintained at a high state of efficiency. Special attention was paid to geophysical work, which is one of the important functions of the Observatory at Ottawa. Investigations were made of a site for the proposed geophysical station at Churchill, Manitoba, and studies were made of a suitable site for a similar station in Labrador or northeastern Quebec. The exact site of the latter station has not yet been chosen. Field observations for magnetic and gravity values were continued and very valuable information was obtained at northern stations. Forty-eight field stations were occupied for terrestrial magnetism data. Seismological work was continued with the full-time recording stations operating as usual. For the time being the rockburst studies which were being undertaken by the Seismological Division of the Observatory at Lake Shore Mines, Kirkland Lake, Ontario, were discontinued. Good progress was made in exploring different methods of measuring the stresses in rock in mine galleries, with the object of determining under what stress conditions rockbursts are the most likely to occur. Research and investigatory studies in the office will be continued.

At Victoria, the Dominion Astrophysical Observatory continued its research work, the latter being greatly benefited by the return to the staff of two of its senior scientists who had been in the Naval Service on scientific work. Observations with the 73-inch telescope were maintained at nearly normal efficiency although computing work has fallen behind owing to reduced staff. The 1945-46 season was a poor one from the standpoint of observations because of abnormal cloud conditions. Instrumental equipment was kept in good order and many minor repairs to telescopic and related equipment were undertaken. Research on radial velocity investigations of certain classes of stars was continued and a large amount of work done. In July, 1945, a senior member of the staff went with the Harvard College Observatory Eclipse Expedition to Bredenbury, Saskatchewan, to observe the total solar eclipse of July 9, 1945. Two new cameras were constructed at the Observatory for taking photographs but unfortunately clouds prevented the carrying out of an extensive program of spectrographic and photographic observations. On December 18, 1945, two senior officers obtained a very satisfactory photographic record of the eclipse of the moon, atmospheric conditions being ideal.

The Dominion Water and Power Bureau experienced an interesting and successful year, keeping in close touch with the general power situation across Canada in view of the allocation of blocks of power from war needs to those of

peace. It is interesting to note that in 1945, when the demands of war production were greatly reduced, the total power output was only slightly less than that of 1944. Canada's water-power development as at January 1, 1946, totalled 10,283,610 horse-power, or 20 per cent of the possible ultimate development. Having in view the future years, special attention was given to an enlarged water resources investigatory program. This includes hydrometric stations for measuring streams along the Alaska Highway in northern British Columbia and the Yukon Territory, which was begun in the previous year, and the undertaking of additional stream measurements in the Yellowknife area of the Northwest Territories. One hundred additional hydrometric stations were operated throughout Canada in the year under review. In the field of administration the important feature was the settlement of the long outstanding questions relating to the administration and operation of the hydro-electric power plants on the Bow River, Alberta. As these plants were located on or adjacent to the Stony Indian Reserve, the Dominion was vitally interested, as well as the Province of Alberta and the Calgary Power Company that built and operates the plants. It is a great satisfaction to report that agreement was reached on all points by the parties concerned, with the rights of the Indians being fully protected. In February, 1946, the Dominion Government decided to construct, through the Department of Mines and Resources, a power plant on the Snare River in the Yellowknife area, N.W.T., to provide power for the mining industry and other activities in the area. Preliminary studies of alternative developments were well along by the end of the fiscal year. The special investigations of the Columbia River watershed in British Columbia, being undertaken simultaneously with studies by the United States of the Columbia River Drainage Basin in that country, were continued. Special attention was given to hydraulic questions relating to power and irrigation.

Work undertaken during the fiscal year by the Engineering and Construction Service included surveys and investigations of roads, bridges, water and sewer projects and electric power installations in National Park areas and in Indian reserves. The maintenance of the Prince Rupert Highway, which had been completed in the autumn of 1944 as a national defence measure, was discontinued in April, 1945, and the Province of British Columbia, in which it is located, was invited to take over the highway and operate it as a provincial road. Japanese construction projects were continued on a reduced scale as the Japanese in various camps were transferred to other work, such as farming and the lumbering industry. The camps on the Hope-Princeton Highway project were closed down in September, 1945, leaving one large project still underway, namely, the Yellowhead-Blue River Highway in British Columbia. A large amount of work for the Indian Affairs Branch, including engineering inspections, repairs to buildings and plants, and the erection of new buildings was undertaken. The latter work was greatly hindered by shortages in competent man-power and building materials. An important location survey was completed during the autumn of 1945 of the Northwest Territories section of the Grimshaw-Great Slave Lake Highway. The provincial section of this road is being built on a joint basis by the Dominion and the Province of Alberta, while the Northwest Territories section is wholly a Dominion responsibility. It will provide an all-weather overland route from the railway station at Grimshaw to Lower Hay River Post on Great Slave Lake.

The Geodetic Service of Canada continued its major triangulation projects, there being three of these. One project was located on the north shore of the Gulf of St. Lawrence; a second project in Alberta between Jasper and Edmonton, and the third project along the Alaska Highway south and east of Whitehorse, Y.T. Smaller projects were carried out in several other areas. The Alberta project is particularly important since when completed it will close the triangulation net leading through central British Columbia to the Yellowhead Pass and through

Edmonton to the triangulation net in the south. An important office project was the triangulation adjustment of the major net encircling the Gulf of St. Lawrence and traversing Newfoundland. The total length of this large net is about 1,300 miles and the completion of the field-work marks the end of ten years of precise triangulation survey work. Very satisfactory closure results were obtained. Precise levelling, so necessary for vertical control for maps and for power development and other construction enterprises, was substantially increased during the year. This had fallen behind during the war years owing to the pressure of work necessary for the national effort. During the fiscal year 1945-46, 900 miles of precise levelling was added to the Canadian precise level system. In view of difficulties in securing technical staff and mechanical transport equipment, this mileage is most creditable. Parties were located on the Alaska Highway, in southern British Columbia on the Columbia River investigations, and on lines of the Canadian National Railways in Prince Edward Island. In the field of geodetic astronomy and isostasy a heavy program of fixations for latitude and longitude was successfully completed. Observations were completed at 62 points in northern Saskatchewan and Manitoba and the District of Keewatin. Special investigations and observations were also made at various points across Canada.

The International Boundary Commission continued its work, under statutory obligation, of maintaining the boundary lines between Canada and the United States and Canada and Alaska. The Boundary Commissioners for Canada and for the United States in regard to the Canada-United States boundary, made inspections of eastern boundaries in the autumn of 1945. Maintenance work was undertaken on the boundary between Maine and Quebec and in the Great Lakes area. A third party was engaged on maintenance work at the western end of the 49th Parallel in the Gulf of Georgia area, British Columbia.

The Hydrographic Service of Canada is responsible for hydrographic charts, sailing directions and tide tables, all of which are so essential in the interests of navigation. This Service which, during the war, had given first priority to all naval requirements, was able to resume some of its long-range survey program. This involved a re-planning of future hydrographic survey work, special attention being given to the need for charts of some of the northern waterways. In addition to large charting programs on the Pacific and Atlantic Coasts, a party was busy throughout the season in the Great Slave Lake and Mackenzie River area. This section of the northern water route is of great importance and some valuable hydrographic data were obtained. It is the intention of the Hydrographic Service to issue complete charts of the Slave River through Great Slave Lake and down the Mackenzie River to Aklavik. With the end of the war the Hydrographic Service was able to anticipate the return of two hydrographic ships requisitioned by the Navy, namely, the *Acadia* and the *Cartier*. Arrangements were made for the overhaul and renovation of the *Acadia*, but inspections by Hydrographic and Navy representatives showed that the *Cartier* could not economically be refitted for hydrographic survey work. Arrangements were made to obtain an unfinished minesweeper of suitable size and convert it for hydrographic purposes. Tidal and current surveys were continued and the standard publications giving this information were published. Volumes of "Pilots and Sailing Directions" were issued. These covered areas on both the Atlantic and Pacific Coasts. Various smaller projects were undertaken as required.

The Legal Surveys and Map Service continued its responsible work of producing and distributing general maps and air navigation charts covering Canadian territory. In addition legal surveys of Dominion areas were undertaken as required. During the year it was necessary to give consideration to the production of aeronautical charts for civilian aviation where a large expansion is anticipated. The deliberations of the Provisional International Civil Aviation

Organization (PICAO), which deals with world air navigation problems and mapping, are of particular interest to the Legal Surveys and Map Service. This organization decided in 1945 on the specifications for a world aeronautical chart series on a scale of 1:1,000,000. Work was continued on the issue of standard air charts on the 8-mile scale, to replace temporary charts that had been issued under pressure during the war. Drafting and related work necessary for the issue of the "Canada Air Pilot" and the "Pilot's Handbooks" were continued. While fewer individual map sheets were distributed during the year owing to the reduction of large single orders from the R.C.A.F., the number of individual orders for maps increased. A large field program was undertaken by this Service during the year. This included base line and meridian surveys in northern areas; the legal survey of the Alaska Highway; the marking of the British Columbia-Yukon Territory boundary, and major surveys of Indian reserves in Alberta and Ontario. Among various miscellaneous projects an important one was the surveying of a new townsite at Yellowknife, N.W.T., made necessary by the increased mining activity in that district. This Service also undertook field survey work in connection with the preparation of plans required for the Columbia River project. Plans of some detail are required in order that storage possibilities can be determined as well as the acreage of lands that might be flooded. The plotting of trimetrogon air photographs necessary for the issue of the standard 8-mile air navigation charts across Canada was continued and good progress made. Planimetry plotted from air photographs totalled 134,000 square miles, most of which is in northern areas. Shortage of experienced personnel in mapping work was encountered and it is hoped that in the succeeding year that this difficulty will be overcome.

Full details covering the work of the services outlined will be found in the section of this report dealing with the different services.

The Surveys and Engineering Branch undertakes its work with funds provided through its own votes, or by other branches of the Department of Mines and Resources or other Government branches where work done is particularly in their interests.

The following tables supply information on expenditures and revenues of the Branch for the fiscal year ended March 31, 1946:

STATEMENT OF EXPENDITURES FOR THE FISCAL YEAR, 1945-46

Regular Votes .....	\$1,322,693 83
Statutory Votes .....	790 00
War and Demobilization	
Post-War Reconstruction Program—Planning	
Branch Administration .....	611 99
Dominion Observatory, Ottawa.....	14,227 44
Dominion Water and Power Bureau.....	15,072 75
Engineering and Construction Service.....	133,372 56
Geodetic Service .....	158,303 83
Hydrographic Service .....	10,808 85
Legal Surveys and Map Service.....	65,193 30
Prince Rupert-Terrace-Cedarvale Highway.....	8,248 09
Japanese Nationals .....	262,206 62
Alaska Highway (Engineering and Construction Service).....	11,731 64
War Risk Zone Bonus.....	3,576 00
Legal Survey of Alaska Highway.....	15,706 82
Sundry Services .....	42,218 80
Preparation and Printing of Air Navigation Charts.....	6,948 57
	<hr/>
	\$2,071,711 09

Expenditures of moneys made available by other branches and departments as follows:

	Regular Votes	War and Demobilization	Trust Funds	Total
<i>To Engineering and Construction</i>				
<i>Service from:</i>				
Lands, Parks and Forests Branch..	\$ 17,057 95			\$ 17,057 95
Indian Affairs Branch.....	113,994 52		\$264 37	114,258 89
<i>To Dominion Water and Power</i>				
<i>Bureau from:</i>				
Dept. of External Affairs .....	89,519 85			89,519 85
Dept. of Fisheries .....	- 894 22			894 22
Dept. of Veterans Affairs .....	512 48			512 48
<i>To Legal Surveys and Map</i>				
<i>Service from:</i>				
Dept. of National Defence (Air) ..		\$ 4,228 47		4,228 47
<i>To Geodetic Service from:</i>				
Dept. of National Defence (Navy)		189 04		189 04
Grand Total .....				<u>\$2,298,371 99</u>

### DOMINION OBSERVATORIES

The Dominion Observatories at Ottawa and Victoria continued restricted research programs, with special attention to astronomical and geophysical problems directly connected with problems of the armed forces. From the close of the war, more intense investigation and application of such problems have developed in ionosphere and other studies relating to navigation, prospecting, and general living conditions.

#### DOMINION OBSERVATORY, OTTAWA

At the Dominion Observatory, Ottawa, considerable advance was made in refinement of time service control. Terrestrial magnetic research and field work, as well as gravimetric and magnetic field traverses, became much more prominent and extensive. Several staff members were appointed as members of geophysical committees.

Observing conditions remained below normal, due to solar and terrestrial atmospheric variations, which are of public interest in the solution of radio and other daily general service problems arising from solar and weather cycles.

Two papers were presented at the May, 1945, meeting of the Royal Society of Canada, one on gravimeter and magnetometer deduction of anomalies in the Maritimes, by A. H. Miller, and the second on industrial earthquake hazards in Eastern Canada, by E. A. Hodgson.

The Junior Astronomical Club held sixteen meetings. The nucleus for a library has been inaugurated with several books, pamphlets, and periodicals. The members gathered at the Observatory for the total eclipse of the moon in December. The Observatory was open to visitors each Saturday evening, and the equatorial telescope was made available when the sky was clear and a short typed description of the telescope distributed on request.

*Position Astronomy and Time Service.*—Observations on the program of stars selected from the Backlund-Hough list were continued, 612 observations being made for right ascension and declination, with 131 readings of instrumental constants. Observing was also depreciated by smoke from Observatory and neighbouring furnaces. The computations were kept up to date as well as was possible with reduced staff. G. E. Woolsey, who was appointed temporarily to the staff in January, has taken part in both observing and computing.



Progress was made towards finishing a list of over 3,000 stars observed from 1912 to 1923.

In the latter part of the year, observations for time were increased in order to provide a closer check on primary clock rates. Computations were made on the mornings following time observations for early correction of the time-signal clocks, which control all mean time circuits, including those for the various time signals and for minute and seconds dials, synchronizing circuits for master clocks in Government buildings throughout the city, circuits to chronographs and seismograph shutters, also the automatic signals transmitted daily to Canadian railway systems.

There are now four sidereal standard pendulum clocks, 3 Riefler, and one Shortt; and two mean time Primary Frequency Standards, one of these being on loan from the Department of Transport.

Comparisons between the various clocks at the time of the observations permit the errors of each clock to be determined. Graphs are kept of these results and by extrapolation errors are predicted.

Some interruptions have occurred due to the slave clock not synchronizing with the free pendulum. Another Shortt clock would be a big asset at such times.

Time signals were sent continuously by wire to the Canadian Broadcasting Corporation, National Research Laboratories, the Monitoring Station of the Department of Transport and Naval Headquarters, Ottawa, for relay to Halifax twice daily and broadcast over CFH to ships in the Atlantic. Wireless time signals were also broadcast through the Canadian Broadcasting Corporation chain daily; over the Department of Transport Station VAA (11990 kc.) for a five-minute period daily except Sundays and holidays, with special signals for survey parties from June to October. (VAA, 8330 kc.), continuously from 7 p.m. to 5 a.m. E.S.T.; and signals to Canadian National Railways broadcast by the Department of Transport from station VAP, Churchill.

Foreign signals were received daily from WWV and NSS on receivers located at 50 Perth Street, Ottawa, tuned to WWV, NSS, etc., connected to the Observatory by telephone line and operated by a selector switch. Reception times were compared and computed as for 10 p.m. E.S.T. for daily correction of primary clock S-29, and comparisons were exchanged with co-operating observatories.

Tube relays continued in experimental use wherever possible. Better temperature controls have been installed in the clock vaults, and a clock device was constructed to keep a visual record of the controls. Experimental work was done with a photo-tube as a pick-up device for seconds, and also for impulsing a pendulum.

The 750 electrically driven clocks in Government buildings in Ottawa, synchronized from the Observatory, were maintained. Observatory clocks, watches, and other timing mechanisms were kept in repair and overhauled for other Government offices.

Tables of sunrise, sunset, moonrise, moonset, phases of the moon, and eclipses were supplied as in other years. The times of beginning, ending, and maximum phase of the total eclipse of the sun on July 9, were computed for Winnipeg and distributed on request. Similar eclipse data at an elevation of 200 kilometres, for Churohill, Victoria Beach, Prince Rupert, Ottawa, and St. Johns, Newfoundland, were supplied, on request, to the Canadian Radio Wave Propagation Committee. Altitude and azimuth of the sun for each hour of the day, at maximum and minimum declination, were also supplied on request.

*Terrestrial Magnetism.*—Forty-eight field stations were occupied, twenty-five repeat and twenty-three new stations, distributed as follows: Prince Edward Island 1, Nova Scotia 2, New Brunswick 1, Quebec 8, Ontario 7, Manitoba 5, Saskatchewan 2, and Northwest Territories 22. Six hundred declination observations, made by officers of the technical services of the Surveys and Engineering

Branch on map control field operations, and by officers of the Topographical Section of the Mines and Geology Branch, were computed, and corrections for daily variation and disturbance were applied. These observations continue to furnish valuable data relative to deducing daily variation and disturbance in northern latitudes.

Field magnetometers and dip circles were compared with the Ottawa B station standards. Thirteen compasses and compass attachments were standardized for other services. Four Pioneer magnetometers, used in the aircraft supporting Exercise Musk-Ox, were standardized and calibrated for the Royal Canadian Air Force.

An aerial magnetic-gravity survey of Northern Canada was inaugurated, and eight magnetic stations were established. Two observers were attached to Exercise Musk Ox. One observer accompanied the ground party and occupied seventeen magnetic stations distributed between Churchill, Denmark Bay, and Great Bear Lake. One observer occupied Baker Lake as the base magnetic station during the exercise. Special programs of magnetic observations were undertaken at the time of the total solar eclipse in July, at Churchill, Manitoba, in conjunction with the Naval Service ionosphere observatory.

The magnetic observatories at Agincourt, Ontario, and Meanook, Alberta, continued to provide continuous photographic records of the magnetic elements; the recording variometers were recalibrated; preliminary computations of records were completed to the end of 1945; computations of final results were continued, and preparation of reports for publication was commenced.

Tables of geomagnetic activity were prepared and supplied to the Magnetic Section of the International Union of Geodesy and Geophysics.

A site was selected for the proposed magnetic observatory at Churchill, Manitoba.

Photostats of observatory magnetograms were supplied to the United States Department of Mines and to the Royal Air Force for use in reduction of the results obtained on the north polar flights of the *Aries*.

Numerous magnetic data were supplied to the various Departments, and to surveyors on request.

*Seismology.*—The teleseismic seismographs were maintained in continuous operation at Victoria, Saskatoon, Ottawa, Seven Falls, and Halifax, and in addition short-period instruments were operated at Ottawa, Shawinigan Falls, and Seven Falls. A second Milne-Shaw seismograph was installed in December at the Saskatoon station in the University of Saskatchewan.

The continuous records of the several stations registered 412 earthquakes. All major shocks were reported to the press and to Science Service at Washington, D.C. Local shocks were reported regularly to Weston for inclusion in the Bulletin of the Northeastern Seismological Association. Monthly bulletins were exchanged with active seismic stations throughout the world. Reports on the records and operation of the two Quebec stations were prepared each month for officials of the co-operating agencies. The Bibliography of Seismology was continued as a semi-yearly publication.

Rockburst research was continued at Lake Shore Mines to the end of October, and the record material arranged for reference.

*Gravity.*—Five hundred and sixty-two stations were observed in southern Ontario, Quebec, and the Maritime Provinces with the gravimeter obtained in 1944 on loan from the American Geophysical Union. Nearly 1,100 stations have been established in Canada with this instrument and a fairly complete regional gravimetric survey has now been completed in the area covered by the observatories. Bouguer anomalies for all the previous seasons' surveys and for about one-half of last season's have been computed and plotted on 8-mile sheets. Definite relations were found to exist between the anomalies and the geological

formations. Most remarkable are the large negative anomalies associated with granite batholiths in the Maritimes. The Caledonia Mountain region of New Brunswick and the Copequid Mountains of Nova Scotia are both areas of positive anomaly. There is reason to believe that these results will assist in the interpretation of geophysical surveys undertaken for locating minerals in that part of the country.

Longitudes and latitudes were scaled from maps for 217 gravimeter stations, and Bouguer anomalies computed. Anomalies for 128 stations were plotted on the Fredericton-Moncton, the Halifax-Louisburg, and the Yarmouth-Windsor 8-mile sheets. The anomaly contours, based on these and several hundred stations observed previously, were projected on the above three maps.

Computations have not advanced sufficiently to form conclusions regarding most of the observations in Quebec and Ontario, but certain definite trends are indicated, which are no doubt related to the geology.

Eight gravity stations were established with the pendulum apparatus in northwestern Canada between the Mackenzie River and Hudson Bay as far north as latitude  $69^{\circ}$ . Results of such observations in high latitudes are of particular value because of their application to the derivation of a formula for gravity over the surface of the earth and because of their use in the determination of the precise form of the figure of the earth.

*Solar Physics.*—Several abnormally large sunspot groups in the rapidly rising cycle produced marked electromagnetic and meteorological disturbances. Increased appreciation, during war years, of the extreme importance of the sunspot cycle influence accounts for a remarkable increase in the number of requests received concerning sunspot activity and its bearing on animal and plant life, and various atmospheric and other astronomical and terrestrial research problems. Among these, involving much investigation of recent sunspot numbers, was one relating to the 3.8 year cycle in lemmings and their predators, which at the Matamek Conference on Cycles in 1931, was suggested as probably related to the similar period found by the Lockyers in solar prominences and barometric pressures.

The 1911, 1912, and 1913 solar rotation results, which were used to establish the new Ottawa Law of Solar Rotation (angular rotation as approximately proportional to the cube root of the distance from the axis of rotation), were tabulated for publication. The range of values found in these and other determinations are accounted for by convection in the pores.

Observations of solar rotation, centre, and iodine in 1914 indicate that solar pores have a convective system similar to that in sunspots, in accordance with the 35-year old Ottawa Pore Theory. This conception of pores explains satisfactorily the limb effect in solar wave-lengths.

*Publications, Reports, and Bulletins.*—Two numbers of the regular series of Publications of the Dominion Observatory were issued: Vol. XIII, Bibliography of Seismology, Nos. 16 and 17. Monthly reports on the magnetic character of the day in connection with international co-operative research on terrestrial magnetism were sent to the Department of Terrestrial Magnetism, Carnegie Institution, Washington, D.C., the acting Agency for the International Association. The following bulletins, pamphlets, and brochures were distributed: Wireless Time Signals (monthly); Seismological Bulletin (monthly); North-eastern Seismological Bulletin (Nos. 126 to 142, and 171 to 181); The Rockburst Research at Lake Shore Mines (Nos. 13 and 14); Dominion Observatory Reprints: No. 39, Rockburst Research at Lake Shore Mines; and No. 40, Industrial Earthquake Hazards in Eastern Canada. Numerous questions were as usual answered by special pamphlets and correspondence, relative to local, standard, and daylight saving time, time zones, sunspot cycle influences, and general astronomy and geophysics. Short articles, and popular notes, were written or edited for publication, including several for the "Sky Facts" column of *The Ottawa Citizen*.

## DOMINION ASTROPHYSICAL OBSERVATORY, VICTORIA, B.C.

During the first half of the year contributions to the war effort were continued. Dr. R. M. Petrie and Dr. Andrew McKellar were on loan to the National Research Council and seconded to the Directorate of Operational Research, Royal Canadian Navy. The former was stationed at Halifax and Newfoundland and the latter at Naval Headquarters, Ottawa. Both made valuable contributions to the anti-submarine warfare in the Atlantic. Dr. C. S. Beals continued his civil defence work as Provincial Gas Officer. A daily time service was maintained for the convenience of the R.C.A.F. and R.A.F. units at the Patricia Bay Airfield.

*Visitors to the Observatory.*—From April to September the majority of visitors were members of the armed forces from the Royal Naval College and the Esquimalt Naval Base, R.A.F. personnel from the Patricia Bay Empire Training Plan, and troops from Esquimalt Fortress, but with the lifting of restrictions on gasoline the number of visitors steadily increased. About 16,000 visited the Observatory, as compared with 5,500 and 3,000 the two preceding years. The two-hour period for public observation on Saturday evenings, discontinued in 1940, was resumed in September, with an average attendance of 75.

*Observing Statistics.*—While the computational work of the Observatory has been greatly retarded due to a reduced staff, the observations with the 73-inch telescope were maintained at nearly normal efficiency. The past year has been one of the poorest in the history of the Observatory for telescopic observations, due to abnormally cloudy skies both day and night. The dome was opened on 148 nights, and 1,037 spectrograms were secured in 877 observing hours. This is approximately 28 per cent less than the 27-year average of 196 nights and 1,209 observing hours.

*Instrumental Equipment.*—The instrument maker carried out a thorough overhaul of the 145-ton dome, and effected many minor repairs to the telescopic and seismographic equipment. Additions to the workshop included a 20-inch milling machine and a 24- by 36-inch surface plate. The intensitometer was altered to make possible the deriving of rectified line profiles without computation. Five logarithmic curves etched on glass were prepared, which permit five intensity curves to be derived from an initial curve giving the intensities on a logarithmic scale. The use of the etched curves in place of those drawn in pencil on ground glass has greatly improved the optics of the instrument, resulting in increased speed and accuracy. A new projection machine was devised by Dr. Petrie which promises to eliminate a great deal of labour involved in measuring spectrograms for radial velocity. The spectrogram is projected on a screen upon which are ruled the comparison lines and the zero-velocity of the stellar lines. The measuring of the comparison spectrum and the subsequent reduction are almost entirely eliminated by mechanical and optical means. Tests show that no important systematic errors are introduced and that precision of measurement is unaffected. The time required to measure and reduce a spectrogram is cut to approximately one-half.

*Spectroscopic and Spectrophotometric Research.*—*Radial Velocity Investigations:* The observation of the Class B stars fainter than 7.5 magnitude and north of declination  $+20^\circ$  was continued, the Cygnus, Cepheus and Taurus regions being especially observed. In order to study the distribution of velocities perpendicular to the galactic plane, a new program of some 250 AO to F5 stars, of magnitudes brighter than 9.5 at the north galactic pole, was compiled. During the last season some 130 spectra of these stars were secured. *Radial Velocity Standards:* A re-examination of wave-length standards has been in progress for some time and new tables of accurate velocity standards have been determined by Dr. Petrie for spectral types F5 to K5 for high dispersion (11 A/mm. at H $\gamma$ )

and moderate dispersion (30/mm. at  $H\gamma$ ). High dispersion wave-lengths rest upon 88 spectrograms and reproduce the solar system and standard stellar velocities within 0.1 km/sec. Those for moderate dispersion are based upon 85 spectrograms and give a mean residual from the standard system of 0.3 km/sec. The wave-lengths are free from personal equation and instrumental errors, and this work which will be extended to other spectral types henceforth will form the basis of the Victoria radial velocity system. *Spectrographic Binaries*: Professor Keeping computed the orbital elements of the massive Wolf-Rayet eclipsing binary star H.D.193576. This interesting system consists of a W6 star of temperature  $80,000^\circ\text{K}$  surrounded by an expanding envelope of hydrogen and helium, and a normal absorption of O6 star of temperature  $40,000^\circ\text{K}$  revolving in a circular orbit in a period of 4.21 days. The radial velocities were determined by micrometer measurements of 55 microphotograms. Considering the complex character of the spectrum, in which wide emission lines of the W6 star are associated with the normal O6 absorption spectrum, more trustworthy radial velocities were obtained by measuring the microphotograms giving a 20-fold enlargement of the spectrum. The elements of the orbit were calculated by least-squares solutions and the dimensions of the system deduced. The masses are large, the Wolf-Rayet star being  $30.8\odot$ , and the O-type star  $17.3\odot$ . This research provides the best determination so far available of the mass of a Wolf-Rayet star, and it is certain that this method of determining radial velocities from microphotograms, used in this case for the first time, will be employed in future studies of similar systems. *H.D.228911*: A new massive binary system was recently discovered by Dr. Pearce. Twenty-one single-prism spectrograms of the 9th magnitude star H.D. 228911 in the constellation of Cygnus were secured in ninety days, and the orbital elements determined by least-squares. The minimum masses are large for stars of spectral type B3, being  $7.2\odot$  and  $6.3\odot$ . The system will furnish two additional important points for the determination of the upper portion of the mass-luminosity curve. *Spectrophotometric Studies of the P-Cygni Stars*: An extended study of all the P-Cygni stars observable at Victoria has been brought close to completion by Dr. Beals. The material consists in part of tables of radial velocity and equivalent widths and in part of profiles of P-Cygni lines. Four fundamental types of profiles have been recognized as typical of these objects, and numerous variations of these fundamental types have been observed. The interpretation of profile types represents the main problem in the study of these stars. Many of the stars exhibit variability in light, or spectrum, or both. The spectrum variability affects the positions, forms and intensities of the lines. Its origin is mysterious, and thus far no satisfactory explanation of its cause has been forthcoming. Both the peculiar profiles of these stars and their variability point to some lack of equilibrium in the output of energy. It is probable that a complete explanation of these phenomena would shed valuable light on the general problem of the sources of stellar energy. While the P-Cygni stars range in type from Class O to Class F, in the late Class B stars a helium spectrum associated with sharp lines of ionized metals is most frequent. All the stars have been reclassified and their absolute magnitudes obtained. *Solar-type Stars*: A comprehensive study of 1,000 line intensities in the spectrum of Alpha Persei was carried out by Dr. Wright. Using the highest dispersion plates available covering the region  $\lambda 3700-6750$ , curves of growth were constructed for each atom, and it was found that those for ionized atoms lay above those for neutral atoms. The observations were interpreted to indicate greater turbulence among the ionized atoms. As the pressures and temperatures for the neutral atoms were greater than for ionized atoms, it is suggested that the atmosphere of this supergiant star is stratified, the mean position of the ionized atoms lying above that of the neutral atoms. Line intensities in the spectra of the sun, Gamma Cygni, Alpha Persei and Alpha Canis Minoris were studied. The intensities of 800 atomic lines were analysed using solar  $f$ -values and

the theory of the curves of growth combined with Saha's ionization theory. Excitation temperatures, turbulent velocities, electron pressures, and the relative abundance of twenty elements have been determined. It is found that the composition of these stellar atmospheres is remarkably uniform and very similar to that of the sun itself. *N-Type Stars*: Dr. McKellar continued his studies of the red giant stars of spectral type N, the observational material comprising 150 spectrograms of 35 stars being essentially complete. The primary object of the study is to measure the relative intensities of the 1.0 main  $C^{12}C^{12}$  and isotopic  $C^{12}C^{13}$  and  $C^{13}C^{13}$  bands of the swan system at  $\lambda\lambda 4737, 4744,$  and  $4752$  respectively. Measurements of the wave-lengths of a number of bands, as yet unidentified, have been made. These absorption bands, degraded to the red, occur most intensely in the spectrum of RY Draconis, the main band heads having wave-lengths  $\lambda\lambda 4540$  (strong),  $4639$  (very strong),  $4866$  (strong), and  $4976$  (very strong). Certain frequency differences point to a common origin for all the bands which have apparently not yet been produced in the laboratory, and so remain unidentified.

*Solar and Lunar Eclipses, 1945.*—Dr. Beals was a member of the Harvard College Observatory Eclipse Expedition to Bredenbury, Sask., to observe the total solar eclipse of July 9, 1945. Two new cameras were constructed for this eclipse, (a) one by Dr. Wright for taking direct photographs of the corona, and (b) one by Dr. Beals for taking Kodachrome motion pictures. For the latter instrument, a 3-inch Moffit f3 lens was used as an objective, combined with a commercial 16-mm. motion picture camera, mounted upon the equatorial mounting of a 4-inch Mogy refractor. Unfortunately clouds prevented the carrying out of the ambitious program of spectrographic and photographic observations planned by Dr. Menzel and his associates. The total eclipse of the moon which was observed at Victoria on the evening of December 18 under ideal atmospheric conditions presented an opportunity for testing the motion picture camera. The camera was mounted on the tube of the 73-inch reflector. Some 3,500 exposures were made on 85 feet of Kodachrome colour film—400 exposures of the moon during total phase and 3,100 as the moon was leaving the umbra. Dr. Beals operated the camera, Dr. Petrie did the guiding with the 6-inch finder, and Dr. McKellar the timing and recording. All pictures were in good form, and a satisfactory record of the eclipse was obtained. The colour of the totally eclipsed moon was a deep red, somewhat darker than the average colour, but probably normal for mid-winter eclipses.

*Seismographs.*—Under the supervision of Dr. Wright, the two photographically registering Milne-Shaw seismographs were maintained. Approximately 50 earthquakes were recorded; epicentres were computed for a few severe shocks, and details announced to the press.

*Publications, Papers and Addresses.*—Five articles were published in scientific journals, and six technical papers presented before scientific societies. Seventeen illustrated addresses on astronomy were delivered to audiences in Vancouver and Victoria. Two numbers of a new series of publications entitled "Contributions from the Dominion Astrophysical Observatory" were prepared for publication.

## DOMINION WATER AND POWER BUREAU

With the ending of the war in Europe comparatively early in the year and of the war in Asia about three months later, the process of reconversion began and many war contracts were scaled down or terminated. In spite of this there was no sudden suspension of industry, at least in so far as the consumption of electrical energy would indicate, and the 1945 production of energy by central electric stations was only slightly less than in 1944.

The development of new water-power enterprises to supply power for the war effort was very great between 1939 and 1943, when new installations aggregating about two million horse-power came into production. This new production proved sufficient for all immediate purposes and no new project of substantial size was recorded in 1945. The only additional installation was a new 19,000-h.p. unit to the Alexander plant on the Nipigon River of the Hydro-Electric Power Commission of Ontario.

In anticipation of post-war activities, which will push outward the present limits of settlement, and to provide for the water and power necessary for the exploitation of other natural resources, a program of enlarged water resource investigation was initiated. Taking advantage of the Alaska Highway, a number of hydrometric stations have been established on the now accessible streams of northern British Columbia and the Yukon Territory, while the flow of a number of rivers in or within transmission distance of the Yellowknife area of the Northwest Territories is being regularly measured. The number of hydrometric stations in Canada as a whole shows an increase during the year of over one hundred, and nearly 3,000 individual flow measurements were made. A further increase may be anticipated as qualified engineering staff becomes available.

### WATER AND POWER

*Lake of the Woods Regulation.*—During the year the run-off throughout the Lake of the Woods watershed was above normal and reached flood proportions in the month of April. Above normal run-off was experienced throughout the winter months. Lake level rose from elevation 1,060·94 on April 1, 1945 to elevation 1,061·0 on April 3, at which point the regulation became subject to the approval of the International Lake of the Woods Control Board. The control facilities were so operated that lake level crested at elevation 1,061·50 on April 28, was brought down to elevation 1,061·0 on May 31 and to elevation 1,060·7 on June 16. The level was again permitted to rise and reached elevation 1,061·0 on July 15. It crested at elevation 1,061·16 on July 26 and fell below elevation 1,061·0 again on August 5. The level was steadily drawn down to elevation 1,059·50 by March 18 after which due to an early break-up, the run-off increased materially and lake level rose to elevation 1,060·03 on March 31, 1946.

*Lac Seul Regulation.*—The actual regulation of Lac Seul continued to be carried on by the Hydro-Electric Power Commission of Ontario acting in co-operation with the Lake of the Woods Control Board. The run-off during the year was slightly above normal but did not reach flood proportions. Lake level rose from elevation 1,167·83 on March 1, 1945 to elevation 1,170·79 on September 28 and was drawn down to elevation 1,166·85 on March 27, after which due to the early break-up it rose to elevation 1,166·92 on March 31, 1946.

*Snow Survey.*—The eighteenth annual snow survey in the Lake of the Woods and Lac Seul watershed was carried out during the first week of March in co-operation with the United States Engineer Office at Duluth, Minnesota, and the Hydro-Electric Power Commission of Ontario. The results show that the water content of the snow on the ground at the time of the survey was well above the average for the 18-year period.

### WATER POWER ADMINISTRATION

Following the transfer of natural resources within the Province of Alberta in 1930, a difference of opinion arose between the Dominion and the Province as to their respective interests under the terms of the Alberta Natural Resources Transfer Agreement, in three developed power sites on the Bow River operated by the Calgary Power Company, complicated by the fact that these sites lie either within or adjacent to the Stony Indian Reserve. The Dominion, relying

on a series of opinions furnished by the Department of Justice, claimed that the major interest and the duty of administration remained with Canada as trustees for the Indians, and only those parts of the developments lying outside the Indian Reserve had passed to provincial control. The Province claimed that, while the Indians were entitled to receive their appropriate share of the revenue arising from the developments, the power sites themselves had passed to the Province as part of the interest of the Crown in the waters and water powers within the Province under the North-west Irrigation Act, 1898 and the Dominion Water Power Act.

The question was settled by an agreement between the Governments of Canada and Alberta made on September 25, 1945 which amended the transfer agreement to the extent necessary to give effect to its terms. Under this agreement, the lowest site at the confluence of the Ghost and Bow Rivers and where the greater part of the power works lie outside the reserve, will pass to the Province as soon as the final licence is issued; the Horseshoe site about 18 miles upstream and wholly within the reserve remains with the Dominion and so also does the Kananaskis site at the western boundary of the reserve where the main power works lie inside the reserve. Under the financial provisions, power rental from the Ghost site will be divided equally between the Province and the Stony Band of Indians; all revenue from the Horseshoe site will go to the Indians and the power rental at Kananaskis will be divided between the Indians and the Province in proportion to the developed head inside and outside the reserve.

The agreement also provides for final licences for all three developments to be issued by the Minister of Mines and Resources, the terms of which have been prepared and accepted by the three interested parties. Under these licences, the power rentals to be paid by the Calgary Power Company are substantially increased, so that the future revenue to the Indians will exceed \$17,000 per annum in place of the present annual payments of \$6,600. In addition there will be back payments amounting to about \$106,600. This agreement has been confirmed by concurrent legislation and took effect on April 1, 1946.

The three power developments on the Bow River benefit from storage in Lake Minnewanka made available through the combined storage and power development in Banff National Park, which is also operated under licence by the Calgary Power Company. All four plants continued to produce power to the full extent of the water supply. Output for the past two calendar years was as follows:—

Calendar Years	Cascade	Kananaskis	Horseshoe	Ghost
1944.....kw. hrs.	53,351,070	66,308,300	77,216,900	128,898,300
1945.....kw. hrs.	44,471,200	65,204,700	73,751,500	127,086,200

In connection with the Lake Minnewanka development, a good deal of minor work was carried out. This included sealing leaks in the power canal by sluicing into it about 30,000 cubic yards of clay; at other points the canal was deepened by dragline, the diversion canal from Ghost River was further improved and a channel was excavated from the spillway to the old Cascade River bed; settlements in the power canal berm were built up; and between January and March about three miles of the south shore of the lake was partially cleared, leaving about two miles of heavy clearing still to be done on the south shore. Comparative level and storage figures for Lake Minnewanka during the past two years are as follows:—

Year	Low Level	Date	High Level	Date
1944.....	4804.98	May 5	4831.98	October 24
1945.....	4805.80	May 3	4836.50	October 23



*Usable storage in acre-feet—*

October 24, 1944	March 31, 1945	October 23, 1945	March 31, 1946
134,500	18,667	160,137	41,514

The power development on the Yellowknife River operated by the Consolidated Mining and Smelting Company of Canada Limited, having an installed capacity of 4,700 horse-power, produced 17,181,300 kw. hrs. of electricity during 1945 as compared with 16,356,400 kw. hrs. in 1944, showing a slight increase in activity among the gold mines served by this development.

## SNARE RIVER POWER PROJECT

As an essential means of expediting the economic development of the Northwest Territories, including the expansion of the mining industry in that area, an Order in Council was passed on February 15, 1946, on the joint recommendation of the Minister of Mines and Resources and the Minister of Reconstruction and Supply, authorizing the Minister of Mines and Resources to secure an engineering report on the desirability of developing power in the Snare River Drainage Basin, west of the townsite of Yellowknife, where preliminary investigations indicate the possibility of an initial development of 8,000 horse-power and the possibility of additional stages of development which may afford a total capacity of approximately 25,000 horse-power.

In the event that a favourable report is received, the Order in Council authorizes the Minister to arrange for the immediate construction by the Crown of the initial development for the supply of power to mining companies and other users, to make an agreement with Giant Yellowknife Gold Mines Limited for the construction by that company of the main transmission line from the power-house to the company's mine and for its use by other prospective users.

The Montreal Engineering Company Limited has been retained as consulting engineers to prepare the preliminary report and action is being taken so that, in the event of a favourable report being received, the fullest possible use may be made of the coming open water season.

## TECHNICAL ASSISTANCE TO INDIAN AFFAIRS BRANCH

In furtherance of applications filed under the British Columbia Water Act for the right to use water on Indian reserves in the Province, three conditional water licences were obtained, one each in the Cowichan, Lytton, and Stikine Agencies for irrigation, and one for domestic purposes in the Cowichan Agency. Six final licences for irrigation were issued in the Lytton Agency. Two applications were made for new irrigation licences to serve reserves in the Nicola Agency and one for domestic purpose in the Williams Lake Agency. In connection with conditional licences which require completion of works by December 31, 1945, representations were made to the provincial Comptroller of Water Rights for extensions of time in necessary cases with satisfactory results. At the request of the Indian Commissioner for the Province, protests were filed against the granting of some new applications which, if granted, would reduce the Indians' share of water or cause flooding of Indian land by the construction of new dams. Relations with the provincial water administration continue to be very satisfactory.

## THE WATER-POWER RESOURCES OF CANADA

Canada's water-power resources are estimated at 25,516,400 h.p. under conditions of ordinary minimum flow, with 39,833,000 h.p. ordinarily available for six months of the year, providing for a commercial installation of some 51,780,000 h.p. During 1945 there was only one large installation of 19,000 h.p.

This addition, together with a re-analysis of developed water-power in Ontario, established Canada's total water-power development at January 1, 1946, as at 10,283,610 h.p. This is slightly less than 20 per cent of the possible development.

#### CENSUS OF THE CENTRAL ELECTRIC STATION INDUSTRY

The central electric station industry installation is over 90 per cent of Canada's total water-power installation and produces more than 97½ per cent of all electricity sold for use in Canada or for export. Hydro-electricity produced during 1945 totalled 39,161,567,000 kilowatt hours which was slightly less than that for 1944.

#### DOMINION HYDROMETRIC SERVICE

The Dominion Water and Power Bureau carries on the work of securing and compiling stream measurement records throughout Canada under co-operative arrangements with the various provinces. During the fiscal year the work was expanded in northern British Columbia and the Yukon, contiguous to the Alaska Highway, and in southern Ontario.

*Run-off Conditions in Canada.*—The run-off for the year was variable throughout Canada and on the average slightly below normal. Above normal run-off was recorded in northern Saskatchewan, southeastern Manitoba and southern Ontario, southern Quebec, and throughout New Brunswick and Nova Scotia. No new maximum or minimum rate of run-off was recorded.

In the Pacific drainage, typical stations showed a range in run-off from 72 per cent of the long term mean in the Bridge River in central British Columbia to 82 per cent of the long term mean in the Campbell River in the coastal area. In the Arctic and Western Hudson Bay drainage, typical stations showed a range in run-off from 68 per cent of the long term mean in the Assiniboine River at Headingly, Manitoba, to 190 per cent of the long term mean in the Red River at Emerson, Manitoba. In the St. Lawrence and Southern Hudson Bay drainage, typical stations showed a range in run-off from 92 per cent of the long term mean in the Missinaibi River at Mattice, Ontario, to 141 per cent of the long term mean in the Saugeen River at Port Elgin, Ontario. In the Atlantic drainage typical stations showed a range in run-off from 111 per cent of the long term mean in the St. Mary River at Stillwater in eastern Nova Scotia to 141 per cent of the long term mean in the LaHave River in southwestern Nova Scotia.

#### POWER AND SPECIAL INVESTIGATIONS

Special investigations undertaken during the year were concerned chiefly with problems arising on international waters or on streams which cross the International Boundary.

In British Columbia, field investigations, begun by the Bureau in 1944 in connection with the Columbia River Reference now before the International Joint Commission, were continued in the Canadian part of the basin, in accordance with a program planned by the International Columbia River Engineering Board appointed by the Commission. Investigations specifically undertaken by the Bureau included installation of gauges and metering stations on the Columbia and its principal tributaries, observation of groundwater conditions in the Kootenay Flats area, reconnaissance of potential storage areas on the Lardeau, Duncan, and Upper Kootenay Rivers, and preliminary investigations of potential dam sites. Important hydraulic investigations were continued with respect to the effect of the regulation of Kootenay Lake in the interest of power development upon reclaimed bottomlands in the Kootenay Flats area of British Columbia and Idaho; backwater effects on the Columbia and Pend d'Oreille Rivers in

Canada from the operation of the Grand Coulee development in the State of Washington, and similar effects, existing or in prospect, on Okanagan and Skagit River from works or obstructions in United States territory; and the supply of water from Phillips Creek for irrigation purposes in British Columbia and Montana. Hydraulic investigations were virtually completed for a Dominion-Provincial Joint Board of Engineers in connection with flood control studies on Okanagan Lake and River. Other engineering studies were undertaken for various Federal Departments and for other branches of this Department including hydrometric data on Vancouver Island streams for the Pacific Biological Station; irrigation problems of the Department of Agriculture at Kamloops; a major problem of the Department of Public Works involving the development and maintenance of permanent ship channels in the Fraser River from Fraser Mills to the sea, and administrative problems of the Lands, Parks and Forests Branch of this Department on various reserves and properties, including the construction of monuments for the Historic Sites and Monuments Board.

In the Northwest Territories a reconnaissance was made of power possibilities on the Snare, Emile, Marian and Lockhart Rivers and permanent gauging stations were established on the Snare and Lockhart Rivers.

In Alberta and southwestern Saskatchewan, extensive studies were again made in the Milk and St. Mary Rivers basins for the purpose of determining the natural flow of the St. Mary and Frenchman Rivers at the point where each stream crosses the International Boundary. The twenty-fourth Annual International Snow Survey on the Upper St. Mary River in Glacier National Park was conducted on May 3 and 4, 1945, in co-operation with the United States Geological Survey; and on March 28 and 29, 1946 the Tenth Annual Bow River Snow Survey was made in the vicinity of Lake Louise, Alberta. Special investigations were again made of ice conditions on the Bow River in the vicinity of Calgary where ice jams caused serious flooding in November 1943. In co-operation with the Calgary Power Company, studies were continued of water storage and power possibilities on the upper reaches of the Bow River and its tributaries. A complaint regarding the use being made of the waters of Sage Creek in southeastern Alberta caused the matter to be referred to the International Joint Commission and special attention was given to conditions on the creek during the 1946 spring run-off period.

In southeastern Saskatchewan and Manitoba continued attention was directed to flow conditions throughout the Souris River watershed in connection with the reference now before the International Joint Commission concerning the apportionment of the water supply of the watershed.

In Ontario special investigations in co-operation with the Hydro-Electric Power Commission of Ontario were continued in rating the discharge of the channel diverting water from the Ogoki River towards Lake Superior. Snow surveys were again made for the Commission during February and March, 1946, in the watersheds of the Wanapitei, Sturgeon, South, Muskoka and Madawaska Rivers. Special hydraulic studies were continued in the Niagara River above the falls to determine the effect upon water levels in the river and at various power intakes of the construction of a submerged weir jointly undertaken by the Governments of Canada and the United States for improving war-time power production from power plants on both sides of the river and also scenic conditions at the falls. Special attention was given to the selection and establishment of seventeen gauging stations on streams in southern Ontario at the request of the Provincial Department of Planning and Development.

In Quebec the securing of special hydraulic data was continued on the Richelieu and Magog Rivers in connection with international problems and co-operation was afforded various power organizations in checking power station ratings.

In New Brunswick an inspection was made of the international reach of the St. Croix River and a report was prepared for the International St. Croix River Board of Control covering conditions in 1945. Investigations of the Petitcodiac Tidal Power Project for the Governments of the Dominion and of New Brunswick were completed by H. G. Acres and Company, Consulting Engineers, Niagara Falls, Ontario, and the Company submitted its report in November 1945.

In Nova Scotia, at the request of the Premier of the Province, an investigation was made and a report was submitted on repairs to a large marshland dyke near Port Williams. The canal and headworks of a power development on the St. Croix River were investigated with a view to securing improvements in water supply.

*Glacier Investigations.*—During the year a study was initiated of the relationship of glaciers to the water supplies originating in the high mountain areas of British Columbia and Alberta. Following a reconnaissance, a number of the most easily accessible and representative glaciers in the Rocky Mountains and in the Selkirk and Coast Ranges were selected for investigation. Reference points were established from which annual observations may be made of the changes which occur in future years.

Members of the Scientific Section of the Canadian Alpine Club have been recording the recession and movement of glaciers since the beginning of the century. In some cases it has been possible to relocate bench marks previously established by members of this Club and thus provide a more or less continuous record of the recession which has been taking place in particular cases for the past fifty years.

#### INTERNATIONAL WATERWAY MATTERS

Reference has been made in the preceding paragraphs to some of the work of an international character performed by the Bureau during the year. In addition, the collection of hydrometric records in connection with numerous other international problems has been continued.

Special mention should be made of the extensive studies which are being conducted for the International Joint Commission in the Columbia River basin. The Bureau has been actively engaged in the investigatory work looking to the solution of the water problems of domestic water supply and sanitation, navigation, water power, flood control, irrigation, reclamation of wet lands, conservation of fish and wildlife, and other beneficial purposes involved in the studies of the International Columbia River Engineering Board of which the Controller is a member for Canada. Through the medium of the staff of the Bureau and arrangements made with the Hydrographic and Map Service, the Geodetic Service of Canada, the Department of Public Works, and the Royal Canadian Air Force, an extensive program of hydrometric work, levelling, and mapping, pertinent to these problems, was advanced during the year.

The collection of hydrometric records in connection with the international problem of the Roseau River and its tributaries was continued.

The International Rainy Lake Board of Control, of which an engineer of the Bureau is the Canadian Member, held two meetings during the year and reported further to the International Joint Commission.

An engineer of the Bureau continued as a member of the engineering sub-committee charged with the responsibility of designing and supervising the construction of the submerged weir in the Niagara River above the falls, jointly undertaken by the Governments of Canada and the United States.

The International Boards of Control which functioned during the year were those relating to Columbia River, Kootenay Lake, St. Mary and Milk Rivers, Souris River, Rainy Lake, Lake of the Woods, Prairie Portage, Lake Superior, Niagara, Massena, Lake Champlain, and St. Croix River.

## REVENUE

During the year the various provinces contributed \$35,568 in support of co-operative water-resource studies; \$98,298.13 was received from the Province of Manitoba in connection with capital and operating costs of Lake of the Woods storages as provided in the Natural Resources Transfer Agreement; \$11,853.75 was the revenue secured from water-power licences, while the sale of publications and miscellaneous revenue brought the total revenue to \$146,048.57. Revenue to the extent of \$3,500 was also received in connection with water-power development on the Bow River on behalf of the Indians of the reserve and was remitted to the Indian Affairs Branch.

## PUBLICATIONS

During the year Water Resources Paper No. 88, Surface Water Supply of Arctic and Western Hudson Bay Drainage in British Columbia, Alberta, Saskatchewan, Manitoba, the Northwest Territories and Western Ontario from October 1, 1939 to September 30, 1941, was published. The annual mimeographed bulletins on "Hydro-Electric Progress in Canada" and "Water Power Resources of Canada" were issued as usual.

## ENGINEERING AND CONSTRUCTION SERVICE

During the period under review, the Engineering and Construction Service continued to function as a general engineering agency of the Department. In addition, the Service undertook engineering and architectural work for other departments of the Government, or acted in an advisory capacity as called upon. Its work included the organization and supervision of construction and maintenance operations for the larger projects, as well as investigations, preparation of plans, estimates, specifications, and designs for such activities. For numerous small projects, inspections and investigations were made, supervision was exercised, and reports and technical advice were supplied as might be required by various Government agencies.

In connection with war-time activities, technical officers have been loaned for temporary work and others seconded for required periods or for the duration.

Continuing from the previous year work in connection with the provision for post-war emergency employment on worthwhile projects which will contribute to the development and welfare of the country, survey parties were employed in obtaining information on the improvement and reconstruction of existing highways, water supply and sewage disposal systems and on highway bridge sites in the National Parks. A staff of architects was engaged in preparing plans, specifications, and estimates in connection with a post-war building program. A summary of work done is given later in this report.

With the approval of the War Committee of the Cabinet, an engineer of the Engineering and Construction Service was stationed on the Alaska Highway early in 1944 to observe and report on all phases of reconstruction and maintenance work carried on by the United States authorities. In June, 1944, a second engineer was also stationed on the highway, after which date observation work was divided between the two officers. Following the taking over of the highway by the Department of National Defence, it is proposed to continue the duties of these engineers so that information on this subject will be available in the event of a change being made in the highway administrative authority.

On the Prince Rupert Highway, maintenance operations were carried on up to the middle of April, 1945, after which date these functions were taken over by the Province of British Columbia.

Pursuant to the policy adopted early in 1942 to provide employment for persons of the Japanese race who were evacuated from restricted areas on the west coast of British Columbia, highway construction camps were operated north of Blue River, B.C., and between Hope and Princeton, B.C. In September, 1945, following the decision to consolidate remaining Japanese on one project, the Hope-Princeton Highway camps were closed out and such Japanese as were willing were transferred to the Blue River camps, the remainder being absorbed by the B.C. Security Commission. A summary of work done is given later in this report.

Major items of work undertaken under the supervision of the Engineering and Construction Service during the period under review are given as follows:

## FOR INDIAN AFFAIRS BRANCH

### BRITISH COLUMBIA

#### LYTTON AGENCY

*Fountain I.R. No. 3 and Siska I.R.'s Nos. 3 and 8*—Improvements to irrigation systems were completed.

*Yale I.R. No. 1*.—Water supply from Yale Creek was investigated and a report prepared.

*Seton Lake I.R. No. 1*.—Following an investigation of water conditions at the Indian Day School at Shalalth, a water supply system was constructed.

#### KAMLOOPS AGENCY

*Kamloops I.R. No. 1*—Work on the irrigation system from Paul Creek was completed.

*Niskonlith I.R. No. 1 and Adams Lake I.R.'s Nos. 4 and 4A*—Following an inspection of and report on the dam and works the wood flume at the intake was replaced with a metal flume.

*Ashcroft I.R. No. 4*—A water supply system was constructed for this reserve.

#### NASS-SKEENA AGENCY

*Kulkayu I.R. No. 4*—A report was prepared on the possibilities of water supply and hydro-electric power for the Indian Villages.

*Metlakatla Indian Village*.—An inspection and report was made of the water supply system serving the village.

*Kitkatla I.R. No. 1*.—A report was prepared covering proposals for a water supply.

*Miller Bay Hospital*.—Alterations to main hospital building were completed, consisting chiefly of changes in partitions, new doors, insulation of refrigeration rooms, changes in plumbing, lighting, and heat systems, and the construction of a building to house the electric standby plant.

A new power transmission line was constructed to the Hospital and the approach road graded and gravelled.

#### BELLA COOLA AGENCY

*Bella Coola Village*.—A report was prepared dealing with the condition of the waterworks system and suggested necessary improvements.

## NICOLA AGENCY

*Lower Nicola I.R.'s. Nos. 1, 9 and 10.*—Irrigation systems were inspected at these reserves and estimates of extensions and repairs made.

*Coldwater I.R. No. 1.*—The irrigation system was inspected and an estimate prepared covering repairs and extensions.

## OKANAGAN AGENCY

*Osoyoos I.R. No. 1.*—Progress was made in connection with the rehabilitation of the irrigation system on this reserve, the work including the construction of a new diversion weir.

## NEW WESTMINSTER AGENCY

*Coqualeetza Hospital.*—Following an inspection and report, a contract was let and re-roofing and tile kitchen floors completed. Improvements to sewage disposal system were made.

*Matsqui I.R. No. 1.*—A survey was made of drainage lines on the reserve and new drainage ditch constructed through the lower section of the reserve which was found to operate satisfactorily during flood periods.

*Pemberton I.R. No. 1.*—Water supply system was constructed.

## WEST COAST AGENCY

*Alberni Residential School.*—Repairs were made to the water main.

*Seshart I.R.*—An inspection was made of the outlet of McCoy Lake followed by a survey of the lake drainage.

## KOOTENAY AGENCY

*St. Eugene Residential School.*—An inspection was made of the pipeline supplying water to determine the cause of a leak in the basement.

*Columbia I.R. No. 3.*—A survey was made of the irrigation ditch to the intake on Tatley Creek.

## WILLIAMS LAKE AGENCY

*Canim Lake I.R. No. 1.*—An inspection was made of the abandoned flume at Canim Lake.

*Dog Creek I.R. Nos. 11 and 2.*—An inspection and reports were made of Dog Creek flume and the proposed partnership ditch. A draft agreement with the Diamond S Ranch Company was drawn up.

## COWICHAN AGENCY

*Chemainus I.R. No. 10.*—An inspection of erosion caused by a log jam in the Chemainus River was made. Conversations with Victoria Lumber Company's representatives were held looking to a settlement of damages caused on the reserve, but a final decision was not reached.

## VANCOUVER AGENCY

*Squamish I.R. No. 1.*—A survey was made looking to a satisfactory solution of the sewage disposal problem on this reserve, which is surrounded by the City of North Vancouver. Plans and report were prepared.

*Siammon I.R. No. 1.*—An investigation was made of the water supply system. Necessary surveys were undertaken and plans and report prepared.

*Chekwelep I.R. No. 26.*—Arrangements regarding necessary easements for the domestic supply pipeline across private lands were put under way.

## ALBERTA

## SADDLE LAKE AGENCY

*Saddle Lake I.R.*—An investigation and report were made of water supply conditions on this reserve.

## PEIGAN AGENCY

*Blood Indian Residential School.*—Following an investigation of conditions in the school basement a survey was made and drainage line constructed to protect foundations and footings.

*Stockman's Residence.*—A report was prepared on suggested improvements to the plumbing and drainage systems.

## EDMONTON AGENCY

*Edmonton Residential School.*—Drawings and specifications were prepared covering repairs to the roof and cornice, and repairs done by contract.

## SASKATCHEWAN

## ONION LAKE AGENCY

Work on the installation of a water supply was started in the autumn but owing to severe weather had to be closed down before completion; the intake dam being 85 per cent complete, and trenching about 50 per cent.

## QU'APPELLE AGENCY

*Residential School Lebret.*—An inspection was made relative to repairs required to the water supply intake.

## TOUCHWOOD AGENCY

*Gordon Residential School.*—The water supply was investigated, report prepared and the Indian Agent instructed to undertake improvements.

## FILE HILLS AGENCY

Specifications were prepared for a new power plant for the Agency Buildings.

## MANITOBA

## BRANDON RESIDENTIAL SCHOOL

An inspection of the high pressure boiler was made, and report prepared covering its replacement. An inspection was made of the water supply at the institution, the supply pump was repaired, the system was checked up and adjustments were made.

## BIRTLE RESIDENTIAL SCHOOL

An inspection was made of the water supply system, roof and interior finish, and report prepared.



## THE PAS INDIAN AGENCY

*Existing Hospital, The Pas Airport.*—Layouts of present buildings on the whole site were prepared with detailed layouts of existing hospital accommodation.

## FISHER RIVER AGENCY

*Office Building.*—Specifications were prepared for a new hot-air furnace.

*Agency Buildings.*—Investigations were put under way regarding the existing water and electrical systems.

## PORTAGE LA PRAIRIE AGENCY

*Little Saskatchewan Reserve.*—Arrangements were made to have a well drilled for the Nurses' Home. A contour survey was made of the site for the Home. Drawings and specifications were adapted for site conditions.

## NORWAY HOUSE AGENCY

*Norway House Residential School.*—An inspection was made of the foundation conditions at the above institution and a report prepared covering remedial measures recommended to be undertaken.

## ONTARIO

## TYENDINAGA AGENCY

Plans and specifications were prepared for a timber bridge over Mud Creek.

## PELICAN LAKE RESIDENTIAL SCHOOL

A survey was made and road and highway bridge were constructed to connect with Sioux Lookout-Hudson Road.

## SIX NATIONS SUPERINTENDENCY

Plans, specifications, and two calls for tenders were prepared and issued for R.C.M.P. barracks building.

## FORT FRANCES RESIDENTIAL SCHOOL

An investigation was made of the water supply intake and report prepared.

## CECILIA JEFFERY RESIDENTIAL SCHOOL

A new steam boiler was installed.

## WALPOLE ISLAND AGENCY

A study was made of the proposed Chematogen Bridge, and tentative design prepared.

## QUEBEC

## ABITIBI AGENCY

Plans were prepared for alterations to the Agent's residence and office, and work in this connection was completed by contract.

Blueprints and specifications were prepared for a typical nursing station at Fort George.

## ST. REGIS INDIAN AGENCY

A report was prepared following an investigation of the sewage disposal system. An inspection was made of existing roads on the reserve and a report prepared covering suggested improvements and possible ferry extensions.

## LORETTE INDIAN VILLAGE

An inspection was made of the village water supply distributing system, and materials purchased for replacement of existing pipelines.

## MARITIMES

## ESKASONI AGENCY

Drawings and specifications were completed for buildings of the Agency development scheme. Tenders were called and Agent's residence, office and warehouse, and principal's residence were constructed. A water supply system was designed for the development area and some progress made in its construction. Difficulty in securing materials forced the closing down of operations for the winter. However, order has been placed for piping and pumping materials required.

An investigation was made of the possibilities of constructing a dam in the Eskasoni River to assist in logging operations, and report prepared.

An investigation was made in connection with the proposal to move and remodel the clerk's residence.

## SHUBENACADIE AGENCY

The day school at this location was completed. Drawings and specifications were prepared for four Agency buildings, and tender calls issued. A survey was made for a water supply system from springs and a system designed.

An inspection was made of the water supply system at the Shubenacadie Residential School, a report was prepared and tenders are being called for on materials.

Drawings and specifications were prepared covering repairs to the roof of the residential school. Work in this connection was carried out by contract.

## FOR NATIONAL PARKS BUREAU

## BANFF PARK

## LAKE MINNEWANKA DEVELOPMENT

An engineer continued acting as Departmental representative in connection with the development of Lake Minnewanka by the Calgary Power Company.

## BUILDINGS.

A storage and warehouse was constructed for the Engineering and Construction Service at Banff.

## BANFF WATER SUPPLY

Water metering devices were placed in Forty Mile Creek and inspected periodically. The question of chlorination was investigated.

## JASPER PARK

## BUILDINGS

Plans were prepared for an attendant's residence at the Fish Hatchery.

## KOOTENAY PARK

## BRIDGES

The east abutment was completed and reinforced concrete slab and parapet walls were constructed for the bridge at Mile 5.2 Sinclair Creek. The old timber structure at this location was dismantled. Cement finish was completed on the parapet walls of the bridge at Mile 3.1.

## YOHO PARK

## BRIDGES

Steel girders were erected and prepared for the concrete slab floor of the bridge over the Kicking Horse River near Leancoil. Work was closed down before completion owing to weather and labour conditions.

## ELK ISLAND PARK

## BRIDGES

Investigations were made of alternative crossings from the mainland to Elk Island in Astotin Lake, and a report was prepared.

## WATERTON LAKES PARK

## BUILDINGS

Alternative sketches were prepared for a proposed apartment house. A sketch plan was drafted for a bungalow residence.

## ST. LAWRENCE ISLANDS PARK

## BUILDINGS

A bill of materials was prepared for a bathhouse at Stovin Island.

## FORT BEAUSEJOUR HISTORIC PARK

## BUILDINGS

Work was continued on the preparation of working drawings for an extension to the Museum Building.

## MISCELLANEOUS

## BUILDINGS

Working drawings were prepared for an addition to the porch of the caretaker's residence, Fort Wellington.

Sketches were prepared for typical meat dressing plants for Banff, Jasper and Riding Mountain Parks, with estimates of cost.

Revised designs were prepared for typical stone monuments for Historic Sites.

## POST-WAR REHABILITATION

## FOR LANDS, PARKS AND FORESTS BRANCH

## SURVEYS AND INVESTIGATIONS

*Banff Park.*—A stadia reconnaissance traverse was run for a ten-mile secondary road to Ptarmigan Valley. Plans and estimates were completed. Reconnaissance lines totalling some thirty miles were run on the route of the proposed Banff to Mt. Assiniboine Road. Preliminary location surveys, revisions,

and bridge surveys were made on eighty-three miles of the section of the Banff-Jasper Highway in Banff Park in connection with preparing the road for paving.

*Jasper Park.*—A transit survey was made of a scenic highway, six miles long, from Jasper Townsite to Lac Beauvert and around the golf course, including one bridge site survey.

The Edith Cavell Highway, eight and one-half miles, was surveyed in preparation for paving.

A survey of the Miette Hot Springs Road, eleven miles, including four bridge sites, was made preparatory to improving for paving.

Surveys of the Jasper Park section of the Banff-Jasper Highway were completed, a total of forty-seven miles of line being run. Six bridge sites were surveyed. This work is preparatory to paving.

A survey was made of the fourteen-mile road from Jasper Lodge to Maligne Canyon and Medicine Lake, preparatory to improving and widening.

A reconnaissance was made for a possible high line route on the road from Jasper to Yellowhead. A survey was made of the existing road between these points with a view to having the road prepared for paving. Six bridge sites were surveyed.

A preliminary transit survey was made around Pyramid Lake, four and one-half miles, and a final transit line was run from Jasper to the lake, four and three-quarter miles.

*Waterton Lakes Park.*—A transit survey, 7.4 miles, was completed on the main entrance road preliminary to paving.

The Akamina Road, from Waterton Townsite to the interprovincial boundary, 10.1 miles, was surveyed with a view to widening and improving the road.

A transit survey for a new road was carried out from Red Rock Canyon on Bauerman Brook to Twin Lakes, six miles.

A transit survey was run between the Akamina Road and Bauerman Brook road via Crandell Lake, two miles, for a new road.

A site at the Narrows of Waterton Lakes was surveyed in connection with the proposal to construct a pony bridge.

*Northwest Territories.*—A transit survey was made of the section of the Grimshaw-Great Slave Lake Road north of the Alberta boundary. Plans, profiles and estimates of cost were prepared.

#### BUILDINGS

Studies were made and preliminary drawings prepared for a new Administration Building, Jasper Park.

Plans and estimates of cost were prepared for a new stores building and repair shop, Kootenay Park.

Sketches were prepared for a new R.C.M.P. Barracks; for a permanent work camp bunkhouse, and for a proposed new Administration Building at Riding Mountain Park.

#### FOR INDIAN AFFAIRS BRANCH

Sketches were prepared for the proposed nurses' residence, Coqualeetza Hospital, Sardis, B.C.

Preliminary sketches and estimates of cost were prepared for a nurses' residence, Fort Qu'Appelle Hospital, Saskatchewan.

Preliminary studies were made of hospital accommodation requirements at Moose Factory, Ontario.

Preliminary sketches were prepared for a new 12-room senior school and for a teachers' residence at Caughnawaga, Quebec.

## JAPANESE PROJECTS

During the period under review Japanese workers were employed on two projects as follows:

*Hope-Princeton Project.*—Operations were concentrated in bringing sections of the road to standard width, working from camps at both Hope and Princeton ends. Work was carried on from the Hope end widening in miles 9 to 12, drilling and blasting in miles 15 to 16, and clearing and grubbing in mile 17; from the Princeton end power shovels widened the road, miles 17 to 30, power grader and bulldozers operated between miles 9 and 26 and clearing was done in mile 31. In order to concentrate the remaining Japanese on one project, arrangements were made in September, 1945, to close down the entire Hope-Princeton work, with the Japanese still on the project transferred to the Blue River-Yellowhead project or turned over to the B.C. Security Commission. Such items of equipment on loan from the Province as were not required elsewhere were returned to the Province. Camp buildings owned by the Dominion Government were turned over to the War Assets Corporation for disposal. The maximum number of Japanese on this project during the period was 118.

The total quantities of work done on this project from its inception in 1942 until the closing down of operations were: Clearing, 379.33 acres; grubbing, 132.90 acres; solid rock excavation, 138,488 cubic yards; other material excavated, 984,228 cubic yards; round logs in drainage structures, 48,135 linear feet; sawn timber, 40,922 M.ft.b.m.; iron and steel, 2,825 pounds; surfacing, 36,912 cubic yards.

*Yellowhead-Blue River Project.*—Two camps were operated during the period under review north of Blue River, B.C. Work consisted in widening and straightening the road between Red Sands and Thunder River, building two bridges, clearing on right of way, removing slides, constructing ditches and culverts and clearing and burning debris and windfall.

The maximum number of Japanese employed during the period on this project was 126, after transfer of 53 individuals from the Hope-Princeton Project.

## GEODETIC SERVICE OF CANADA

During the fiscal year the Geodetic Service of Canada carried on its basic function of providing horizontal and vertical control in various areas from the Atlantic to the Pacific and as far north as the Arctic Islands. With the cessation of hostilities post-war planning projects provided the incentive for practically all geodetic operations during the fiscal year. In the main, 1945 operations were concerned with control for such important projects as aerial photography in the extreme north, precise levels for large hydro-electric planning in British Columbia, horizontal control for important large mineralized areas and International Boundary areas in eastern Quebec, as well as the extension of basic control of various kinds commenced in previous years where the need has become apparent.

As in previous years the Geodetic Service has endeavoured, in laying out a portion of its program of work, to anticipate future requirements for control so that it would be available when required, as well as to supply data for immediate needs. For example, control for prospective surveys of the boundary between Quebec and Labrador, as well as the anticipated needs for control in the important mineralized areas in eastern Quebec, have been met by triangulation nets extended from the Gulf of St. Lawrence northward along the St. Augustine, Natashquan, and Moisie Rivers. This policy has paid good dividends in numerous instances where it has been feasible.

## TRIANGULATION

Major triangulation operations were carried on in three areas during the fiscal year, namely, north of the Gulf of St. Lawrence, in Alberta west of Edmonton, and along the Alaska Highway south and east of Whitehorse in Yukon. Smaller jobs were carried out in other areas. Despite delays in delivery of motor transport which caused a late start for the western parties, lack of suitable aeroplanes in the St. Lawrence areas, and the paucity of experienced personnel on all parties, fair progress was made. Details of these operations follow:—

## GULF OF ST. LAWRENCE

During 1945 primary and secondary triangulation in their various stages—reconnaissance, station preparation and angle measurement—were carried on in three areas northward from the Gulf of St. Lawrence, namely, along the St. Augustine River, the Natashquan River, and in the Moisie River watershed. In addition to the provision of control points all along the nets for provincial and other surveys, all three operations have one common aim, the provision of control points to the Labrador-Quebec boundary area, so that when the survey of this boundary is undertaken accurate geodetic locations will be available at intervals of 50 to 150 miles along the boundary. The Moisie River net has an additional aim, the provision of a main control into the potentially important mineralized area in the centre of the Ungava Peninsula, some 350 miles north of the Gulf of St. Lawrence.

These operations were in charge of J. W. Menzies, assisted by Professor L. J. Arcand, K. H. Ewing, M. C. Coulter, N. E. Kelly, and A. M. Deschenes.

Early in the season the small incompleting portion of the triangulation on the St. Augustine River was observed, thus giving a net of continuous triangulation from the north shore to the Quebec-Labrador boundary at the 52nd Parallel of latitude.

A similar operation was continued northerly along the Natashquan River, with the view of tying in survey marks of the Quebec Government, as well as placing control points at the intersection of the Natashquan River with the Quebec-Labrador boundary in latitude 52°. Transportation of these parties was by canoe, though food caches were placed at two points along the river by plane. At the start of the season progress was impeded by continuous high water, but a distance of 50 miles was covered during the season, eleven new stations including a base net were selected and prepared for observations, and angular measurements were completed at nine stations. At the close of the season only another 50 miles remained to be completed to the boundary.

In the Moisie River watershed northward from Seven Islands, Quebec, transportation of all parties was by aeroplane to lakes in the vicinity of the triangulation stations. In 1944 an aerial reconnaissance had been made of the net for a distance of 100 miles north of the Gulf, and a tentative scheme of triangulation selected. North of this area a route for triangulation 250 miles farther north was selected along a string of lakes and rivers which will provide splendid canoe transportation, with supply caches provided by aeroplane. In 1945 a fair start was made on ground reconnaissance, station preparation and angle measurements. Nine stations were located and prepared and observations were completed at four of these.

Throughout the season's operations portable radio sets were used to maintain communication with the field parties and the Canadian Pacific Air Lines' base at Walker Lake. The longest distance over which telephonic communication was maintained satisfactorily was about 75 miles. The topo-

graphical features at the base are not suitable for a fair test, but on the whole it is considered that their future use will assist towards efficient operations of the parties.

#### ALBERTA

Following an interval of seventeen years, primary triangulation operations were resumed under the direction of J. M. Riddell, assisted by J. H. Kihl, in the vicinity of Edmonton, with the object of extending the Alberta network westerly to effect a junction with the British Columbia network at the interprovincial boundary near Jasper.

The reconnaissance westward to Edson had been previously made and a few of the stations monumented. During the season fourteen stations were prepared, of which eight required observation towers measuring about 50 feet in height. For the remaining six, line cutting was necessary to obtain intervisibility between stations. Care had to be maintained throughout to ensure intervisibility between stations, as the growth of the poplar trees during the interval had been considerable. Angular observations were completed at twelve stations, and at nine of these, traverse connections were made to the Dominion Lands Surveys system.

#### YUKON

In 1945 a start was made on the primary triangulation along the Alaska Highway easterly from Whitehorse, Yukon Territory, by parties in charge of F. P. Steers assisted by G. D. Hueston. In 1943 the U.S. Coast and Geodetic Survey had completed a net of primary triangulation from the summit of White Pass through Yukon and Alaska via Whitehorse, and the 1945 operations commenced at stations laid down during the 1943 work of the United States triangulation.

During the season, shortened to two months by delays in delivery of motor transport, the net was extended to Tagish Lake and ten stations were selected and prepared, at six of which angle measurements were completed.

It is the policy to establish stations very close to the highway at convenient intervals to supply control points for legal-survey traverses of the highway: two such stations were established in 1945.

#### OTTAWA AREA

In co-operation with the National Research Council officials, a triangulation scheme was completed to the west of Ottawa to provide a basis for photographic triangulation experiments carried out by the Council. The work has been on the secret list, and consequently details are omitted here.

#### NEWFOUNDLAND

W. M. Dennis was seconded to the Commission of Government of Newfoundland for the purpose of aiding in the organization and training of a geodetic survey bureau to undertake the extension of the basic Newfoundland triangulation, which had been performed under a co-operative agreement with the Geodetic Service of Canada. A satisfactory season's work is reported for the then existing conditions, and with a return to peace-time activity a more rapid expansion of the local survey is anticipated.

#### PRINCE EDWARD ISLAND

The Geodetic Service has designed a projection suitable to the extent of the Province, upon which the control data of all the Federal surveys in the Island have been calculated. The Province has legalized these data by an Act of Legislature, and for all future surveys by the Province it is now possible to

define boundaries in terms of the co-ordinates so determined. Local governmental surveys are being based on the system thus established. A feature of the adoption is that uniformity of survey information is possible and that re-establishment of boundaries is more easily made than by the methods of former surveys.

#### INVESTIGATIONS

An investigation has been undertaken as to the best type of oil to be used in precise surveying instruments under the varying conditions of temperature existent in Canada. The qualities sought are as follows:—(a) It should hold to the lubricated surfaces for more than a year; (b) it should not stiffen within the temperature ranges in which the instrument must serve, nor should it run too freely at high summer temperatures; (c) it must not oxidize within this range; (d) it must not deposit a residue material; (e) it must not creep appreciably, and (f) it should be anti-corrosive. In the search for such qualities, four oils are now being tested under practical conditions.

The deterioration of the glass circles in use from 18 to 20 years is at present the subject of investigation, but no definite conclusions are at present available as to the underlying causes. This study will be continued and periodic examination of the circles is expected to reveal the probable growth of the deterioration and the extent to which they must now be replaced to avoid difficulties in the field.

#### TRIANGULATION ADJUSTMENTS

The principal work carried on by this division was the final loop-closure adjustment of six primary triangulation nets forming the major part of the unadjusted section of triangulation encircling the Gulf of St. Lawrence. These nets extended along the north shore of the Gulf of St. Lawrence from Anticosti Island to the Strait of Belle Isle, thence southward along the west coast of Newfoundland to its southwesterly corner at Cape Ray.

The preliminary adjustment of the North Shore triangulation series of three nets was made commencing from a fixed line near the westerly end of Anticosti Island which had been included in the previously adjusted loop of triangulation extending down the lower St. Lawrence River and through New Brunswick and Nova Scotia. The adjustment of the North Shore series of nets was terminated on the line "Parent-Forteau", adjacent to the southwesterly end of the Strait of Belle Isle.

Similarly, a preliminary adjustment of the series of three nets extending up the west coast of Newfoundland from the southwesterly corner was made, commencing on the previously fixed line "Cape Ray-Cape Anguille", which had been included in the Nova Scotia primary net. The adjustment of this series of nets was also terminated on the line "Parent-Forteau". By this method of computation, two independent values of latitude and longitude were deduced for the station "Parent", one value computed through the North Shore route and the other through the Newfoundland route.

The total axial length of the series of nets encircling the Gulf of St. Lawrence and meeting at the common line "Parent-Forteau" was about 1,300 miles. As the section of this loop extending southerly from Anticosti Island through New Brunswick and Nova Scotia to the southern tip of Newfoundland had already been subjected to a loop closure adjustment involving some of the eastern nets of the U.S. Coast and Geodetic Survey, it was held fixed. The position closure discrepancy of the Gulf loop, as indicated at the station "Parent", was distributed through the six component nets extending 360 miles from Anticosti Island to the Strait of Belle Isle, thence 280 miles southerly to the southwest extremity of Newfoundland.



## CLOSURE IN POSITION

The following results show the latitude and longitude of the station "Parent" after the preliminary adjustments, including angle, side, length, and Laplace equations had been made.

Station	Route	Latitude	Longitude
Parent	North Shore	51° 25' 16".574	57° 09' 43".263
Parent	Newfoundland	51° 25' 16".516	57° 09' 42".727
	Closure	+0".058	+0".536

The closure of 0".058 in latitude and 0".536 in longitude represent 6 feet and 34 feet, respectively, in the meridian and prime vertical plane, or a hypotenuse distance of 34.5 feet. This discrepancy, which had to be absorbed in the six component nets represents a ratio error of 1/98,000. As the axial lengths of the series of nets to the west and south of "Parent" were almost equal, each section was given approximately half of the total correction.

## CLOSURE IN AZIMUTH

From the preliminary adjustments the azimuth of the line "Parent-Forteau", forming the junction of the two sections of triangulation, was as follows:—

Line	Route	Azimuth
Parent-Forteau	North Shore	45° 54' 37".421
Parent-Forteau	Newfoundland	45° 54' 36".114
	Difference	+1".307

The smallness of this difference is undoubtedly due, to a large extent, to the corrective effect of Laplace stations introduced at intervals of about 90 miles.

## CLOSURE IN LENGTH

Similarly from the preliminary adjustments, the closure in length of the line "Parent-Forteau" was deduced from computation by the two routes:—

Line	Route	Log. Length
Parent-Forteau	North Shore	4.0690558
Parent-Forteau	Newfoundland	4.0690382
	Difference	+ .0000176 =1/25,000

As the easterly end of the North Shore chain of triangulation had a measured base at Bradore, close to the line "Parent-Forteau", the value 4.0690558 was held fixed in the final loop-closure adjustment. The value 4.0690382, derived from the preliminary adjustment of the most northerly section of the Newfoundland net, was without benefit of measured base-line control at its northerly end. The rather large closure of 1/25,000 in length is more apparent than real for this reason. In the final loop-closure adjustment, length equations were of course introduced to hold the length of this line fixed so that its logarithm would remain 4.0690558.

The best indication of the accuracy of the triangulation loop as a whole was the small discrepancy in the position of "Parent" as derived from computation over the two routes. The indicated accuracy of 1/98,000, before the loop-closure equations were included in the final adjustment, was highly satisfactory. It showed that the inclusion of base line and Laplace azimuth checks in the component nets of the loop was invaluable in maintaining the general precision at the desired level.

As each component net had to absorb its proportional share of the loop-closure error, latitude and longitude equations were added by a differential method of solution to the preliminary adjustment. An azimuth and a length equation were also included in the differential adjustment of each component net to ensure that the azimuth and length of the terminal line were held fixed at the values given by the preliminary adjustment.

All secondary work pertaining to these nets, including unoccupied stations located by three or more intersections, lighthouses and church spires, was adjusted and the geodetic positions were computed.

The adjustment of a primary net extending through the Strait of Belle Isle, together with a number of secondary points, including lighthouses and a radio direction-finding station, has been completed. The Least Squares adjustment of this net gave unusually small corrections to the observed directions for both primary and secondary work, indicating a high order of accuracy in the observation of the horizontal angles. It is believed that the cold atmospheric conditions obtaining in this area, with the consequent reduction of horizontal refraction of sight lines, was a contributory factor in attaining such high accuracy.

A start was made near the end of the fiscal year on the adjustment of the nets extending from the west coast area of Newfoundland, near Cornerbrook, eastward towards St. Johns. According to the agreement between the Canadian Government and the Commission of Government for Newfoundland, the Geodetic Service of Canada undertook to make the adjustments, compute the geodetic positions, and publish the resulting data pertaining to the Newfoundland section of triangulation.

Engaged on the previously mentioned work were L. N. Wadlin, W. H. MacTavish, T. H. Parker, J. W. Menzies, F. P. Steers, G. F. Dalton, J. M. Riddell, J. E. Lilly, J. H. Kihl, G. D. Hueston, C. R. Westland, and K. H. Ewing.

#### OTHER OPERATIONS

In connection with the Subcommittee on Navigation, Associate Committee of Aeronautical Research, National Research Council, some mathematical investigations of polar map projections have been made by C. H. Ney. A modification of the Lambert Conformal Projection with two standard parallels has been computed. The projection, which was designed to cover the area between latitude  $65^{\circ}$  North and the Pole, was worked out with one standard parallel at latitude  $71^{\circ}$  and the other at  $89^{\circ} 59' 58''$ . It was found that it was inadvisable from a practical point of view to place one standard parallel exactly at the pole.

To give a basis of comparison, a Stereographic Polar Projection was computed. Drawings of each projection were made on a scale of 60 nautical miles to the inch, and a number of theoretical flight lines (great circle courses) were computed and plotted on the projections. Intermediate points on each course at intervals of two or three hundred miles were computed by geodetic formulæ, so that an accurate comparison could be made of true and scaled azimuths and lengths. The modified Lambert Conformal Projection was found superior to the stereographic.

A series of tests was made on two telescopes sent from England to determine the practical efficiency of non-reflecting films on optical lenses. The lenses of one of the telescopes had been treated with a thin transparent film of magnesium fluoride. In all other respects the instruments were identical. While in theory a definite improvement in the ability to see faint stars or distant objects should result from the fluoriding of the lenses, a definite test was desired in Canada, where favourable atmospheric conditions might be expected. Following an extended test on the two English telescopes, the lenses of two astronomical telescopes of the Geodetic Service of Canada were fluorided in the Optics Laboratory of the National Research Council and then compared by the

Geodetic Service of Canada with a similar instrument having untreated lenses. In all cases, a definite improvement was observed due to fluoriding. The cost of fluoriding should be less than ten dollars per instrument.

A great many requests for triangulation data have been received and answered. The distribution of published results has been made in cases of special request by Federal and Provincial Government survey bureaus, private surveyors and consulting engineers. Technical data has also been furnished to the Canadian National Railways and the Alberta Government Telephones in connection with construction of new systems of radio communication involving quasi-optical rays.

### LEVELLING

During the year some 901 miles of new precise levelling was added to the Canadian level system, being the greatest mileage of precise levels added to the net since the season of 1922. Four double unit parties were in the field throughout the season.

Two parties continued operations on the Alaska Highway. One party, working eastward from Whitehorse, Y.T., carried levels to Mileage 674, about 40 miles west of Watson Lake Junction. The other party, continuing operations westward from a point 75 miles south of Fort Nelson, reached Muncho Lake at Mileage 452. Thus of the 1,232 miles of precise levelling undertaken in 1944 by the Canadian Government to connect Edmonton, Alta., to the U.S. levels at Whitehorse, Y.T., there remains at the end of two field seasons some 222 miles to be done.

One party was working in southern British Columbia at the request of the International Columbia River Engineering Board.

The fourth party carried out levelling operations over the lines of the Canadian National Railways in Prince Edward Island.

An inspection was made of 436 bench marks established by the U.S. Coast and Geodetic Survey in 1943 between White Pass, B.C., via Whitehorse, Y.T., to the Alaska-Yukon boundary along the Alaska Highway. The regular inspection of secondary bench marks in Alberta was continued.

In connection with the investigations now being conducted by the International Columbia River Engineering Board, the problem of removing the anomalies which exist between the two national precise level nets along the International Boundary in the Columbia River Basin is being studied jointly by the U.S. Coast and Geodetic Survey and this Service. The ultimate solution will probably be a local adjustment of those portions of the two national nets lying within the Columbia River Basin. Before this adjustment can be made it will be necessary to carry out additional field operations in both countries.

With the lifting of war restrictions a number of levelling publications were printed, the first since 1942.

### PRINCE EDWARD ISLAND

Precise levelling was carried over the entire Island system of the Canadian National Railways. E. W. Berry was in charge of the party, and C. E. Weyman and F. J. Horgan were his assistants. The datum was based on mean sea level as determined from automatic gauge records at Charlottetown by the Tidal Division, Hydrographic Service, of this Department. The work was started towards the end of May and concluded around the middle of September. Two railway motors and one automobile were used for transportation of the units working along the railway, while camp was moved by freight or by trucks.

## ALBERTA

The inspection of iron pipe bench marks established on secondary levels run before 1925, which was started in 1944, was continued this year by R. H. Montgomery. The first area covered lay between Vegreville and Edmonton and Camrose and Bruderheim. The second area was in the vicinity of the 4th and 5th Base Lines north of Lethbridge. In the Edmonton area the loss of this type of bench mark from various causes was around 30 per cent. In the Lethbridge area it was around 45 per cent; the increased loss could be largely attributed to drifting soil being more prevalent in the southern area. The inspection in 1945 confirms the conclusions reached by the 1944 inspection as to the value of the iron pipe type of bench mark for durability and stability.

## BRITISH COLUMBIA

The party in southern British Columbia was in charge of D. McMillan, assisted by R. W. Arnett and W. J. Muller. It was engaged in levelling operations required by the International Columbia River Engineering Board in connection with their investigation of the water resources of the river basin. The first work undertaken was the re-running by precise methods of a line connecting the Upper and Lower Arrow Lakes, i.e., from Nakusp to Edgewood. This had originally been run in the year 1931, but only to secondary accuracy. As it was deemed necessary to have levels of the highest precision between these points for the purposes of the investigation a complete re-running was made. On the completion of this line levels were run from Beaton, on the east shore of Upper Arrow Lake, to Lardeau, on the west shore of Kootenay Lake. This entailed a water transfer from Arrowhead to Beaton, in order to furnish a datum for the line, thence levelling to Trout Lake village, at the northwest end of the lake of the same name, thence a water transfer to Five-Mile Point, near the southeast end of the lake and thence levelling to Lardeau, whence water transfers were made by automatic gauge across Kootenay Lake to Kuskonook and Queens Bay. The water transfers, with the exception of the Arrowhead-Beaton transfer, were made by the Dominion Water and Power Bureau. Their gauges at Kuskonook and Queens Bay were also connected with the trunk line of precise levels through southern British Columbia.

Elko to the International Boundary between Newgate, B.C., and Gateway, Mont., was the next line run. At the latter point the levels were closed on bench marks of the United States Geological Survey. The last line to be run was along the course of the Upper Kootenay River starting from Canal Flats, on the Kootenay Central line of the Canadian Pacific Railway. At the end of the season levelling was discontinued at Gibraltar Rock, some 18 miles from Canal Flats. Throughout the season considerable delay was caused to this party by poor transportation facilities on the lakes, boat service being very infrequent. In some instances too it was impossible to transport the party's trucks by the boat service available, and a scow had to be engaged for this purpose or the trucks driven overland by some circuitous route.

## ALASKA HIGHWAY

The eastern party on this highway was in charge of D. J. Fraser, assisted by G. S. Raley and H. L. Waisman. This party, starting at Indian Creek, mileage 234, where the previous season's operations had stopped, carried levels north-westerly through Fort Nelson and the Rocky Mountains and reached Muncho Lake by the end of the season. The portion of the highway covered by this party was entirely in northern British Columbia, and levelling operations were difficult on account of heavy grades. The lowest point on the Alaska Highway,

elevation 963 feet, occurs at Mileage 300 at the crossing of Muskwa River, and the highest point occurs at Mileage 396, the summit of the highway in the Rockies with an elevation of 4,236 feet.

The western party on the highway in charge of L. O. R. Dozois, assisted by A. B. Farnam and S. Pataran, was transported by plane to Whitehorse, Y.T. This party, starting from precise level bench marks established in 1943 by the U.S. Coast and Geodetic Survey, carried levels easterly along the highway to Big Creek, a point about 40 miles west of Watson Lake Junction. For at least half the field season, this party was handicapped by inadequate mechanical equipment. Standard iron pipe bench marks referenced by a stone cairn were planted at intervals of about 2.5 miles and at least every 20 miles a bench mark was established in bed-rock, a bridge abutment or a standard concrete pier.

#### YUKON

In 1943 the U.S. Coast and Geodetic Survey ran 585 miles of first order levels between White Pass, B.C., via Whitehorse, Y.T., to Big Delta, Alaska. Casual inspection in 1944 revealed that much of the ground record would be lost through faulty descriptions due to changing conditions unless immediate action be taken to secure correct descriptions of bench marks. This danger was brought to the attention of the U.S. Coast and Geodetic Survey, and it was agreed that the entire line should be inspected in 1945. Canada undertook to look after the 400 miles of levels which were run in Canadian territory.

This inspection was carried out by R. H. Montgomery with one assistant, using an automobile on the highway for transportation. On the railway he was taken over the route by the roadmaster of the White Pass and Yukon Railway in his railway motor car. Along the railway between White Pass and Whitehorse the inspection revealed that of the 116 permanent bench marks established in 1943, there had been a loss of 10 per cent. Along the highway, of the 320 bench marks established, the loss was 15 per cent. It is interesting to note in comparison that the routine inspection of precise level bench marks in Canada reveals that a loss of 13 per cent takes place between 10 and 15 years after establishment. Owing to the changes that had taken place on the highway in the two years since the bench marks had been established, entirely new descriptions were necessary in many cases. As a result of this inspection, the valuable contribution made by the U.S. Government to the Canadian level system has been safeguarded for an indefinite period.

#### PUBLICATIONS

War restrictions were responsible for the placing of a number of levelling publications in the category "out of print". The demand for levelling information increased rather than diminished during the war. Intensified oil prospecting in Alberta was responsible for the exhaustion of the Alberta publications in the early years of the war. With the removal of printing restrictions, the following publications were printed—

No. 17, "Precise Levelling in Quebec, South of St. Lawrence River".

No. 18, "Precise Levelling in Quebec, North of St. Lawrence River".

No. 20, "Precise Levelling in Ontario, North of Parry Sound".

No. 49, "Altitudes in Alberta, South of 15th Base Line".

However there still remains in the category "out of print":—

No. 16, "Precise Levelling in Nova Scotia, New Brunswick and Prince Edward Island".

No. 15, "Bench Marks in Saskatchewan".

No. 23, "Precise Levelling in Alberta".

No. 53, "Bench Marks in Alberta".

No. 24, "Precise Levelling in British Columbia".

Unfortunately, the revision of these publications will be held up pending such time as the essential field inspection can be carried out.

*Detailed Statement of Precise Levelling Run in 1945*

	Miles	B.M.'s.
Prince Edward Island lines .....	284.2	155
Alaska Highway, mileage 233.7 to 452.2 .....	218.5	93
Alaska Highway, mileage 909.6 to 674.2 .....	235.4	98
Nakusp to Edgewood (rerunning) .....	45.0	*
Beaton to Lardeau, exclusive of water transfers.....	57.5	30
Kuskonook branch .....	3.6	1
Elko to Newgate .....	33.3	13
Canal Flats northeasterly .....	18.5	9
Extra bench marks, Kaslo and Nakusp .....	—	2
<b>Total .....</b>	<b>901.0</b>	<b>406</b>

\*The 32 bench marks on this line are not counted as new bench marks but have been transferred in the records from secondary to precise classification.

*Summary*

	Miles	B.M.'s.
<i>Precise Levelling</i>		
Prior to 1945.....	27,244	9,705
1945 .....	901	438
<b>Total .....</b>	<b>28,145</b>	<b>10,143</b>
<i>Secondary Levelling</i>		
Prior to 1945.....	12,057	4,282
1945 .....	—	—
<b>Total .....</b>	<b>12,057</b>	<b>4,282</b>

NOTE.—The Nakusp-Edgewood line, 45 miles in length and containing 32 bench marks has been transferred from secondary to precise levelling, thus reducing the former secondary figures by this amount.

The total mileage of levelling in the Canadian level net, at the end of the fiscal year 1945-46 was as follows:—

	Precise	Secondary	Public Works	Total
Prince Edward Island.....	284	—	—	284
Nova Scotia .....	779	—	309	1,088
New Brunswick .....	1,106	—	403	1,509
Quebec .....	3,418	1,288	2,231	6,937
Ontario .....	7,069	1,324	2,012	10,405
Manitoba .....	2,963	368	113	3,444
Saskatchewan .....	4,113	5,098	—	9,211
Alberta .....	3,291	3,799	—	7,090
British Columbia .....	4,376	180	—	4,556
Yukon .....	651	—	—	651
Minnesota .....	89	—	—	89
Vermont .....	6	—	—	6
	<b>28,145</b>	<b>12,057</b>	<b>5,068</b>	<b>45,270</b>

*Supplementary Information*

	Mileage	B.M.'s.
Chief of Party		
McMillan .....	163	60
Berry .....	284	155
Dozois .....	235	98
Fraser .....	219	93
	<b>901</b>	<b>406</b>

*Mileage by Provinces*

Prince Edward Island.....	284
British Columbia .....	424
Yukon .....	193
	<b>901</b>

## GEODETTIC ASTRONOMY AND ISOSTASY

The field work of the Division of Geodetic Astronomy and Isostasy during 1945 consisted of one precise longitude and latitude determination near Cape Cook on the west coast of Vancouver Island, and sixty-two longitude and latitude determinations in northern Saskatchewan, northern Manitoba and the District of Keewatin. The engineers engaged in the observing of these sixty-two latitudes and longitudes also made determinations of magnetic declination at forty-two of the stations visited.

## PRECISE LONGITUDE AND LATITUDE

At the request of the Department of National Defence (Naval Service), T. C. Dennis made a precise longitude and latitude determination on Spring Island near Cape Cook in the northwestern part of Vancouver Island. As in similar determinations made in former war years, the information thus secured is being used in certain investigations being made by the Naval Service in co-operation with officers of United States research bureaus. The astronomical values were partially reduced to geodetic data by applying the estimated corrections for the deflection of the vertical.

## SECONDARY LONGITUDE AND LATITUDE

The extensive program of longitude and latitude determinations for control of reconnaissance aerial mapping, commenced in 1942, was continued during 1945. Four parties under general charge of B. J. Woodruff were engaged in these operations. The engineers assigned to this work were B. J. Woodruff, W. H. Stilwell, T. H. Manning, and G. A. Corcoran.

The method of longitude and latitude determination employed is the fixed altitude method. A determination of latitude and time is secured by observing the transit of four stars, one in each quadrant, N.E., S.E., S.W., and N.W., over the horizontal wire of a five-inch Wild transit, the vertical circle of the transit being clamped at a fixed altitude of either 45° or 60°. The probable error of a geographical position obtained from six to eight sets of four stars is less than 100 feet, apart from deflection of the vertical errors. This method, therefore, provides information from observations on a single night for control of reconnaissance mapping on the scale of four miles to one inch.

The Geodetic Service party of four observers and four assistants left Ottawa on June 3, and arrived at The Pas, Manitoba, on June 7, where No. 2 Photo Survey Detachment of the R.C.A.F. under the command of Flight Lieutenant R. Reid was in waiting. This unit was to provide the transport for the northern operations and consisted of the crews of three float-equipped Norseman aircraft, one amphibian Canso aircraft, the necessary ground crew, and the observers for three meteorological stations.

During the season three R.C.A.F. bases were established in successive northward stages at Brochet Base, Nueltin Lake, and Kazan River. The Canso aircraft served as a supply ship and transported personnel, equipment, and supplies from The Pas and Churchill to these bases and finally to Baker Lake, the other planes being used exclusively to move the survey parties from point to point.

The late season was responsible for eight days' delay at The Pas, for it was found that Clearwater Lake just 20 miles away was still covered with ice, and a reconnaissance flight of the area where it was hoped to establish the first base indicated no possibility of obtaining suitable landing places.

By June 15, although Reindeer Lake was still completely covered with ice, a smaller lake about 10 miles north of Brochet Post and Mission was found

suitable for landing, and the first base was established and called Brochet Base. Even at this date the larger lakes northward from the base were still ice-covered, but indications were that the continued warm weather and winds would soon serve to make landings possible.

The survey party was organized into four groups. As some of the desired control points lay southerly and easterly from Brochet Base, it was possible on June 14 to transport one group direct from The Pas to its first station, and on June 15 the remaining three parties landed at Brochet Base.

From reports made by reconnaissance flights it was impossible to move northward to the vicinity of latitude  $60^\circ$  until the lakes were clear, and it was later than July 15 before the last traces of ice cleared from lakes lying between the 60th and 61st Parallels.

This delay in the clearing of the lakes, and the sad drowning accident at Nueltin Lake, where two of the crew of the Canso were lost, presaged a bad season, but fortunately subsequent progress made up for these delays, and it was possible to report on August 24 that the season's program of 62 control points had been completed, three in northern Saskatchewan, nine in northern Manitoba and fifty in the District of Keewatin extending from latitude  $57^\circ 36'$  to  $64^\circ 42'$  and from longitude  $90^\circ 43'$  to  $107^\circ 14'$  and covering an area of approximately 257,000 square miles.

Besides the determination of latitude and longitude and the necessary ground survey at each point, over 1,000 aerial photographs were taken. The experimental use of a larger camera than in previous operations resulted in pictures that will be of service in plotting the topography surrounding each control point.

Elevations from aneroid barometer readings were obtained for each station, and through the co-operation of the R.C.A.F. meteorological observers who were supplied with barometers, daily readings at each of the three bases were recorded, and these readings, extending over periods of a month or more, gave data for a strong determination of the elevation of the base points, and this was used as a control for fixing the elevation of outlying points.

In this connection, it should be mentioned that Mr. Noble of the Meteorological Service of the Department of Transport has aided greatly in the reduction of the field readings, and his suggestion of a method of combining the daily record of pressures from meteorological charts with the aneroid readings at each station should lead to a better determination of elevations in future operations.

Readings of the compass needle were also taken wherever possible and over 5,000 pointings were recorded to indicate the magnetic declination at 42 stations. These data have been placed at the disposal of the magnetic division of the Dominion Observatory.

All the information obtained has been classified as technical or descriptive. T. H. Manning has prepared reports both technical and descriptive for the eastern part of the area covered, and the western section is covered in W. H. Stilwell's technical report, while the central section, in which G. A. Corcoran and B. J. Woodruff were observers, is comprised in a third report.

The description of the central and western section has been grouped in one report illustrated by photographs obtained by the three observers operating in that area.

#### WIRELESS EQUIPMENT IN USE ON ASTRONOMIC CONTROL POINT LOCATION

The wireless equipment used by the Geodetic Service parties in Northern Canada had two separate functions. First, shortwave receivers were used for the reception of time signals for the astronomic work, and secondly, transmitters for both wireless telephone and code communication were in operation. Time signals were recorded from VAA—Ottawa, WWV—Washington, D.C., and NPG—Mare Island, California. Reception from NSS—Annapolis—was usually



faint and not in general use. The special program of Dominion Observatory time signals, transmitted by VAA from dusk to dawn on a frequency of 5405 kc., and beamed in the direction of the operations, proved especially useful, and there were few occasions when these signals were not available.

The continuous signals enabled the observers to record the time at periods of good reception and avoided the loss of signals by fading which so often occurs when only five minutes in the hour are used for transmission. Some of the engineers used signals from WWV for time recording, and all observers were able to check their mean-time watches during the day by the signals from this source. These were a portable forestry type and a special aircraft type. The former operating on a frequency of 4356 kc. proved the more efficient and was quickly put into operation without the need of a ground. The aircraft type was very critical with regard to loading and ground connections and on several occasions salt and water had to be used to get an efficient ground circuit. Possibly the frequency range of the aircraft set which operated at 3437.5 kc. was an unfavourable factor since the efficiency of transmission frequencies varies with the conditions in different localities. In spite of these difficulties almost 100 per cent communication was kept up for the four parties.

Although the aircraft type was rated as less efficient than the forestry type, a record of 325 miles for wireless telephone conversation was established by one of these sets. Most of the messages were transmitted over distances of less than 200 miles, and when any difficulties arose from poor reception it was usually possible to relay the message from party to party to its destination.

### INTERNATIONAL BOUNDARY COMMISSION

After the completion of the survey and demarcation of the boundary line between Canada and the United States and Alaska, by the treaty of 1925 the Governments of the two countries agreed to maintain the boundary line in a state of effective demarcation. Each country pays the salaries and travelling expenses of its Commissioner and his staff but the expenses jointly incurred by the Commissioners in maintaining the demarcation of the boundary line, in accordance with the provisions of the treaty, are borne equally by the two Governments.

The boundary treaty of 1908 between Canada and the United States provides for the appointment by each country of an expert geographer or surveyor as a Commissioner to carry out the provisions of the treaty. The treaty further provides that in case a vacancy occurs in the Commission constituted by this treaty, by reason of the death, resignation or other disability of a Commissioner, the vacancy so caused shall be filled forthwith by the appointment of another Commissioner by the party on whose side the vacancy occurs, and the Commissioner so appointed shall have the same powers and be subject to the same duties and obligations as the Commissioner originally appointed.

On January 16, 1945, the United States Commissioner, Thomas Riggs, died at his home in Washington and on May 15, John A. Ulinski, of Buffalo, New York, was appointed by the President of the United States to succeed him. On June 27 Mr. Ulinski came to Ottawa to present his credentials and meet the staff of the Canadian section of the Commission. The Commissioners discussed boundary matters in general, signed the annual joint report for 1943, and made plans for an inspection of the eastern part of the boundary in September.

On September 16 Mr. Ulinski again came to Ottawa and the following day he and Noel J. Ogilvie, the Canadian Commissioner, drove to Montreal. From here the Commissioners started their inspection of the eastern part of the boundary by visiting points along the 45th Parallel south of Montreal. From Montreal they went to Quebec, then on the Kennebec Highway to Maine, crossing

the boundary at Monuments 353-A and 353-B. They drove across Maine and inspected the boundary through the St. Croix River at Calais and St. Stephen. On their return they inspected the eastern part of the 45th Parallel and continued on to the Niagara River where they inspected the boundary reference monuments and triangulation stations along the river. Mr. Ogilvie then returned to Ottawa on October 9.

#### MAINTENANCE OPERATIONS

A Canadian party in charge of Mr. Chisholm was again engaged on maintenance work on the Highlands section of the boundary between Maine and Quebec. Work has been going on along this part of the boundary for the last two years and this season's work completed the final section. The forest growth in this district is such that the vista has to be recleared about every ten years.

The boundary along the Highlands was originally surveyed by British and United States officers in 1844-45 and was marked by cast-iron monuments located by traverse at the more important changes of direction. When the line was resurveyed in 1914 the old traverse was followed as closely as possible and smaller monuments were set at all the turning points between the cast-iron monuments. These smaller monuments were made by setting a 3-inch bronze disk in a 4-inch vitrified clay pipe filled with concrete and planted with the bell end down, so that the top end bearing the disk was flush with the surface of the ground. The crest of the watershed follows a very sinuous course and there may be upwards of fifty small monuments between a pair of cast-iron ones, some of them less than one hundred yards apart. These small monuments are occasionally damaged by tractors using the vista clearing as a logging road.

A motor car and truck could be depended on for transportation on the main roads, but on approaching the boundary the roads got so bad that the motor transport had to be left and horses and wagon used. The trails are really only winter logging roads and often had to be cleared out and occasionally new sections built. Where a road was carried on corduroy over a low place, it sometimes happened that an accumulation of water had floated the logs and the road had to be rebuilt before a load could be taken over it. Some of the roads were so bad that a wagon could not be used and in these cases, a drag was made of poles fastened to the front axle with their ends trailing on the ground to carry the load.

This year marked a change in the labour situation. For the first time in three years men applied for work and stayed for the season instead of having to be coaxed and remaining with the party for only a few days.

During the season the party worked between Monument 370 near Lake Emily and Monument 393-13, reclearing the vista for a distance of about 17 miles. They inspected 396 monuments and repaired one of them.

The boundary line through the Great Lakes is defined by a series of straight-line courses, approximately through the middle of the lakes, and each change in direction of the line is called a turning point. When the survey of the boundary line through the lakes was last done by the International Waterways Commission in the years 1909-13, the geographic positions of the turning points were referenced from lighthouses along the shores of the lakes. Since then, some of these lighthouses have been abandoned, some have been burned, and some have been rebuilt. In order to perpetuate the positions of these lighthouses, a party from the United States section of the Commission, to which a Canadian representative was attached, was engaged during the summer in identifying, photographing, and permanently referencing their positions. Where time allowed, the positions of some of the lighthouses were connected to the local triangulation system and this will be done for the remainder of the lighthouses at convenient times in the future.

The party started at the mouth of the Pigeon River in Lake Superior and worked eastward through the lakes, finishing at Oswego near the eastern end of Lake Ontario. Of the eighteen lighthouses that had been used as reference points they found that two had disappeared, either burned down or dismantled, and two were no longer being used as lighthouses and were falling into ruins. Seven of the remaining fourteen were connected to Canadian or United States triangulation stations and preliminary investigations were made at the remainder with a view to connecting them at some future time.

The boundary along the 49th Parallel from the summit of the Rocky Mountains to the Gulf of Georgia was defined in the Oregon Treaty which was signed on June 15, 1846. It is interesting to note that June 15, 1946, marks the centennial of the signing of this treaty and joint celebrations are being planned at Blaine, Washington, and at Osoyoos in the Okanagan Valley to commemorate one hundred years of peace and good will along our common boundary.

This year a party from the Canadian section of the Commission was engaged on maintenance work on the western end of the 49th Parallel from Monument 48 to Zero Monument on the shore of the Gulf of Georgia. Owing to heavy rains and the long growing season, the forest growth on this section of the line is very rapid and the vista has to be recleared every two or three years to keep it open for the law enforcement authorities along the border. In addition to clearing out the young trees and brush, the old logs and stumps were removed so as to make a clear passage along the line. The party worked from the east side of Columbia Valley to the Initial Monument on the west side of Point Roberts and in this distance of thirty-four miles, twenty-seven miles of vista were recleared, and fifty-five monuments were inspected.

#### MISCELLANEOUS

In the course of the year, boundary reports or maps or detailed information on boundary matters were supplied to National Defence Headquarters, the Cuban Minister to Canada, the National Film Board, the Ontario Department of Lands and Forests, the Royal Canadian Mounted Police, the Bureau of Geology and Topography, and the New Brunswick Department of Lands and Mines, as well as to private parties.

Another examination of the pile foundation of the offshore boundary range mark of the west side of Point Roberts showed that no further damage had been done. In January, 1943, it had been found that the wooden piles in the foundation of this range mark had been eaten away by teredos, causing an uneven settling of the structure. Subsequent investigations have shown no further settlement.

Further progress was made on the preparation of the Commissioners' joint report on the survey of the Southeast Alaska section of the boundary.

### HYDROGRAPHIC AND MAP SERVICE

The Hydrographic and Map Service, through the production of the official nautical and air charts of Canada, contributes to the safety of life and property at sea and in the air. The dual service is organized in accordance with the universal trend towards integration of sea and air services. The component units, the Hydrographic Service and the Map Service, have individual fields of operations, but their closely related work is co-ordinated under a single administration and final processes of chart and map production are completely centralized. The functions and the year's work of each unit is dealt with separately in this report.

#### HYDROGRAPHIC SERVICE

The Hydrographic Service of Canada produces and distributes all Canadian hydrographic aids to navigation. The scientific work conducted begins with field surveys and is completed by the production and distribution of the navigation

charts of Canada, volumes of Pilots and Sailing Directions covering coastal and inland navigable waters; standard tidal publications for the Atlantic and Pacific Coasts, and the Water Level Bulletins for the St. Lawrence-Great Lakes Waterway.

The various divisions comprising this Service are administered from Hydrographic Headquarters at Ottawa, which office is also the clearing centre for general navigational information. The District Hydrographic Office at Victoria supervises the charting and tidal operations on the Pacific Coast and serves as a distributing base for hydrographic publications pertaining to that seaboard. The two hydrographic establishments permit close contact with shipping authorities and with chart requirements on both coasts.

Canada emerged from the war with a considerable advance in the total area of coastal waters charted and, as a result, the Hydrographic Service is in a position to present to post-war shipping sets of navigation charts greatly improved over the pre-war issues. For six years hydrographic operations were concentrated on specific war requirements. Charts were instruments of war but they are no less implements of peace, so when setting the geographic limits and the working scales for each charting project to be undertaken, the needs of normal post-war shipping were taken into consideration. On the Atlantic Coast, due to the transference of two hydrographic ships to the Navy, charting operations were restricted to those areas where sounding could be performed with small boats equipped with echo-sounders.

During the war years several important harbours and their adjacent coastal areas on the Atlantic and Bay of Fundy were charted. A considerable portion of Northumberland Strait and numerous small harbours on the Gaspe Peninsula were surveyed, obsolete charts of the St. Lawrence River between Quebec and Montreal were replaced by modern productions, and detailed charts of important areas in Newfoundland, Labrador, and Hudson Bay were made available. On the Pacific Coast, a number of modern navigation charts covering vital sections of the "Inside Passage" were issued.

Though much hydrographic work was accomplished in strategic waters, the charting of other extensive ocean, lake and river areas had to be held in abeyance during the period of hostilities. In consequence, the general charting situation was out of balance. Under normal peace-time conditions hydrographic operations are spread over a wide field to meet most urgent requirements of diversified shipping and to keep existing charts up-to-date with changing physical conditions of navigable waters.

Among the regions which require to be charted are the vast offshore areas of the continental shelf—the zone which effects the transition from land to oceanic depths. On the continental shelf lie some of the greatest fishing banks in the world, but the development and protection of their resources require accurate charts of our marginal seas. Lying between the banks are deep, well-defined gullies and channels which, if adequately charted, would be of great assistance to navigation in locating ship-position by echo-sounding. Many of the existing charts of these areas were made as a result of surveys conducted over a hundred years ago. Comparatively few soundings were then obtained and, as a result, present day hydrographic publications warn the mariner not to put too much reliance on a ship-position assumed from depths alone.

Urgent, also, is the necessity for the production of modern charts of inland waters. In Georgian Bay, inside the labyrinth of islands and rocks which fringe the shore, exists a network of intricate but uncharted channels. This is a potential cruising ground of great attraction for yachtsmen from Canada and the United States, and a profitable waterborne tourist trade would follow in the wake of hydrographic operations. In the development of the Northwest Territories, also, water-transportation plays a leading role. Extensive mining projects in Great Slave Lake are located on the eastern shores of the northern arm—a

locality congested with rocky islands and fronted with submerged shoals. Limited hydrographic operations were commenced in the Northwest Territories some years ago and charts of certain isolated areas were made available but during the war charting operations in that vicinity had to be almost entirely suspended. It will be many years before even the most urgent demands can be overtaken.

Confronted with this general situation, outstanding administrative problems in the year under review pertained to the reconversion of the Hydrographic Service from a war-time to a peace-time basis. This comprised the planning of future charting projects, the acquiring and fitting-out of hydrographic ships with which to execute the work, and an endeavour to fill vacancies in the technical ranks of this Service. The Hydrographic Service which devoted its entire resources to war requirements is now being geared to pursuits of peace.

In the fiscal year, 1945-46, demands for hydrographic aids-to-navigation underwent some notable and significant changes. During the first part of the year Canada's war effort required a high percentage of all chart production but, at the year-end, shipping had assumed a more normal character and the total volume of chart distribution was only about five per cent below the all-time peak figure of 1944. The decline in war requirements was, therefore, largely offset by greater civilian demand. There was further marked advancement in cartographic standardization of marine charts and the complete chart series was renumbered in accordance with a modern geographic-district numbering system.

New charting on both seaboard was accomplished to the full extent of available resources, but a shortage of trained technical staff, and a lack of hydrographic ships on the Atlantic Coast, continued to handicap the scope of operations. The two hydrographic vessels *Acadia* and *Cartier* which, on the outbreak of war, had been loaned to the Naval Service, were on June 5 and August 9, 1945, respectively, declared surplus to Navy requirements. Both ships aged abnormally during the years of war, but an examination of the *Acadia* resulted in her being declared fit to recondition for resumption of her former hydrographic duties. Repairs were accordingly taken in hand by the Naval Service for completion by the spring of 1946. A similar inspection of the *Cartier* revealed that, after 30 years of hydrographic survey work and 6 years of arduous war duties, this ship had deteriorated to the extent that it was no longer economical to repair and recondition her for charting operations. Pending ultimate disposal, she has remained in the temporary custody of the Naval Service and plans have been made for her replacement by a smaller wooden vessel of the minesweeper class for hydrographic operations on the Atlantic Coast. To assist in prosecuting the planned post-war program of charting the "Inside Passage" route to northern British Columbia ports, and for the conduct of surveys of the coastal inlets, the Hydrographic Service secured the loan of an 84-foot diesel-engined reserve patrol vessel from the Naval Service.

The Tidal and Current Division continued its important function of obtaining and disseminating data pertaining to tides and tidal current movements in Canadian waters, the prediction of tides and currents, and the determination of datum planes for nautical charts and engineering purposes. As in previous years, much special tidal data were supplied on request to Canadian Government Departments, the British Admiralty, the United States Government, and the extensive fishing industries of Canada. Serving in a related capacity was the Precise Water Levels Division whose bulletins and reports of water surface elevations of the Great Lakes-St. Lawrence Waterway were in steady demand.

*Exchange of Hydrographic Data.*—The Hydrographic Service of Canada constitutes a link in the chain of similar hydrographic services throughout the world. An encouraging sign during the year was the resumption of normal contact with a number of European and South American marine services and particularly with the International Hydrographic Bureau at Monaco. Through

the offices of this latter association of hydrographic services a world-wide exchange of nautical charting data is effected and new hydrographic and navigation methods are studied and made available for the general benefit of shipping. There was no abatement in the flow of standard and confidential information circulating between the Canadian Hydrographic Service and the Hydrographic Offices in London and Washington. As a case in point might be cited representations made by both the latter countries in regard to the necessity for replacing a number of obsolete Admiralty charts of Canadian waters by new ones based on modern hydrographic surveys. Close co-operation was maintained with Canadian Government and other mercantile authorities concerned with shipping. Numerous consultations were held and much useful data were received from the Departments of Public Works, Transport, and National Defence. Reciprocating, this service conducted special charting operations in widely separated areas and supplied these departments with the latest standard charts and related hydrographic aids-to-navigation.

*Pilots and Sailing Directions.*—Important hydrographic aids-to-navigation are the volumes of Pilots and Sailing Directions compiled and issued by this service. These reference books supplement the information given on the standard navigation charts and describe in detail the nature of the coasts and navigable waters of Canada. Instructions are given for navigating the Atlantic and Pacific seaboard of Canada, Hudson Bay Route, Gulf and River St. Lawrence, and the Canadian portion of the Great Lakes-St. Lawrence Waterway. Thirteen volumes are published and supplements are issued as new data become available. Urgent nautical information is promulgated from time to time through the medium of the official Notices to Mariners. Masters of vessels, shipping and engineering interests are supplied with special data relating to harbour and channel depths, water-levels, recommended loading draughts, harbour facilities, ice conditions, and general navigational information.

The following Pilots or Supplements thereto were prepared: Nova Scotia (S.E. Coast) and Bay of Fundy Pilot, 2nd edition; British Columbia Pilot, Vol. 1, 4th edition; British Columbia Pilot, Vol. 2, 2nd edition; Gulf of St. Lawrence Pilot, 3rd edition; Supplement No. 4 to St. Lawrence River Pilot, Quebec to Montreal; Supplement No. 4 to Great Lakes Pilot, Vol. 1. The sailing Directions Section also continued to act as a ready reference service for supplying navigational information of all kinds through correspondence and personal contact. An important phase of the work was the preparation of lists of chart place-names for approval of the Geographic Board of Canada. A "Gazetteer of British Columbia Coast Names" was prepared in the Victoria office.

#### HYDROGRAPHY

Each year, hydrographers trained in this Service carry out important charting operations in widely separated parts of coastal and inland waters. As a result, new charts and other hydrographic publications appear from time to time. In the period under review seven hydrographic units were assigned to duty. The main hydrographic projects were undertaken in accordance with the established long-term program of progressive coastal charting and, in general, were continuations of the previous year's operations. Special hydrographic surveys and emergency undersea examinations were carried out on the request of various departments. Summary reports of the work of each charting project follow:

##### ATLANTIC COAST AND INLAND WATERS

*Atlantic Coast.*—This unit, equipped with the hydrographic launch *Dawson* and a small motor-boat, continued the inshore charting of the southeast coast of Nova Scotia, from East Ironbound Island to Betty's Island, including St.

Margaret Bay. Actual charting operations commenced on June 4 and continued until November 1. From October 4 to 25 the officer-in-charge conducted a special survey of Halifax Harbour for the purpose of checking up parts of the existing chart. As a result of the season's main operations, progress was made on the proposed new chart covering St. Margaret Bay and approaches.

*Summary of Season's Work*

Boat sounding .....	782 linear miles
Coastline plotted .....	70 " "

*Northumberland Strait.*—Northumberland Strait was first charted by the British Admiralty between the years 1839 and 1857 and the result of the work is published on the general chart of the strait at a scale of approximately 4 miles to one inch. The chart is obsolete in important respects and for this reason the Canadian Hydrographic Service is engaged in a rigorous recharting of the area. In the year under review the echo-sounding equipped launches *Anderson* and *Henry Hudson* were again assigned to the work. The *Anderson* conducted operations on the north side of the strait between Victoria and Summerside. Operations began on June 2 and terminated on October 15. As a result of the work considerable data were obtained for the proposed new charts "Pictou Island to Tryon Shoals" and "Tryon Shoals to Cape Egmont." Special work consisted of current observations in the vicinity of the car ferry terminals at Borden and Cape Tormentine, the latter operations being conducted at the request of the Department of Transport.

*Summary of Season's Work*

Boat sounding .....	1,172 linear miles
Coastline plotted .....	40 " "
Shoals examined .....	30

*Gulf of St. Lawrence.*—On completion of fitting-out at Charlottetown, the launch *Henry Hudson* proceeded on June 1 to Port Hawkesbury where, at the request of the Department of Public Works, several sections of the Strait of Canso were charted. Regular coastal charting of Northumberland Strait was resumed on July 4. Caribou Channel was re-sounded, a net of triangulation was established, and sounding lines were run from shore to shore across Northumberland Strait in the same vicinity. Later, the triangulation was extended to Cape John to connect the Amet Sound net. At the beginning of October the *Henry Hudson* returned to the Strait of Canso where further detailed sounding was conducted. Work terminated on November 4.

*Summary of Season's Work*

Boat sounding .....	680 linear miles
Coastline plotted .....	20 " "
Shoals examined .....	9

*Cape Breton.*—Main work of this unit consisted of the detailed charting of Bras d'Or and St. Andrews Channels. The season's work started on June 11 and terminated on December 13, sufficient data being obtained for the production of a new large-scale chart of St. Andrews Channel and Great Bras d'Or. Supplementary work during the year consisted of the examination of a reported shoal at North Sydney.

*Summary of Season's Work*

Boat sounding .....	960 linear miles
Coastline plotted .....	86 " "
Shoals examined .....	29

*St. Lawrence River.*—Further progress was made in the recharting of the St. Lawrence River between Quebec and Montreal to replace the obsolete set of charts covering that waterway. The hydrographic survey launch *Boulton* and a smaller motor-boat, both equipped with echo-sounding instruments, left Prescott on May 29 and, after re-sounding and locating buoy ranges in the North Channel 3 miles east of Prescott, proceeded downstream for Contrecoeur. En route, a shoal 3 miles east of Cornwall was examined at the request of the Department of Transport. During the season field operations in connection with the new chart "Head of Lake St. Peter to Lavaltrie" were completed. Velocities and directions of the strong river currents, as well as magnetic observations, were taken over the charted area. The season's survey operations terminated on October 24.

#### Summary of Season's Work

Boat sounding .....	1,172 linear miles
Coastline plotted .....	40 " "
Shoals examined .....	30

*Mackenzie River.*—The purpose of hydrographic work conducted in this river was to locate the natural channels and to ascertain where dredging was required. The section charted in 1945 was the 25-mile stretch between the Rabbit-skin River and Fort Simpson, one of the most difficult portions of the river to navigate. Here the water is shallow, the current is swift and the channels change their positions due to boulders being transported during the spring break-up. The Green Island Rapids occupy the mid-section of the area. In conjunction with the regular hydrographic work, current directions and velocities were surveyed over the stretch of river charted. Operations commenced at Fort Simpson on June 18 and terminated on September 10 after which the boats were taken to Yellowknife for wintering.

As the result of the work a new chart "Rabbit-skin River to Fort Simpson" will be published. Large-scale prints of the section "Green Island Rapids" were supplied to the Bureau of Northwest Territories and Yukon Affairs for distribution.

#### Summary of Season's Work

Boat sounding .....	515 linear miles
Coastline plotted .....	65 " "

#### PACIFIC COAST DISTRICT

In few parts of the world is the need for modern hydrographic surveys more urgent than off the Pacific Coast of Canada. Vast areas are still almost completely unsurveyed and many existing charts of important areas are based on marine surveys made at a time when navigational requirements were very much less exacting than they are to-day.

Major charting operations are undertaken by the *Wm. J. Stewart*, a modern vessel specially designed for work on this coast. The ship is 214 feet in length, 1,295 tons displacement, draft 11.7 feet and speed 12 knots. She is equipped with the latest hydrographic instruments and has accommodation for 12 hydrographers.

In the year under review the ship left Victoria Harbour on May 15 with the houseboat *Pender* in tow and on May 17 the latter was moored in Canoe Pass as a base from which to conduct tidal observations in Seymour Narrows. Before the ship left the area the coast was suitably marked for the projected operations. On May 22 and 23 examinations were carried on in Vancouver Harbour and during the next two days ship sounding operations were conducted in Jervis Inlet. After coaling, reported shoals were swept at Welcome Pass and Plumper Bay. The survey of the east side of Fitz Hugh Sound, from Adden-



brooke Light to Namu and Fisher Channel and Lama Passage, was begun on May 30 and completed on July 28. The period between July 30 and September 30 was occupied in the charting of Grenville Channel from Camp Point to Watson Rock light including a portion of Ogden Channel. From October 2 to 9 work was carried on in the Goletas Channel area. On October 10 coal was obtained at Hardy Bay and the ship proceeded south to Seymour Narrows the same day. The season's field operations terminated on October 13 when the ship tied up at Victoria.

#### Summary of Season's Work

Ship sounding .....	283 linear miles
Boat sounding .....	996 " "
Coastlining .....	345 " "
Shoals examined .....	146

#### TIDES AND CURRENTS

The Tidal and Current Division of this Service continued to serve the needs of navigation and marine interests generally for information in regard to tides and tidal action in Canadian and Newfoundland waters. The scope of scientific work undertaken embraces the obtaining of data in regard to tides and tidal streams, predictions of tides and tidal currents and also the determination of mean sea-level and low water datum planes for charts and engineering purposes.

Analysis of tidal records obtained from primary tidal stations are made to determine the long-term variations in tidal constants for the improvement of tidal predictions. Information in regard to the time of high and low tide and the rise of tide, in localities not already dealt with, is obtained year by year for inclusion in the tide table publications. Tidal streams are charted and reports concerning them are published. The "Tidal and Current Charts for the St. Lawrence Estuary" is the result of recent work, and tidal streams through Seymour Narrows in British Columbia were charted in 1945. From the latter observations predictions for the rates of the flood and ebb through the passage are published. Other data ascertained by the Tidal and Current Division are temperatures and densities of the sea and the establishment of mean sea level. The latter, deduced from records of primary tidal stations, is the basis of the Canadian Geodetic system of levels. Monthly and annual values of mean sea level at all tidal stations are determined.

The annual Tide Tables issued by this service are sold through the Department of Public Printing and Stationery. Postmasters, customs officers in seaport towns, maritime newspapers, libraries, and tourist bureaux are supplied free with single copies. Large quantities are acquired by the Department of Fisheries for distribution to fishermen generally.

The Tide Tables, which are an annual publication, were prepared for the year 1946 and progress was made on the 1947 issue. Two complete editions, one for the Atlantic Coast and one for the Pacific Coast, are published for shipping interests generally. Besides these, there are six abridged pocket editions to serve the needs of fishermen and others locally, four covering the east coast and two the west coast. The publications are classified as follows:—

*Atlantic Coast Tide Tables.*—"Tide Tables for the Atlantic Coast of Canada," complete edition, which includes Tide Tables for St. John's, Newfoundland. There are also four abridged editions entitled "Quebec and Father Point", "Charlottetown and Strait of Canso", "Halifax and Sydney", "Saint John and Bay of Fundy".

*Pacific Coast Tide Tables.*—"Tide Tables for the Pacific Coast of Canada", complete edition. There are also abridged editions entitled "Vancouver and

Sand Heads" and "Prince Rupert and Northern British Columbia". The 1947 Tide Tables will be improved by having predictions for the velocity of the flood and ebb streams through Seymour Narrows.

Publications on current and tidal streams for the assistance of navigation are: "Tables for Direction and Velocity of Currents in the Bay of Fundy and its Approaches"; "The Currents in the Gulf of St. Lawrence"; "The Currents in the Entrance to the St. Lawrence"; "The Currents in the St. Lawrence Estuary, Ste. Anne des Monts to Father Point", and "Atlas of Current Charts for Hourly Stage of the Tide, Orleans Island to Father Point".

Other publications not bearing definitely on navigation are: "Tide Levels and Datum Planes, Atlantic Coast"; "Tide Levels and Datum Planes, Pacific Coast"; "Tide at the Head of the Bay of Fundy", and "Tide and Tidal Streams".

The principal tidal stations maintained in operation are:—

*Atlantic Coast.*—Quebec, Father Point, and Harrington, P.Q.; Charlotte-town, P.E.I.; Saint John, N.B.; Halifax, N.S.; Churchill, Man. A station at Chicoutimi is operated during the open season.

*Pacific Coast.*—Vancouver, Caulfeild, Victoria, Clayoquot, Canoe Pass, Beaver Cove and Prince Rupert, B.C. Temporary tidal stations were operated at Port Hardy and Digby Island, also at Bloedel and Brown Bay. The latter two were in connection with the Seymour Narrows investigation.

*Special Investigations of Tides and Tidal Streams.*—The only survey of tidal streams carried out during the year was in Seymour Narrows, B.C. A fast boat was employed to measure the stream velocities and directions in the area between Ripple Rock and Maude Island. From the results of this work the harmonic rate constants obtained along with slack water predictions can be converted to predicted rates of the mid-flood or mid-ebb streams for use in the tide table publications.

*Information Service.*—Special tidal data were furnished to navigational interests, engineers, coast industries, and Government Departments.

#### PRECISE WATER LEVELS

Essential to shipping and engineering purposes on the Great Lakes-St. Lawrence Waterway is the maintenance of adequate water-levels. The continual fluctuations and the seasonal and long-term trends are closely watched, and extensive remedial works have been constructed. The authoritative source of information in regard to lake and river levels is the Hydrographic Service which maintains a complete system of self-registering water-level gauges from Quebec to Port Arthur. Analytical studies are made, concise summaries are promulgated, and a consultative service is maintained for public and departmental use.

In the year under review, water-level gauging stations were maintained at 47 locations on the Great Lakes and St. Lawrence, and Ottawa Rivers. The sum total of recordings was 524 months and well over 600,000 water-surface elevations were compiled into comprehensive tabulations. Over 14,070 sheets of bulletins, profiles and special data were issued and 12 monthly, 5 annual, 6 general data and 5 graphic bulletins were also published. The "Memoranda re Bench Marks, Low Water Datums, etc., covering the St. Lawrence River from Montreal to Quebec" was completed and distributed. There was a large increase in requests for information and data relative to specific problems in which water-levels were the main factor. The unusual, but not unprecedented, annual cycle in Lake Ontario levels during 1945 was the basis for numerous inquiries from interests along the lake shores, especially in the vicinity of Toronto and Hamilton.

As indicated in last year's report the work of the Precise Water Levels Division has extended to the Mackenzie River, where industrial requirements have greatly increased waterborne traffic. To enable the establishment of a preliminary low-water datum for charting and engineering purposes, arrangements were made with Government and commercial interests to establish staff gauges at various points on the river. Some records have been received and will be used for preliminary study, but a low-water datum co-ordinated for the whole river will require the running of a line of precise levels and the establishment of geodetic bench marks throughout the waterway.

#### CHART CONSTRUCTION

The shift of emphasis from the abnormal war-time demands of the defence forces to normal requirements of peace-time shipping was reflected in a decline in the number of charts published. This should not be interpreted as indicating any slackening of activities, however, as the cessation of hostilities provided a much-needed opportunity for undertaking a class of work which long had to be held in abeyance. This, in part, consisted of the preparation of new charts from data on hand, and the making of extensive cartographic revisions of other existing charts which had become almost obsolete. The need for such work is acute but the shortage of draughtsmen trained to undertake it is even more so and, as a result, this division is faced with a growing arrearage of cartographic work.

In the period under review 88 charts and other navigational publications were printed as follows: 47 charts published in colours; 15 charts printed in black only including 1 reprint of an Admiralty chart; 13 wall and special charts for the defence forces; 6 index maps; 4 patches for chart correction; 2 miscellaneous charts and one Catalogue of Nautical Charts.

A list of nautical charts published during the year may be obtained by mariners or interested persons on application to the Surveyor General and Chief, Hydrographic Service, Department of Mines and Resources, Confederation Building, Ottawa.

#### DISTRIBUTION OF NAUTICAL PUBLICATIONS

As indicated by the following figures of annual chart distribution, demand for these aids to navigation was well sustained in 1945:

1939, 19,850; 1940, 33,136; 1941, 47,699; 1942, 50,968; 1943, 83,936;  
1944, 106,042; 1945, 101,633.

Hydrographic publications distributed during the year were as follows: Catalogue of Charts, Sailing Directions and Tidal Information with Index Maps, 1,188; Navigational Charts 101,633; Pilots and Sailing Directions, 977; Supplements to Pilots, 256; Tide Tables, 59,203; Water Level Bulletins, Graphs, exclusive of those distributed through Notices to Mariners, 14,070.

Many Canadian charts are reproduced in quantity by other hydrographic offices for the use of their own vessels. Total world circulation of these publications is, therefore, greatly in excess of the above figures.

#### LEGAL SURVEYS AND MAP SERVICE

The principal functions of this Service are the production and distribution of a wide variety of maps and air charts covering Canadian territory, the making of legal surveys under the direction of the Surveyor General, and the photographing and printing of hydrographic charts.

During the year an important development affecting the production of aeronautical charts was the preparation made to accommodate and regulate

the expected large expansion of civil aviation with the cessation of hostilities. Within the Provisional International Civil Aviation Organization set up at the Chicago conference in November 1944 is included a map division, one of the functions of which is to lay down specifications for all the various aeronautical charts required for safe air navigation on a world wide basis. At its first meeting in Montreal in November, 1945, the specifications for the World 1:1,000,000 aeronautical chart series for contact or visual pilotage were drawn up and subsequently approved. One chart of the series in Canadian territory, the Athabaska River sheet, is now under course of preparation and will be published in 1946. The total requirement to cover Canada in this series is about 68 sheets. Many of them are in our northern territory where the present knowledge of topography is limited. Progressively further specifications will be produced by P.I.C.A.O. to cover other aeronautical charts, the keynote being to provide all the aid possible in the interests of safe air navigation.

Although the quantities of the eight mile to one inch aeronautical charts required have diminished considerably, the same necessity for the revision of the air information plates continues in order to keep them up-to-date, the changes occurring being those needed in the change-over from the war-time set up to an expanding peace-time requirement. The great value of the complete coverage of Canada by the eight mile sheets is evidenced by the many orders for maps in the series. An attempt is being made to add all new topographical information as it becomes available from the Photogrammetry Division or from other sources. The one hundred and thirty-four thousand square miles plotted by the Photogrammetry Division during the year has not been all included in the maps.

The supervision of the draughting required in the amendments to the Canada Air Pilot and the Pilot's Handbook continued throughout the year. It is expected that the Service will shortly be required to undertake all the compiling, draughting, and distribution in connection with them.

Owing to diminishment of the very large orders from the R.C.A.F. the number of maps distributed decreased about fifty per cent during the year to a total of 540,761 copies, but the number of letters and requests dealt with increased about seven per cent and as the tourist season advances this increase is expected to accelerate. The total cash revenue from the sale of all classes of maps was \$24,271.

Eleven field parties operated during the year. Four were employed in laying down control for legal surveys in the Yukon and Northwest Territories and in making miscellaneous legal surveys including a new townsite at Yellowknife made necessary by the increased mining activities in the adjacent area; two parties made major surveys of Indian reserves in Alberta and Ontario and one party made miscellaneous Indian reserve surveys principally in Quebec. Two other minor parties were employed in making field revisions of aeronautical charts that had been compiled from surveys made many years ago. Under the direction of the British Columbia-Yukon Boundary Commission, one party laid down and monumented a portion of the 60th Parallel as determined by precise astronomical observations. The cost of this survey is borne equally by the Province and the Dominion. The survey of the Alaska Highway was continued.

This Service has been requested to make the topographical plans required for the studies to be made in connection with the international Columbia River Project. The full extent of the work is not yet known but it is estimated that it will take several years to complete it. During the past summer one party was employed in making a plan at the scale of 1,000 feet to one inch with accurate contours at the two-foot interval. The area surveyed included both the reclaimed and unreclaimed lands in the Kootenay Flats adjacent to Creston, British Columbia.

Both field and office operations were restricted because of the lack of properly qualified surveyors, draughtsmen, and map compilers. This is a condition common throughout Canada and other countries and can only be corrected in time through education and training.

## LEGAL SURVEYS

### FIELD WORK

The attention which in recent years has been focused on the economic possibilities of Northern Canada continued during the year to stress the need for surveys in the Northwest and Yukon Territories.

The program of surveys undertaken was limited by a lack of qualified surveyors and was designed to meet only the immediate requirements in the Territories and the most pressing needs in the settled parts of the provinces.

*Yukon Territory.*—The survey of the right of way of the Alaska Highway commenced in 1944 was extended an additional 180 miles westerly to a point about one mile west of Whitehorse. In addition to defining the limits of the right of way, this survey is intended to serve as semi-precise control for future surveys in its vicinity. The semi-precise control survey along the Dawson-Whitehorse Road, also commenced in 1944, was extended an additional forty miles northerly to a point about seven miles north of Kynoeks. A preliminary survey was made of Teslin Settlement and a layout for a subdivision into village lots was designed to suit the conditions on the ground at that point. Traverse surveys were made of roads, telephone lines, and oil pipelines at Careross and at Tagish to facilitate formalization of rights of occupation.

*Northwest Territories.*—Sixty miles of base line and block outline surveys were carried out in the Mackenzie River Valley in continuation of the system of control surveys adopted for the Northwest Territories. The survey was made of an addition to Yellowknife Settlement providing an additional 550 lots, and the subdivision was made of blocks 19 and 20 of the existing settlement. The airport at Yellowknife was surveyed and a road four miles in length connecting it with the settlement was also laid out. Nineteen settlement lots were laid out at Pokiak and fifteen additional lots at Aklavik, and a survey was made for drainage purposes at the latter point. Settlement surveys were made at Rat River and at Taltson River, and a retracement survey was made of lots 1 and 5, group 765, at Bell Rock. In addition, instructions were issued to seven Dominion Land Surveyors in private practice for the survey of 121 mineral claims in the Yellowknife and Prosperous Lake areas.

*Alberta.*—In fulfilment of treaty obligations two new reserves totalling 46,700 acres were surveyed in the vicinity of Rocky Mountain House for the Sunchild and Ochiessie bands of Indians.

*Ontario.*—A preliminary survey was made of the Indian settlement in the unceded portion of Manitoulin Island with a view to designing a system of farm lots to suit conditions on the ground. A preliminary survey was also made of the Indian-owned summer resort site at Snake Island in Lake Huron. A hospital site and sites for the Anglican mission and for the Hudson's Bay Company were surveyed on Moose Island (near Moosonee) for the Indian Affairs Branch.

*Quebec.*—Retracement surveys were made of a large number of lots in Caughnawaga Indian Reserve for the purpose of clarifying titles of the Indian owners. A resurvey was made of the boundaries of Restigouche Indian Reserve and a cemetery was surveyed on that reserve.

## OFFICE WORK

In addition to preparing the instructions for the above surveys and to examining the plans, field notes, and other returns relating to them, the usual routine work of preparing descriptions, reports, plans, and sketches relating to surveys affecting the 2,220 Indian reserves in Canada and to the extensive surveys carried out in the Prairie Provinces by this Department prior to the transfer of the natural resources, was continued.

Two hundred and sixty descriptions for insertion in legal transfers and eight Orders in Council relating to land transfers were prepared; fifty-eight new plans were drawn and one hundred and fifty additional plans were examined and checked. Three thousand, one hundred and fifty blue-prints and photostat copies of plans and field notes in the records were requisitioned and despatched in response to requests and additional information was added to seven hundred and twenty-two of the blue-prints.

One thousand, three hundred and forty-eight letters or memoranda relating to surveys were prepared for signature by the Surveyor General.

## AIR PHOTOGRAMMETRY

The work of this division during the past fiscal year was devoted almost exclusively to plotting trimetrogon air photographs for 8-mile aeronautical charts.

Field photography was limited in quantity, owing to bad weather. In addition to areas covered by R.C.A.F. trimetrogon air photographs, certain additional areas mapped as a war measure by the U.S. Army Air Forces were re-mapped by the division using the U.S.A.A.F. air photographs. The U.S.A.A.F. plotted these photographs rapidly to meet the urgent war demand for reconnaissance aeronautical charts at the 1:1,000,000 scale. Examination showed that to meet the requirements of our 8-mile aeronautical charts replotting was necessary. The detail extracted from the photographs covers the requirements for four mile to one inch maps. Additional control, however, is needed to meet the accuracy requirements.

Planimetry plotted from trimetrogon air photographs amounted to 134,198 square miles, distributed as follows:

8-Mile Map Sheet No.	Name	Area Plotted
105-N.1/2	Pelly River	5,000 sq. mi.
95-N.1/2	Wrigley	10,000 "
117-S.1/2	Herschel	18,500 "
22-SW.	Chicoutimi-Rimouski	25,138 "
12-NW.	Mingan-Cape Whittle	24,120 "
23-NE.	Dyke Lake	15,300 "
23-SE.	Ashuanipi	17,440 "
94-SE.	Hudson-Hope	1,550 "
115-N.1/2	Fort Selkirk	4,500 "
74-NW.	Lake Athabaska	3,162 "
74-NE.	Black Lake	6,325 "
74-SE.	Mudjatik-Geikie	3,163 "

Indices were prepared for 20,000 air photographs during the year. Miscellaneous work comprised air plots for four airports, and three small-scale plots for the study of legal survey requirements.

Eight requests to the Air Surveys Committee were prepared for vertical air photography for the Surveys and Engineering Branch.

Thirty-five operational maps for vertical air photography of Indian reserves, comprising eighteen copies of each, were prepared and delivered to the R.C.A.F.

Forty-one base maps were prepared for the 1946 vertical photographic program.

Technical advances keeping pace with experience were made during the year, whereby the rate of production was stepped up and accuracy increased. A method of adjusting the complete net of major and minor control points was devised, which contributes materially to trimetrogon mapping.

Additional instrumental equipment was purchased to supply the needs of the division. This included a high precision air base-lining instrument.

*Personnel and Training.*—The staff gradually increased from 12 at the beginning of the year to 21 at the close. Eleven operators resigned during the year and were replaced by ten new ones, who had to be trained in the various phases of the work. Training is a continuous process, and practice, apart from knowledge, is an essential before proficiency is attainable.

The quality of R.C.A.F. air photographs in respect to resolution, contrast, navigation, and horizons, together with well calibrated cameras, promotes economy and accuracy in the plotting of photographs. The co-operation of the R.C.A.F., diligent and painstaking in its efforts to meet our office requirements, is gratefully acknowledged.

### MAPPING

During the past fiscal year, the concentration on mapping for war purposes gave way to a gradual resumption of a more normal peace-time program.

*Field Work.*—In British Columbia a plane table survey, on a scale of 1,000 feet to the inch and with two-foot contours, was begun of the Kootenay River Flats, starting from the International Boundary. This survey is required by the International Joint Commission for the study of the Columbia River Project.

The survey of the British Columbia-Yukon boundary was continued easterly from the west shore of Teslin Lake, approximately 42 miles to the vicinity of McNaughton River, and the preliminary triangulation was completed to a point about 14½ miles farther east.

In Manitoba the field work necessary for the revision of the Brandon-Winnipeg 8-mile sheet was done, and in Quebec similar field work was done for the revision of the Noranda-Wasanipi sheet.

*Office Work.*—In map compilation, emphasis was continued on the production of the National Topographic Series—particularly the 8-mile to the inch sheets, special editions of which are used as aeronautical charts. These sheets, covering the whole of Canada at a uniform and convenient scale, have a usefulness extending far beyond their war-time purpose and a special effort is being made to revise them as new material becomes available.

The complete series of the 8-mile maps—a full description of which has been given in previous reports—consists of 221 sheets, of which seventy-one are standard editions and the remainder preliminary. During the fiscal year nine standard and thirty-two preliminary sheets were revised to show new topography obtained mainly through aerial photography by the trimetrogon method.

To keep pace with changing information regarding aids to aerial navigation 115 plates showing the latest aeronautical information were compiled or revised during the year in preparation for overprinting in magenta colour on the air navigation editions.

In anticipation of a big demand by the long neglected and valuable tourist trade, and by the public at large, for "general purpose maps" on a larger scale, a start was made by the much needed revision of a few sheets of larger scale maps more suited to the peace-time needs of civilian life. In addition a map of the Ottawa district, on a scale of one mile to the inch, was prepared for use in the National Capital Planning Service.

The work of compiling or revising plotting charts for use in air navigation without visual ground contact, an essential factor in the Commonwealth Air Training Plan, showed a decline from the early war years. During the past fiscal year two new plotting charts were compiled and two more were revised, two of them being on the 1:1,000,000 scale and two on the 1:2,000,000 scale. A fifth chart of northwest Canada on the scale of 1:4,000,000 was prepared for Operation Musk Ox.

Work done in the preparation and revision of miscellaneous smaller scale maps included the compilation of the Athabaska River sheet, first in a series of aeronautical charts belonging to the World 1:1,000,000 Aeronautical Chart Series, the revision of the overprint of the 50-mile map of northwest Canada showing the transportation facilities, and the preparation and bi-monthly revision of an index showing the latest dates of publication of the 8-mile to one-inch aeronautical charts.

The usual routine work of the office included the annual revision of the astronomical field tables; the checking and recording of field returns and the planning of next season's field program; the maintenance of the Federal electoral maps; the supplying of information regarding latitude and longitude, the magnetic declinations, and elevations at certain designated points; the inspection of all names appearing on the maps prepared by this service and on the charts submitted by the Hydrographic Service, and the usual large number of miscellaneous jobs of calculating and compiling required for a diversity of uses by the various branches of the Government Service.

Among these latter may be mentioned the preparation of statistical information regarding stream lengths, areas, etc., for the Canada Year Book; the calculation of official air line distances for the Post Office Department; the preparation of a map of the world on an azimuthal equidistant projection, centred at Churchill, for the Naval Service; the preparation of three field maps on a scale of 16 miles to the inch for trimetrogon photographic operations and for necessary astronomical control observations; also many four-mile operational maps throughout Canada for use in planning vertical photography programs, and the preparation of a skeleton map of Canada, Alaska, Labrador, and Newfoundland for the R.C.A.F. showing airways, routes and restricted areas.

This division also co-operates with other mapping organizations in exchanging information. During the year many requests of this nature were received and complied with, and about 500 maps and prints of various kinds were indexed and filed for reference.

Among the more important maps in hand at the year's end, not previously mentioned, are the Gatineau River, 1:1,000,000 aeronautical chart; a new 16-mile map of Manitoba south, and a new map of Canada on the scale of 64 miles to the inch to replace the previous 60-mile map published in 1930 and now out of print. The new map is being entirely recompiled from the latest information and in addition to the railways will show the more important trunk roads and the National Parks.

#### SURVEY RECORDS AND DISTRIBUTION

This division has charge of the registration and recording of all survey notes and plans affecting Dominion lands and the distribution of topographical and geographical maps, aeronautical charts, publications, and official plans.

The main work of the division is complying with requests from government agencies and the public. In addition to dealing with correspondence and serving many visitors it is necessary to keep records; compile indexes, lists and catalogues; to make inventories, estimates, and reports; to receive, arrange, store, and ship maps, and to care for the many thousands of official survey records.



During the year 21,774 letters and requests were dealt with, and 540,761 maps, aeronautical charts and plans together with 3,555 publications were distributed. Up to the end of the fiscal year 22,412 books of survey notes and 40,264 plans have been placed on record. During the year 690 technical requests were dealt with, and 8,770 official plans were distributed.

At present the stock of maps, charts, and official plans consists of nearly eleven thousand items. As in the past, a constant inventory is kept, and requests for reprints and estimates of future requirements are made.

Upon the close of hostilities the demand for maps and aeronautical charts by the armed services showed a sharp decline and this is reflected in the total distribution being 50 per cent less than the previous year. At the end of the war the Chiefs of Staff Committee, Department of National Defence, removed all restrictions governing the distribution of maps and charts. This factor in conjunction with the demand for maps by business concerns, government agencies, tourists, and educational institutions, resulted in an increase in individual requests dealt with during the year. After five years of war, during which no publicity was issued due to military restrictions and to pressure of war work, the volume of maps distributed during the year is over 300 per cent greater than any pre-war year.

Stocks of the various sheets of the National Topographic Series published by the Geographical Section, G.S., Department of National Defence, were requisitioned as needed and 42,747 were distributed. This total shows an increase of 60 per cent over the previous year. The geographical and topographical sheets produced by the Bureau of Geology and Topography were also stocked. The revised graphical indexes to sheets of the National Topographic Series and a new index to aeronautical charts, issued bi-monthly, were distributed. The distribution of maps to those on the mailing lists, which was suspended during the war, has been resumed.

#### MAP PUBLICATION

When the compilation of the maps has been completed they are sent to the Draughting Division where finished drawings are made for each colour plate required in their production. They are then photographed to the printing scale and the necessary zinc printing plates prepared in the Photo-Mechanical Division. The printing plates are then sent to the Lithographic Division for printing. The drawings prepared by the Hydrographic Service are also photographed, printing plates made, and the charts printed in this office.

#### DRAUGHTING

In the Draughting Division the finished drawings of three standard and thirty-eight preliminary 8-mile to one inch aeronautical charts were revised or corrected for new editions, and 10-minute grids according to the new plan of showing graticules were drawn for overprinting on eight charts of this series. Five new plotting charts were drawn and one was revised. Drawings of fifteen larger scale maps were also made, revised or corrected for new editions. Twenty-three new township plans and a wide variety of miscellaneous other maps, plans, projections, and diagrams were drawn. One hundred and eleven drawings for the magenta overprints showing aeronautical information for the air editions were made.

#### PHOTO-MECHANICAL

A program of reconversion got well under way during the fiscal year 1945-46. There was a rapid decrease in the volume of work, from all sources, passing through the Photo-Mechanical plant. However, since January a considerable increase in the amount of work is noted. Much of it is seasonal but conditions approaching normal are in evidence.

Greater use is being made of photo-mechanical film, particularly for work where extreme accuracy as to scale is not important and where the negatives are not related to a colour set.

The work performed in the Photo-Mechanical Division included: wet plate negatives 1,512; photo-lithographic plates, 570; photographic prints, 4,140; vandyke prints, 2,522; vandyke printing, 7,875 square feet; blue-printing, 275,180 square feet; photostat work, 7,669 sheets. As usual much of this work was done for other branches and for other departments.

LITHOGRAPHY

The total production of maps, charts, and miscellaneous printing jobs in this office during the fiscal year was 302, as compared with 460 last year and 586 the year before. The decline in the total number of copies printed was even more marked, being from 1,529,000 in 1943-44, to 1,321,615 in 1944-45, and to 340,633 during the last fiscal year. A comparison with pre-war conditions, however, indicates an increase of nearly 30 per cent in present production over the annual average of 263,000 copies produced during 1937-38-39. The decrease from the war-time production is due mainly, of course, to the drop in the demand for the 8-mile to one inch aeronautical charts and plotting charts, both of which were used in large numbers in the Commonwealth Air Training Plan.

Details of the work printed in 1945-46 are as follows:—

	Maps Published 1945-46	Total Copies
New maps printed.....	29	46,108
Maps reproduced .....	5	30,975
Maps revised .....	62	81,175
Maps reprinted .....	119	114,430
Hydrographic charts .....	79	61,520
Miscellaneous .....	8	6,425
Total .....	302	340,633

In addition, 166 plates showing aeronautical data were overprinted on 115,855 eight-mile sheets; 15 plates showing other information were overprinted on 22,160 maps of varied scales. The total number of impressions required to produce the maps printed during the year was 1,158,893.

An analysis of the maps printed shows that the revisions included fifty-three of the two, four, and eight-mile sheets of the National Topographic Series and three Sectional or other 3-miles-to-one-inch maps. The reprints included thirty-six 8-mile maps, fifty-eight township or settlement plans, eight plotting charts, and twelve other scale maps. New maps included five plotting charts, ten maps showing boundaries of European countries, and a miscellany of indexes and small scale maps.

Early in the war the Lithographic Division was handicapped by the difficulty of obtaining adequate supplies of almost all the essential requisites of a printing office. In spite of the prompt and energetic manner in which all requisitions were handled by the Department many necessities including pigments, oils, and chemicals were soon unobtainable or in very short supply. Some substitutes were tried but all were not satisfactory. Extraordinary efforts had to be made to obtain zinc and aluminum plates. Suitable fabrics and good leather were very scarce or at a premium, and rollers made from synthetic rubber gave substandard impressions. Notwithstanding this situation the presses were run at high pressure throughout the war and in the main stood up well, though the replacement of worn parts and breakages was a constant

problem. The restoration of normal conditions will, it is hoped, soon result in the resumption of pre-war standards of supplies and essential services.

Another problem, not connected with the war, is the difficulty of obtaining good registration due to the uneven expansion of paper through variations in humidity, especially in the late spring and early autumn. This problem is particularly acute when overprints have to be run on base maps which have been in stock for some time. At present the only available means of correcting this condition is by separating and racking the sheets and exposing them to electric heat in a closed room. This method interrupts production, causes loss in man-hours and moreover is not satisfactory. The only practical solution seems to be the installation of an adequate air conditioning system.

#### BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS

The Board of Examiners for Dominion Land Surveyors held two meetings during the year. The first was a special meeting convened on October 24 in connection with an examination held at Zeist, Holland, in September for candidates in the Canadian Occupation Forces. This examination was requested by the Director of Education, Canadian Legion War Services Overseas, and was held under his auspices. Forty-six candidates wrote the examination and of these twenty were successful.

The second meeting was the statutory one, held from February 11 to March 14. During this time examinations were conducted at Ottawa, Regina, and Edmonton. Twenty-eight candidates presented themselves, twenty-four for the preliminary and four for the final examination. Four candidates were successful at the preliminary and two at the final examination.

Three commissions were issued to candidates who had passed the final examination and had furnished oaths of office and allegiance and bond for the sum of \$1,000 as required by Section 25 of the Dominion Land Surveys Act.

Six Certificates of Preliminary Examination were issued to successful candidates who had complied with the requirements of the Act.

One Dominion standard measure of length was issued to a Dominion land surveyor.

## INDIAN AFFAIRS BRANCH

R. A. HOEY, DIRECTOR

The Indian population generally shared in the prosperous conditions and employment advantages prevailing in various parts of the Dominion. Hunting Indians of the northern regions, Indian fishermen on the Pacific Coast, and Indians employed in industry derived substantially greater financial returns from their vocations than during the previous fiscal year. Earnings from agriculture showed a decline owing to adverse climatic conditions in certain areas. There was an increase, however, in the proceeds of stock raising. The future economic position of the Indians in the post-war period may present difficult problems in some localities during the period of readjustment, but during the past year the Indians as a whole appeared to be more prosperous than at any previous time.

### POPULATION

The quinquennial census of the Indian population was taken in 1944. The records of the Branch indicate that there has been a slow but steady increase in the population from year to year.

The following table shows the number of Indians by provinces according to the 1944 census:—

Province	Population
Alberta .....	12,754
British Columbia .....	25,515
Manitoba .....	15,892
New Brunswick .....	2,047
Northwest Territories .....	3,816
Nova Scotia .....	2,364
Ontario .....	32,421
Prince Edward Island .....	266
Quebec .....	15,132
Saskatchewan .....	14,158
Yukon .....	1,531
Total Indian population .....	125,946

A more detailed statement giving statistics of the Indian population under the headings of religion, age, and sex in the various provinces will be found in Table 1 on page 224.

### INDIANS IN THE WAR

The previous annual report contained a review of Indian participation in World War II and war activities. Since that report was published revised enlistment figures have been received showing Indian enlistments recorded as follows:—

Prince Edward Island .....	27
Nova Scotia .....	117
New Brunswick .....	203
Quebec .....	316
Ontario .....	1,324
Manitoba .....	175
Saskatchewan .....	443
Alberta .....	144
British Columbia .....	334
Yukon .....	7
Total .....	3,090

Details of decorations awarded to Indians, not available when the last report was written, have also been received as follows:—

Rifleman Charles Nahwegezhik, Canadian Infantry Corps, Manitoulin Island Indian Agency. Awarded Military Medal.

A/Sergeant Thomas Prince, Canadian Infantry Corps, Clandeboye Indian Agency, Manitoba. Awarded Military Medal.

Private George Thomas Munroe, Canadian Infantry Corps, Duck Lake Indian Agency, Saskatchewan. Awarded Military Medal.

Matters pertaining to the rehabilitation of Indian returned veterans are dealt with in a separate section of this report.

The monetary war contribution was large, the following donations having been received from Indian bands and individual Indians throughout the Dominion:—

Canadian Red Cross .....	\$13,797.50
Canadian War Services .....	1,787.45
Salvation Army .....	100.00
"War Effort" .....	2,822.51
Catholic Refugee Children .....	69.00
British War Victims' Fund .....	400.00
London Orphans' Fund .....	432.30
British War Effort .....	100.00
Queen's Canadian Fund .....	850.00
Canadian Aid to Russia Fund .....	610.34
Wings for Britain Fund .....	2,427.61
Christmas Cheer for British Children Fund .....	200.00
Total .....	\$23,596.71

This represents only part of the contribution. Many subscriptions were sent directly to local organizations, and substantial donations of furs, clothing, and other articles were made, the monetary value of which has not been calculated.

### PROGRESS DURING THE YEAR

#### NORTHWEST TERRITORIES

Indians in the Fort Norman Agency remained in relatively good financial circumstances throughout the year, a big factor in this connection being the appearance of large numbers of caribou closer to the Mackenzie River than had been the case for many years.

Houses were repaired in the Franklin District, but little new building was done. Summer fishing activity was limited, although sufficient fish were caught for dog feed. Although fur-bearing animals were scarce a good catch was reported, and prices held up well.

Making the annual fishing trip to Great Slave Lake in the Fort Simpson Agency, the Indians made good hauls, and started home early enough to avoid the freeze-up. Experience has been a good teacher, and for a long time now no Indian has been trapped in the ice although some twelve years ago it was usual to learn of fishermen being caught by staying on the lake too long. In view of the sizeable catch of fish, the Indians did not suffer from the absence of rabbits, although a scarcity of caribou and moose was regretted. There was a general shortage of fur, with fox being of poor quality and lynx very few in number. There was almost no sign of mink, although these animals had been fairly numerous in previous years. Those who did manage to trap mink received excellent prices for them.

The Fort Simpson Indians had enough rain for their gardens, and wild fruit grew in greater profusion than in many years. Large quantities of strawberries, raspberries, saskatoons, gooseberries, and mooseberries were gathered and

enjoyed. Bluefish was plentiful in the river and a few whitefish were caught. Most of the children of the settlement had garden plots of their own with attractive borders, and produced flowers and vegetables. Each child was permitted to select the seeds he wanted, and carrots seemed to be the predominant vegetable. The children took great pride in showing visitors around their garden plots, and Indian parents benefited by the produce for their tables.

In the Fort Resolution Agency a scarcity of muskrat was reported and the catch was small.

#### BRITISH COLUMBIA

The Indians of British Columbia had a good year, continuing by their industry and conduct to improve their lot; returns from trapping, lumbering, and fishing were satisfactory. The spring was late and consequently seeding was not completed in some agencies until the end of May. No outstanding agricultural project was reported during the year. The hay crop was light in parts of the interior as a result of lack of moisture and inadequate grasshopper control.

Prosperity of the war years and absence of Japanese competition continued with great benefit to those Indians engaged in the fishing industry. Much of the increased earnings of the Indian fishermen went to purchase new boats and fishing equipment and to provide improvements to the fishing craft.

Indian trapping returns on the coast and in the northern interior remained very high.

Widespread opportunities for employment at high wages still prevailed. The demand for Indian farm workers in the United States at high wages attracted a large number of West Coast, Cowichan, Vancouver, New Westminster, Lytton, Okanagan, and Kootenay Agency Indians across the line, and a number of Indians normally employed in agriculture obtained employment in the logging industry.

The Osoyoos irrigation project advanced somewhat and the sum of \$4,429 was expended in construction by the Dominion Water and Power Bureau towards the close of the fiscal year.

In the New Westminster Agency the weather was extremely good all summer and wages were high.

The men in the Sardis area operated a club entitled the "Sardis Indian Cattle Club" with a view to maintaining interest in the improvement and protection of their stock.

The Native Women's Welfare Clubs were in operation and did useful work on the reserves. Basketry and sweater knitting continued on the Katzie, Chehalis, Skwah, and Pemberton Reserves and good work was turned out. Plenty of work was obtainable across the border and weeders in the Washington berry fields were reported to have received as much as 85 cents per hour. Employment was obtained in the hop-picking fields around Sumas, Sardis, and Agassiz. Conditions at this Agency were good and work plentiful for Indians of all ages. The men engaged in logging, fishing, and farming and the women and elderly people, as well as the older children worked in the canneries and berry and hop-fields, both in British Columbia and in the State of Washington. The hop companies paid an average of 5 cents per pound to pickers. Crops were good and returns to the Indians were most satisfactory.

The Kamloops Agency reported an improvement in crops due to a decrease in grasshoppers and an increase in water storage.

Many Indians grew good crops of peas and beans under contract and more new land was brought under cultivation. More hay was grown and a good price realized.

Assistance was given to Indians to purchase implements and harness. Members of the Kamloops Band were again encouraged by loans from band funds to purchase breeding stock to build up their cattle holdings.

There was vast improvement in beef stock brought down from the ranges in the Lytton Agency. Cattle were in prime condition and showed the benefits derived from the purchase of good bulls.

Great activity was reported in the logging and lumber industry, and Indians obtained work both in the woods and in the mills. Logging operations at Bella Coola continued with satisfactory results. A new tractor, with equipment, was purchased. The acute shortage of material and limited funds prevented any great improvement in the housing situation.

Owing to the scarcity of labour and demands for war work with resultant high wages, Indians did not engage in much handicraft during the year and the products were below standard. The Cowichan sweaters, however, continued to be turned out in considerable quantity at enhanced prices.

As a result of drought in July and August grain crops were very light in the Stuart Lake Agency and garden and root crops were also far below average. About 30 additional tons of hay were harvested by the Fraser Lake Band on the Fondeur Hay meadow recently purchased by the Department for the use of the band.

Trapping in the Williams Lake Agency was reported fairly good, the largest revenue coming from squirrels, which brought fifty cents a skin. Some Indians made as much as \$30 to \$40 in a day.

Trapping returns from winter hunting were moderate in the Stikine Agency and all trappers had slightly increased revenue as lynx were more plentiful and brought a good price. Wolves continued in great numbers and besides seriously depleting and driving moose from the country they attacked beaver and fox.

Salmon fishing ended late in October in the Kwawkweth Agency and all Indian fishermen concluded the season with a fair catch and return for their labour. Herring fishing was also good and the price of fur was high.

Autumn weather conditions in the Kootenay Agency were reported to be the most severe for many years, with early and heavy snowfall in October making it necessary to feed hay to Indian stock. The grasshopper pest did a great deal of damage to the crops on Upper Nicola Reserves in the Nicola Agency. Some good gardens were grown and the store of vegetables for winter consumption was ample. Large herds of deer roaming on the reserves caused some damage to the hay stacks. Stock on all reserves in this Agency was reported to be in fine condition.

#### MANITOBA

The spring of 1945 was cold, wet, and consequently late. In some districts the land could not be prepared in time and so was summerfallowed. On the Roseau River Reserve, 1,200 acres of summerfallowing were done, the largest in years. Crops harvested yielded heavy returns. Total yield at the Griswold Agency was approximately 65,000 bushels, wheat averaging 24 bushels and oats and barley 30 bushels to the acre. The income of one Indian on the Oak River Reserve was over \$3,700. The autumn was wet but all crops were safely harvested and the better farmers did well financially.

As a result of heavy rains in the autumn, large quantities of potatoes rotted and could not be harvested. In addition to potatoes, the Indians grew carrots, onions, peas, beans, corn, tomatoes, cucumber, squash, and pumpkins.

Cattle wintered well and came through in good condition. Work horses increased in number and were well cared for, since Indians now realize the economic value of a team of horses.

Hogs, poultry, and sheep showed a marked increase, and breeding sows were kept by approximately 60 Indians. In most cases, hogs were butchered for home consumption. About 30 Indians kept sheep and some of the flocks numbered from 15 to 20 head. Poultry increased, and day-old chicks were purchased from large hatcheries, with resulting improvement in stock.

The Indians did fairly well both in summer and winter fishing. Those who worked for wages were paid from \$75 to \$125 per month, plus their keep.

The trapping Indians on provincially-controlled areas did well and regular monthly returns made it possible for them to attain a much higher standard of living. The price of muskrats was high, ranging from \$1.50 to \$3, and although the catch was small the Indians received a fair return.

The Indians made an excellent showing in relieving the labour shortage. Many worked for white farmers or assisted in lumber camps and in securing pulpwood, while others were employed in cities, factories, delivering coal, and in packing and cold storage plants. At some points the Indians worked on the railroads as section hands and in other districts they cut cordwood for fuel and helped greatly to relieve a critical situation.

The past year gave the Indians of Manitoba continuous work at top wages. They lived well and many built new homes. Others built additions and made minor improvements to roofs, windows, and floors.

The War Service Women's Clubs did exceptionally fine work. The list of re-made garments numbered over a thousand, and in addition certain clubs donated money to the Red Cross.

#### ALBERTA

At all agencies where binders were used some grain remained unthreshed as a result of the advent of early snowstorms. On the Blackfoot Reserve, sawfly damage was not so serious as in previous years, and although the yield was somewhat improved it was still poor. Returns from irrigated lands varied in direct proportion to the amount of water that could be obtained. The Hobbema area was heavily hailed. In the Edmonton Agency the crops were fair, considering the amount of precipitation received.

In the northern part of the province hail and early frost played havoc with all grains and garden truck, and as a result quality was too poor for seed purposes. In most cases seed grain and potatoes had to be purchased for farming operations in the spring. Community gardens were operated where irrigation was available and a good tonnage was harvested.

More summerfallowing was completed during the year due to the dry summer, which enabled easier weed-growth control, and the better farming methods employed. A definite effort was made on the Blood Reserve to clean up weedy areas by bringing in white farmers with good equipment on a crop-share basis. The control of couch-grass and Canadian thistle continued to be a problem for the Indian farmers. On the Blackfoot Reserve the increased operation of power equipment brought good results.

Excellent work was accomplished by Indian agents and farming instructors in the maintenance and repair of old farming implements.

The largest irrigated area on the Blackfoot Reserve has a community farm of 1,000 acres. Yields from alfalfa and coarse grains were good where the Indian farmers irrigated properly. A considerable acreage was irrigated on the Old Sun School farm and the results were encouraging. Indians are beginning to see the advantage of irrigated farming, although they have not as yet adopted it in full.



Hog sales were considerably lower, with 505 hogs bringing \$9,553. The number of Indians milking cows showed an increase and some made butter and sold milk and cream.

It was an extremely hard winter for the stock in most areas, with the exception of the Peigan Reserve. Range cattle were put on feed shortly after the first snow in early November. Feed supplies were limited and not sufficient for the large herds, making it necessary to purchase grains and roughage. Prices were high for poor quality hay, particularly on the Blackfoot and Stony Reserves. However, losses were surprisingly small, chiefly because of the close supervision and increased feeding of grain to range stock.

A more thorough use of spray for warble fly was made on the Blood, Peigan, and Blackfoot Reserves, where large-scale cattle raising is in operation, and resulted in improved hides and beef.

The various band and welfare herds were well cared for. From these herds breeding stock is given to young Indian men to start them in cattle-raising. A small pure-bred herd at the Peigan Reserve did very well and it is hoped that this new venture will produce good bulls for issue to the Peigan, as well as to other reserves.

There was a decided increase in the returns from trapping and hunting, due to higher prices for pelts and the fact that the industry is gradually becoming better organized.

Beaver and other fur-bearing animals were live-trapped and moved to various reserves. Organized trap-lines in the central and northern parts of the province were carefully supervised. Returns were especially good at Hobbema and Stony in the south, and Athabaska, Lesser Slave Lake, and Fort St. John in the north. Heavy snow-storms in all areas hindered trapping and reduced returns from big game.

Elk and buffalo hides from the slaughter of surplus animals in Banff and Jasper Parks were issued to the Indians for tanning, thus affording an opportunity for part-time livelihood.

The lakes in the north abounded in whitefish and the Edmonton Agency showed a return of over \$5,000 from this source.

Coal mines were operated on the Blackfoot and Stony Reserves. The demand at Blackfoot was greater than the supply, but higher wages elsewhere attracted many of the miners away.

Opportunities for work outside the reserves were many, and Indians returned to the same employment they had held in previous years, receiving higher pay as their skill increased. Indians living in the southern part of the province crossed into the United States and obtained employment in orchards and packing plants.

#### SASKATCHEWAN

Generally speaking the crop year throughout the province was not satisfactory. Three agencies had normal crop yields but the remainder were victims of a cold spring, a dry summer, and early frosts.

All community farms, however, had reasonably successful crops. Their financial position is now good, the majority having paid off their debts. Some have handsome surpluses. It is to be noted that agencies with community farms lead the way in the breaking of new land. In this the tractor plays a role. The Duck Lake Agency, where 1,024 acres were newly broken, made a most creditable showing.

Efforts to interest Indians in vegetable gardens were somewhat handicapped by poor crops due to bad weather. However, a steady increase in garden acreage is to be expected in view of the fact that many Indians have now developed a taste for vegetables.

Livestock sales continued on a high level, 1,249 head being sold for a total of \$105,278 as against last year's 1,042 head. The average price was slightly higher than the previous year. It is of interest to note that about 75 per cent of the cattle sold were two-year-old steers.

There was a slump in fishing owing to parasites which infested the northern lakes. Whitefish caught in these lakes cannot be marketed unless processed at filleting plants. Consequently, Indians in these areas, who previously were able to earn a livelihood at certain times of the year by fishing, had to confine their activities to fishing for their own needs.

During the year some changes in provincial fur and game regulations came into effect and muskrat trapping in the southern portion of the province is now directly under the control of the Department of Natural Resources, which has been reasonably generous in permitting Indians to take a fair share of the crop. Systematic trapping and control of water levels will result in a moderate revenue to the Indians from this source. In the north the policy is to follow the group control system rather than that of individual trapping leases. This should work to the advantage of the Indians, particularly those of the two new reserves.

Attendance at all Indian schools, both day and residential, showed a marked increase during the year. The increased attendance at day schools may be attributed to family allowances. Indian agents, farming instructors, as well as day school teachers, all showed a marked interest in the expenditure of family allowances and the resulting effect on Indian children as a whole was excellent.

#### ONTARIO

Throughout the year employment conditions among the Indians in Ontario remained on a high level and able-bodied Indians engaged in agriculture, trapping or lumbering who desired employment in industry found steady work at higher wages than they received in the past. The satisfactory employment conditions were reflected in better living conditions and resulted generally in many improvements being effected in homes. Indians, employed in industry for the first time during war years, continued to show steady improvement in their attendance at work. It can be said that the tendency to work only periodically is being overcome in favour of regular attendance in steady employment. Many Indians in southern Ontario are employed in industries in the United States to good advantage and commute regularly to their homes on Ontario reserves. The seasonal demand for workers at high wages in the tobacco growing sections of Ontario and in the fruit and vegetable canning factories has greatly increased the incomes of many Indian families whose men and women operate small farms on reserves and are able to take advantage of this work.

Agricultural operations on Indian reserves in the southern part of the province were generally successful with an increased acreage under cultivation and better-than-average crops harvested. Cash returns from canning factory crops, particularly tomatoes, corn, peas, and beans, and from hog production, were increased considerably over the previous year. On reserves in the central part of Ontario where beef-raising provides the main source of agricultural revenue a satisfactory year was experienced by Indian farmers who enjoyed good market prices.

Returns to Indians engaged in commercial fishing in the Georgian Bay area remained high with an advantageous market for an average season's catch.

The program to reforest submarginal lands on Indian reserves continued, with the planting of some 100,000 seedlings of mixed varieties.

Approximately 12,000 Indians are engaged in trapping in the northern part of the province and, while the total number of pelts taken showed a decrease from the previous year the loss in quantity of fur was more than offset by the

increased prices obtained. The Kesagami Beaver and Fur Preserve, started in 1941 and containing 3,840,000 acres, has now reached the stage of production when moderate trapping is contemplated. The estimated beaver population on this preserve is 3,360. The Albany Beaver and Fur Preserve, started in 1943, containing 6,960,000 acres, shows satisfactory progress, and the restocking with live beaver of this preserve continues.

During the year a marked advancement was again made in defining Indian registered trap-lines throughout the northern part of the province.

The organization of Indian women's clubs on reserves made a marked advancement during the year with many new clubs being formed. A conference of club presidents and leaders was held at Tyendinaga Reserve when exhibits of remodelled clothing were displayed and other club activities discussed. The enthusiasm and willingness to assist in club work by Indian women members generally is resulting in a marked improvement in homes throughout the reserves.

#### QUEBEC

In the settled parts of Quebec, Indians continued to find profitable employment in agriculture and general industry.

The hunting and trapping Indians in the interior and northern parts of the province received substantially larger returns than during the previous year.

On the whole economic progress among the Indians of Quebec has been satisfactory and there is a noticeable improvement in their living conditions.

#### MARITIME PROVINCES

The Indians of the Maritimes, who were in a depressed condition economically in the pre-war period, have enjoyed better circumstances in recent years through increased opportunity for employment in agriculture and industry.

In Nova Scotia and Prince Edward Island the Department has endeavoured to centralize the Indian population on a few large reserves where improved facilities are being provided and this policy is producing beneficial results in living conditions and health.

### INDIAN HEALTH SERVICES

By Order in Council P.C. 6495 the Indian Health Service Division, including Eskimos, of the Department of Mines and Resources was transferred, as of November 1, 1945, to the Department of National Health and Welfare. The Annual Report, therefore, will cover the operation of the Division for the entire fiscal year. Indians who come within the responsibility of the Indian Health Services Division, according to the 1944 census, number 125,686 and Eskimos approximately 7,700. The estimated yearly increase in the population of the foregoing is 1,500, as nearly as can be computed.

In addition to special medical services provided to Indians through health units and provincial treatment, 4,446 patients were treated at the following departmental hospitals for a total of 176,760 patient days:

<u>Name of Hospital</u>	<u>Province</u>	<u>No. of Patients</u>	<u>No. of Days</u>
Tobique Hospital	New Brunswick .....	93	884
Manitowaning Hospital	Ontario .....	18	2,381
Lady Willingdon Hosp.	" .....	410	12,433
Squaw Bay Hospital	" .....	31	7,062
Dynevor Hospital	Manitoba .....	231	17,200
Fisher River Ind. Hosp.	" .....	292	7,077
Fort Alexander Ind. Hosp.	" .....	254	3,204
Clearwater Lake Hospital	" .....	100	5,483
Norway House Hospital	" .....	500	12,139
Fort Qu'Appelle Hospital	Saskatchewan .....	585	23,569
Peigan Hospital	Alberta .....	124	1,005
Sarcee Hospital	" .....	10	347
Morley Hospital	" .....	183	1,406
Blackfoot Hospital	" .....	433	7,462
Blood Hospital	" .....	849	9,067
Coqualeetza Ind. Hosp.	Br. Columbia .....	232	60,863
Fort Norman Hospital	N.W.T. ....	101	5,178
		<u>4,446</u>	<u>176,760</u>

Apart from the foregoing, through contractual and special arrangements made with provincially and locally operated hospitals, 16,239 patients were treated for a total of 404,730 patient days. These services were performed in 434 hospitals in Canada.

The U.S. Army Airport Hospital at The Pas, Manitoba, having a bed capacity for 75 patients, was acquired by the Department during the year and under arrangements made with the Sanatorium Board of Manitoba treats tubercular Indian patients to the capacity of the hospital. Included in plans for the Division is the enlargement of existing facilities to provide for approximately 125 additional beds.

The Jesuit College Hospital at Edmonton, Alberta, was acquired by the Division from the Department of National Defence (Army) towards the end of the fiscal year and treated tubercular Indians and some patients under the responsibility of the Department of Veterans Affairs. The capacity for this hospital should eventually reach about 400 patients.

The Miller Bay Hospital at Prince Rupert was acquired early in the year from the Department of National Defence for Air and, when staff is available, will be able to accommodate about 150 patients.

The Indian Hospital at Fort Norman in the Northwest Territories was totally destroyed by fire in February of 1946. Due to the prompt and heroic efforts by the staff, all patients were evacuated without injury or loss of life. The building, however, including the contents and all the personal effects of the patients and the staff, was lost.

The general health picture during the year remained about the same as the previous year, with acute infectious diseases, tuberculosis, malnutrition, and venereal disease still constituting the major health problem.

#### COMMUNICABLE DISEASES

Various epidemics of measles, whooping cough, and mumps occurred with the incidence about the same as among the white population. Epidemics of these infections, affecting isolated bands, were because of isolation and relative lack of immunity more severe than in other areas.

### DIPHThERIA

While cases of diphtheria occurred, these did not reach epidemic proportions. In view, however, of the nomadic habits of Indians in the northern areas of Canada, control of diphtheria, as well as certain other infectious diseases, is difficult and adds considerably to the administrative cost.

### TYPHOID

The major epidemic which occurred during the year was typhoid in the Cape Dorset area of Baffin Island and which caused about sixty deaths. Immediate steps were taken on the outbreak of this epidemic being reported to have Dr. N. R. Rawson, the Medical Officer at Chesterfield Inlet, flown into the area. He took prompt steps to institute all recognized and proper epidemic control measures and merits the utmost commendation for his conscientious and untiring services to the population concerned under the most difficult circumstances.

### IMMUNIZATION

All Indians are required to be immunized against smallpox and this is responsible for the absence of any outbreak of this disease. Where indicated or where facilities were available, immunization against diphtheria, whooping cough, and typhoid was actively undertaken. Because of difficulty in transportation and inaccessibility of the population concerned, this campaign could not be undertaken on an overall basis but was confined to the areas where it was possible and where reports indicated its local necessity.

### TUBERCULOSIS

The Advisory Committee for the Control and Prevention of Tuberculosis among Indians, appointed by the Government, met in Ottawa on May 30 and 31, 1945. Discussion took place of the general problem of tuberculosis prevention and control, and recommendations which were made have, as far as possible, been implemented. Included in the recommendations were the acquisition of certain hospitals. Mention has been made in the foregoing portion of this report regarding these hospitals and the number of patients which they are presently serving or will ultimately serve. Other recommendations which were made are included in the plans for the Indian Health Services Division and will be implemented as soon as conditions make it possible to do so. Provincial anti-tuberculosis organizations which were represented on the Advisory Committee have been most active in co-operating with the Department in conducting the services and in making possible hospitalization of a large number of tubercular patients.

As part of the Tuberculosis Prevention and Control Campaign, it has been the policy of the Indian Health Services Division to make yearly surveys of children and staff in Indian residential schools. These surveys were continued throughout the year in all schools wherever a clinic service could be made available and, in addition to this, certain other surveys were provided where indicated if beds in sanatoria were available.

As of January 31, 1946, there were 990 tubercular patients receiving treatment in hospitals of various types, as follows: Sanatoria, 269; Departmental Hospitals, 412; General Hospitals, 237; Preventoria, 72.

Because tuberculosis constitutes one of the major Indian health problems, the utmost attention, consistent with available staff and existing facilities, was given to ensuring of adequate measures for the prevention and control of tuberculosis amongst Indians.

### VENEREAL DISEASE

Because of war conditions, large numbers of the Indian population moved to the more densely populated industrial areas and the white population had greater contact with the Indian population from isolated areas. This has been a factor in the increase in the incidence of venereal disease among Indians.

The wide distribution and isolation of Indians and Eskimos enormously increase the difficulty of an adequate venereal disease control campaign. All officers of the Indian Health Services, however, were given particular instructions with respect to the control and treatment of venereal disease, and prompt and energetic treatment was arranged in all reported cases. Mention should be made of the assistance provided by provincial government organizations who have been very active in aiding the Division in the treatment of venereal disease, and in many areas supplied complete service to the Indian population at their local clinics. The use of new drugs, and in particular penicillin, materially decreased the infectious period of both gonorrhoea and syphilis with corresponding reduction in the treatment period.

### MENTAL HEALTH

Mental health is not one of the major problems as regards Indians and the yearly increase in this connection is not great. During the year 209 Indian patients received treatment in mental hospitals. This figure, compared with 167 in the fiscal year 1942-43, shows an increase in three years of 42 patients.

Bearing in mind that the natural increase in native population is approximately 1,500 annually, it is not considered that this increase is excessive.

### DRUGS

Through arrangements made with the Central Medical Stores of the Department of Veterans Affairs, some 1,200 drug requisitions were filled and shipped to approximately 500 centres throughout Canada and the Arctic. These centres included the above-mentioned hospitals, nursing stations, trading posts, R.C.M.P. posts, and missions.

Drugs of all kinds were included in the foregoing requisitions. In addition to these, biologicals were to a great extent purchased separately.

### PERSONNEL

Throughout the war the Division suffered through the loss of technical and professional personnel to the Armed Forces. Since the cessation of hostilities, however, an increasing number of departmental employees have been discharged from the Armed Forces and have returned to their employment with the Indian Health Services.

In addition to the foregoing, many positions have been established to meet the continually expanding need of the health problem of the native population of the country. The requirements in this connection are still far from being adequately met and the Indian Health Services Division is urgently in need of additional doctors and nurses in order to meet the requirements of the present situation, to say nothing of the program which is planned in this connection. Every effort is, however, being made to recruit the personnel which is required, and it is hoped that during the forthcoming year the requirements of the Service will be more adequately supplied.

### TRANSPORTATION

Because of lack of regular and organized methods of transportation and communication in isolated and northern outposts, coupled with the nomadic habits of the natives, the problem of reaching the native population is very

difficult. This is particularly so in providing routine services to reach sparsely settled communities. It is, therefore, a matter of practical impossibility to maintain adequate routine medical services for all the native population in such areas.

In regard to epidemic diseases and emergency cases in such areas, service is wherever possible provided by air transportation. This involves the use of the facilities of commercial air transport companies in the northern areas where regular air travel routes have been established. Many areas, however, are not reached by such routes and it has often been necessary to charter commercial planes for special trips. Tribute should be given to the R.C.A.F. and to the U.S. Army Air Force, who have on numerous occasions furnished planes and, in some instances, professional personnel, to undertake emergency and hazardous trips to isolated and difficult areas in both the Eastern Arctic and the Northwest Territories. This service has included the landing of medical and other supplies by parachute to areas where conditions were such that the plane could not land. In addition to the landing of personnel and supplies, the foregoing also covers the bringing out of emergency cases for operative and other treatment in hospitals.

#### ESKIMOS

With the transfer of the Indian Health Services Division from the Department of Mines and Resources to the Department of National Health and Welfare, the responsibility for Eskimos, which had previously been under the Northwest Territories administration, was likewise transferred to the Department of National Health and Welfare.

Toward the end of the fiscal year a conference of the Eastern Arctic administrators and medical officers, who had seen service in the Arctic, was held in Ottawa. At this conference the general problem of Eskimos' health was discussed and recommendations were made with a view towards ensuring an adequate medical health service for Eskimos in the country. These recommendations are, as far as existing personnel and facilities are available, being implemented as soon as possible.

In 1945 the Northwest Territories administration who were then in charge of this work arranged with the Canadian National Institute for the Blind to send an eye-specialist to make a survey and see what could be done to help the Eskimos. An optometrist was sent with the party who was able to fit metal spectacle frames to 68 of the 112 examined. In addition to these some whites were also fitted. This procedure is being repeated this year. It is felt that this may prove to be an extremely valuable service to the Eskimos. Two objectives were kept in mind: it is essential to the Eskimos' survival that the hunter gets his game; he was fitted for long vision; it is equally essential that his wife be able to make his clothes; she was fitted for close work.

The extensive post-war program for a health service to Indians and Eskimos is under active consideration and it is hoped that subsequent reports will indicate an expansion in the service which is being rendered in this connection.

### WELFARE AND TRAINING SERVICE

#### WELFARE

Employment of Indians continued at a very high level during the fiscal year 1945-46. Income from sales of beef cattle increased, while other agricultural returns decreased due to the late season and poor cereal crops. The quantity of furs taken by the Indians during the year decreased, but as fur prices reached a new all-time high the financial returns were greater.

The total number of cattle owned by the Indians has increased. Sales of beef cattle brought very substantial returns to the Indian stock-owners.

During the year the policy of encouraging the raising of goats by Indians was continued. Some herds in outlying districts increased, but this increase was not so great as we desired. In order to popularize their use a moving picture film on goats has been made.

Indian fishermen experienced a most successful year. Returns reached very high levels, and reports from our officials on the West Coast indicate that many Indian deep-sea fishermen are paying substantial income tax, in some cases in excess of \$2,000.

The Homemakers' Clubs continue to be active and the results of their activities are being increasingly noted in improved living conditions on their reserves. Large quantities of military clothing were purchased from the War Assets Corporation for Indian reserves throughout the Dominion. These have been remodelled by the Indian women thus reducing the demand on new clothing stocks. The Clubs have manufactured dressing-gowns, pyjamas, nightgowns, and windbreakers for the Indian Health Services hospitals at a time when these goods were in short supply and our Purchasing Agent was unable to obtain them from the usual sources of supply. During the summer the Homemakers' Clubs of Eastern Canada held a very profitable three-day convention at Tyendinaga, near Deseronto, Ontario. The 1946 convention is to be held at St. Regis, Quebec.

The centralization program in the Province of Nova Scotia is proceeding in a satisfactory manner. Thirty houses and two barns were erected and twenty houses repaired at Eskasoni, while eighteen houses were erected at Shubenacadie. During the winter of 1945-46, 900,000 ft. b.m. of logs were cut at both Eskasoni and Shubenacadie. If the 1946-47 plans are carried out more than half of the program will be completed before another fiscal year ends.

*Welfare Expenditure by Provinces, 1945-46 and 1944-45*

Province	1945-46		1944-45		Province	1945-46		1944-45	
	\$	cts.	\$	cts.		\$	cts.	\$	cts.
Nova Scotia.....	125,938	72	107,566	16	British Columbia.....	98,340	23	84,226	68
Prince Edward Island.....	11,143	10	9,763	22	Northwest Territories...	17,579	18	14,829	21
New Brunswick.....	30,262	71	24,502	52	Yukon.....	10,790	68	12,596	86
Quebec.....	130,926	53	136,738	41	Headquarters Salaries....	19,622	99	15,489	98
Ontario.....	124,658	09	107,221	90	Triennial Clothing.....	224	66	9,929	21
Manitoba.....	140,635	00	98,066	69	Miscellaneous.....	8,704	11	11,195	05
Saskatchewan.....	87,815	55	67,372	83	Handicraft.....	1,133	81	2,982	73
Alberta.....	69,832	39	63,853	34					
						877,607	75	766,334	79

TRAINING

A table of pupil enrolment and attendance follows:—

Fiscal Year	Residential Schools		Day Schools		Total		
	Enrolment	Average Attendance	Enrolment	Average Attendance	Enrolment	Average Attendance	Percentage of Attendance
1936-37.....	9,040	8,176	9,257	5,790	18,297	13,966	76.34
1937-38.....	9,233	8,121	9,510	5,978	18,743	14,099	75.22
1938-39.....	9,179	8,276	9,573	6,232	18,752	14,508	77.36
1939-40.....	9,027	8,643	9,369	6,417	18,396	15,060	81.87
1940-41.....	8,774	8,243	8,651	6,110	17,425	14,353	82.37
1941-42.....	8,840	8,283	8,441	5,837	17,281	13,935	80.63
1942-43.....	8,830	8,046	8,046	5,395	16,876	13,441	79.64
1943-44.....	8,729	7,902	7,858	5,355	16,587	13,257	79.92
1944-45.....	8,865	8,006	7,573	5,159	16,438	13,165	80.09
1945-46.....	9,149	8,264	9,532	6,691	18,805	15,043	79.99



Owing to the scarcity of teachers, considerable difficulty was experienced in securing sufficient staff for the day schools. It was found necessary to employ several unqualified teachers. However, through the co-operation of church representatives and our own officials in the field, only 14 schools were not reopened owing to inability to secure teachers.

The distribution of vitamin biscuits was continued to Indian day schools in northern Ontario, Manitoba, and Saskatchewan. Twenty-four tons of these biscuits were distributed during the academic year.

The erection of the day school on the new Shubenacadie Reserve, Nova Scotia, was completed and the school was in operation during the academic year 1945-46. Extensive repairs were completed at several residential schools and day schools. However, owing to shortage of both material and labour it was not possible to carry out all the repairs that were necessary. As a result we will have to provide in future years for repairs and improvements that have not been carried out due to circumstances beyond our control.

The main building at the Norway House Residential School, Manitoba, the Alnwick Day School in the Rice Lake Agency, and the Mississauga Day School in the Sault Ste. Marie Agency, Province of Ontario, were destroyed by fire.

Continued attention is being given to increasing the vocational training at all residential schools and at several of the larger day schools. Some qualified vocational teachers were secured and further efforts in this regard will be made in order to increase the efficiency of this branch of the training.

The payment of family allowances is reflected in the increased enrolment and average attendance at Indian day schools.

*Indian Education Ordinary Expenditure, 1945-46*

	Day Schools		Residential Schools		General		Total	
	\$	cts.	\$	cts.	\$	cts.	\$	cts.
Nova Scotia.....	49,927	42	33,272	66			83,200	08
Prince Edward Island.....	1,229	58					1,229	58
New Brunswick.....	18,502	86					18,502	86
Quebec.....	68,657	80	11,752	50			80,410	30
Ontario.....	122,225	09	319,254	46			441,479	55
Manitoba.....	63,470	42	221,121	24			284,591	66
Saskatchewan.....	42,843	53	350,106	09			392,949	62
Alberta.....	1,712	48	357,425	08			359,137	56
British Columbia.....	90,060	00	380,864	33			470,924	33
British Columbia Vocational Instruction.....					8,316	92	8,316	92
Northwest Territories.....	1,464	71	46,483	68			47,948	39
Yukon.....	4,409	04	13,766	59			18,175	63
Assistance to Ex-pupils.....					30,031	51	30,031	51
Freight and Express.....					243	59	243	59
Salaries and Travel.....					16,037	34	16,037	34
Stationery.....					44,587	28	44,587	28
Miscellaneous.....					554	49	554	49
Totals.....	464,502	93	1,734,046	63	99,771	13	2,298,320	69

### HANDICRAFT

The demand for Indian craft products throughout the year has again far exceeded production, although during this period a number of Indians who were previously engaged in industry or serving with the armed forces have returned to their reserves. There are great opportunities throughout the country in

connection with the production and marketing of Indian craft goods. Tourist bureau, hotels, associations, and summer resorts, as well as large merchandising firms, have shown marked interest in this type of work, realizing its value as a truly Canadian production.

The few reserves organized prior to 1939 have been maintained in operation, but lack of staff has made it impossible to extend organization to many suitable reserves.

A short special course in pottery, weaving, spinning, and silver work was arranged for a small group of school teachers and other workers during the Christmas vacation. The course was held and instructors provided by the Women's Art Association of Canada, Toronto, Ontario.

In addition to various forms of basketry, woodwork, carvings, and pottery, the initial steps have been taken to promote another industry which has great possibilities, namely, the cutting, polishing and setting of native Canadian semi-precious stones, of which many in beautiful colours are available. This project goes hand in hand with silver work and craftsmanship in various metals now obtainable, and it is hoped that by providing necessary supervisors for such field work, this and many other interesting lines of handicraft will be available to the public within a reasonable period.

#### GRANTS PAID TO AGRICULTURAL EXHIBITIONS AND INDIAN FAIRS

<i>Ontario</i>		1945-46
Ohsweken Agricultural Society, Brantford .....	\$	225.00
Garden River Agricultural Society, Sault Ste. Marie.....		100.00
Caradoc United Indian Fair, Muncey .....		150.00
Manitoulin Island Unceded Agricultural Society .....		150.00
Canadian Lakehead Exhibition .....		250.00
Mohawk Agricultural Society .....		100.00
<i>Manitoba</i>		
Manitoba Provincial Exhibition .....		250.00
Rosburn Agricultural Society .....		25.00
<i>Saskatchewan</i>		
Prince Albert Agricultural Society .....		400.00
Regina Agricultural and Industrial Exhibition Association, Ltd.		400.00
<i>Alberta</i>		
Calgary Exhibition .....		500.00
Edmonton Exhibition Association, Ltd. ....		400.00
<i>British Columbia</i>		
Windermere and District Fall Fair, Kootenay .....		175.00
Chilliwack Fair, New Westminster .....		50.00
Armstrong Fall Fair, Okanagan .....		250.00
<i>General</i>		
The Canadian Handicrafts Guild .....		50.00
Garden Prizes, Standing Crop Competitions .....		1,133.46
Home Improvement Competitions .....		135.13
		<hr/>
		\$4,743.59
		<hr/>

#### VETERANS' LAND ACT ADMINISTRATION

Order in Council P.C. 2122, dated April 13, 1945, approved an amendment to The Veterans' Land Act adding Section 35A thereto. This section authorized the Director (Veterans' Land Act) to grant an amount not exceeding \$2,320 to an Indian veteran who settles on Indian Reserve lands, the said grant to be paid to the Minister of Mines and Resources who shall have control and management thereof in trust for the Indian veteran. The grant is to be disbursed by the Minister of Mines and Resources on behalf of the Indian veteran only for one or more of the following purposes:

- (a) The purchase of essential building materials and other costs of construction.
- (b) The clearing and other preparation of land for cultivation.
- (c) The purchase of essential farm live stock and machinery.
- (d) The purchase of machinery or equipment essential to forestry.
- (e) The purchase of commercial fishing equipment.
- (f) The purchase of trapping or fur farming equipment but not breeding stock.
- (g) The purchase of essential household equipment.

By regulation the amount to be expended for household equipment is limited to \$250 and for trapping and fur farming \$850. Essential household equipment is restricted to the following articles: stoves, washing machines, refrigerators, kitchen tables and chairs, dining-room tables and chairs, standard bedsteads, standard mattresses, and springs.

The following additional purpose was added by Chapter 34 of the Statutes of 1945:

- (h) The acquisition of occupational rights to lands, vacant or improved, located within the boundaries of any Indian reserve.

Detailed instructions setting forth the conditions governing these grants and the procedure to be followed in making application were forwarded to all Indian agents. The necessary forms were prepared and machinery set up for obtaining approval and subsequent administration of the grants.

Owing to the length of time required to inform those Indians who had been discharged from the services up to that time and the fact that the majority of the Indians who had enlisted were still serving at that time the immediate response was small.

With the cessation of hostilities and consequent return to civil life of Indians in the service the number of applications was greatly accelerated during January-March, 1946.

The outstanding merit of the settlement scheme within Indian reserves is that there is no repayment to be made. The Indian veteran who has a poor crop year does not become discouraged by getting into debt.

The total number of Indian enlistments of which the Indian Affairs Branch has record is 3,090. Of these it is estimated that 1,500 may ultimately take advantage of the opportunity of obtaining these grants.

Up till March 31, 1946, eighty-seven applications were received. Forty-seven had been recommended by the Minister of Mines and Resources and of these thirty-two were approved and funds transferred to the Department of Mines and Resources on behalf of the Indian veterans.

#### FAMILY ALLOWANCES

Under the Family Allowances Act 1944, Section 11 (d), the Governor in Council is authorized to make regulations to "provide that in the case of Indians and Eskimos payment of the allowance shall be made to a person authorized by the Governor in Council to receive and apply the same." Regulations were passed accordingly.

Early in 1945 an understanding was reached between the Department of Mines and Resources and the Department of National Health and Welfare with respect to the provisions of the Family Allowances Act, and their application to the Indian population.

By this agreement the Department of National Health and Welfare accepted responsibility for:

- (a) Issuance of cheques monthly to Indian families qualified for the receipt of Family Allowances in cash.
- (b) Issuance of cheques monthly to Indian Agency trust accounts where administration is necessary.
- (c) Issuance of credits monthly to the Indian Affairs Branch in favour of Indian families qualified to receive Family Allowances in kind.

The Department of Mines and Resources accepted responsibility for:

- (a) Supervision of moneys spent under the Family Allowances Act.
- (b) The administration of Family Allowances moneys through Agency trust accounts where necessary.
- (c) Buying specially selected foods and clothing for Indian families qualified to receive Family Allowances in kind.

Where Family Allowances are payable in kind, individual credits are set up monthly for each eligible family and a cheque representing the total is paid monthly to the Chief Treasury Officer, Indian Affairs Branch.

Immediately following this understanding a senior official with the necessary stenographic and clerical help was appointed to the Indian Affairs Branch and charged with the administration of all Family Allowances payments for which the Branch had assumed responsibility.

REGISTRATION

Indian families registered under the Family Allowances Act as at December 31, 1945, totalled 16,215 representing 47,021 Indian children.

Registration of eligible families is nearly complete with the exception of a few families, principally from the Six Nations, Caughnawaga, and Tyendingaga Agencies.

Payments to Indian families are being made as follows:

(a) cheque direct to Indian.....	10,105
(b) cheque direct to Indian but mailed c/o Agent.....	1,959
(c) allowances administered through Agency trust accounts	602
(d) allowances being administered in kind.....	3,549

16,215

Owing to the geographical location, transportation, and mailing facilities, considerable difficulty was encountered in registering the Indians in the northern regions. This was completed at Treaty payment which in some cases is the only time that vital statistics can be brought up-to-date.

The following breakdown shows the registration and method of payment by Provinces:

Provinces	Families Reg.	Children Reg.	Payment			
			(a)	(b)	(c)	(d)
British Columbia.....	3,712	10,945	3,047	363	134	168
Alberta.....	1,902	5,689	1,071	217	94	520
Saskatchewan.....	1,948	5,809	1,033	648	45	222
Manitoba.....	2,314	6,852	1,445	524	220	125
Ontario.....	3,716	10,369	2,144	117	81	1,374
Quebec.....	1,315	3,806	546	90	3	676
Prince Edward Island.....	38	108	38			
Nova Scotia.....	331	898	331			
New Brunswick.....	290	817	265		25	
Yukon.....	165	483				165
Northwest Territories.....	484	1,245	185			299
<b>Totals.....</b>	<b>16,215</b>	<b>47,021</b>	<b>10,105</b>	<b>1,959</b>	<b>602</b>	<b>3,549</b>

## WELFARE

From Agents' reports and general observations of the field staff, it is apparent that in the majority of cases Family Allowances are being spent to good advantage on behalf of the children. Indian children attending day schools are much better dressed than before.

Indian parents are spending these moneys on nutritious foods such as milk, eggs, and vegetables. The same holds true in the far north where allowances are being paid in kind. The traders are co-operating to ensure that the Indian children are being supplied with food and clothing in accordance with the approved list prepared on the advice of medical officials of the Branch and dietary authorities of the Sick Childrens' Hospital, Toronto.

The payment of Family Allowances in kind, while presenting considerable administrative difficulties, would appear to be sound. This method of payment is still too much in its infancy to produce figures reliable enough to present an accurate comparative price chart. However it is all too apparent that the purchasing value of a dollar declines rapidly as the distance from rail-head increases.

## SCHOOL ATTENDANCE

A betterment in school attendance over previous years is indicated by day school monthly reports. A new monthly day school attendance report has been designed to provide information with respect to school attendance as it affects the Family Allowances Act.

It is considered that in the light of Family Allowances being of a voluntary nature, a moral obligation is undertaken to spend the money on the children and to send them to school regularly.

Under Section 4 (2) of the Family Allowances Act, where school facilities are available, the procedure adopted is to warn the parents immediately if a child shows an unreasonable absence of over five days in a month. If the next month does not show improvement, allowances are immediately suspended until such time as the child returns to regular attendance.

## GENERAL

With a view to uniform Indian administration, provincial conferences of Indian Agents were held in Winnipeg, Manitoba, October 2, 1945; Regina, Saskatchewan, October 4, 1945; Edmonton, Alberta, October 9, 1945; Calgary, Alberta, October 10, 1945; Fredericton, New Brunswick, December 3, 1945, and Halifax, Nova Scotia, December 5, 1945.

The Supervisor of Family Allowances, Indian Affairs Branch, and the Regional Directors of Family Allowances of the provinces affected were present at these conferences. Many administrative difficulties were overcome and a common policy was established. It is felt that these conferences were instrumental to a great extent in the administration getting away to a proper start.

Delay in reporting of births and deaths in isolated regions is one of the difficulties which presents itself in the administration of this Act. The use of radiotelegraph has been of great assistance to the field staff in obtaining and relaying information to Family Allowances officials.

There are two phases of the Family Allowances Act which are not possible to assess in their true light at the present time.

- (a) Whether Family Allowances will tend to make the Indian lean too much on the monthly payment and not pursue his regular occupation to the fullest extent.

Officials will be in a better position to report on this matter after Treaty time. So far, the Branch is not aware of any large number of Indians who have allowed Family Allowances to interfere with their earning capacity.

- (b) Whether it is a good practice to attempt to spend a year's accumulated credits in the three or four summer months without causing waste and being of questionable benefit to the Indian families.

Where the Indian trapping family leaves in September and does not show up again until May, their credits have no way of being spent and must accumulate. Whether this money can be spent successfully or not in summer is something that only can be determined by a thorough trial in the field.

The Branch is endeavouring to carry out the spirit and letter of the Family Allowances Act to improve the economic status of the Indians, but at the same time trying to keep undisturbed the Indian means of livelihood.

## CONSTRUCTION AND ENGINEERING WORKS

### AGENCY BUILDINGS AND STRUCTURES

Repairs and improvements were carried out at practically all Indian agencies in Canada. New buildings and structures were in most cases constructed under the supervision of the Surveys and Engineering Branch, and a report will be found in the section of that Branch. In some cases, however, materials were purchased and buildings and structures constructed without reference to the aforementioned Branch. These are as follows:—

*Ontario.*—A cabin was built on Spanish River Reserve, Sault Ste. Marie Agency, and a bridge over Echo River in the same agency was erected. A telephone line was built from Manitowaning to Wikwemikong, Manitoulin Island Agency, and a bridge on the Walpole Island Reserve was replaced. On the same reserve a protection wall was built under the supervision of officials of the Department of Public Works.

*Manitoba.*—A ration house was built on Rolling River Reserve, Birtle Agency, and a workshop, boathouse, and prefabricated residence were erected at Norway House. Warehouses were wholly or partially built at Nelson House, Cumberland House, and for the Mathias Colomb band, Pas Agency.

*Saskatchewan.*—A barn was provided for John Smith's Reserve, Duck Lake Agency, and a barn and ration house were built or partially built on Big River Reserve, Carlton Agency. A barn was provided for the Nut Lake Reserve, Touchwood Agency, as well as outdoor toilets and coal storages at the agency itself.

*Alberta.*—Ration houses were constructed or purchased for Fort Fitzgerald, Athabaska Agency, and Fort St. John Agency, and a double garage was erected at Lesser Slave Lake Agency.

*British Columbia.*—Bridges were built on Tsawassen Reserve, New Westminster Agency, and over Stein Creek, Lytton Agency. Two prefabricated huts were acquired for the Bella Coola Agency, and a two-car garage and storeroom was built at Williams Lake Agency.

### LAND

Property was purchased for agency purposes at Norway House, Man., High Prairie, Alta., and Fort St. John, B.C., and property required for a water supply system at Shubenacadie, N.S., was also acquired.

## ROADS

A new road was opened up through Nimpkish Indian Reserve No. 9, Kwawkewlth Agency, B.C., and roads on Indian reserves throughout Canada were improved and culverts installed.

## WATER SUPPLY SYSTEMS

Water supply systems were repaired as required and sewerage lines replaced. Dug-outs and wells were provided at File Hills, Touchwood, and Qu'Appelle Agencies, Sask., and Lake Manitoba Reserve, Portage la Prairie Agency, Man.

## IRRIGATION WORKS

Funds were transferred to the Surveys and Engineering Branch for the construction of irrigation works and the replacement of existing works in British Columbia. A report of the work undertaken will be found in the report of that Branch. Repairs not requiring engineering supervision were carried out at Kamloops, Williams Lake, Lytton, Kootenay, Nicola, and other agencies in British Columbia.

## MISCELLANEOUS

Fencing was repaired as required.

An electric range was purchased for R.C.M.P. quarters at Caughnawaga Reserve, Que. Oil burning stoves were purchased for James Bay office, Ont., and for Stuart Lake office, B.C. Batteries for lighting plants, etc., were purchased for James Bay, Ont., Fisher River and Griswold Agencies, Manitoba. The furnace in the Fisher River office was replaced. Telephones were installed at the Manitoulin Island Reserve, and road graders were acquired for Caradoc and Tyendinaga Agencies, Ont. Pumping equipment was acquired for Hobbema Agency, Alta., and water and drainage systems were installed for the Peigan Agency buildings.

## RESERVES AND TRUSTS SERVICE

## RESERVES DIVISION

## LAND SALES AND LEASES

A total of 106 sales of Indian lands was made during the fiscal year, 78 being cash sales totalling \$28,478.38 and 28 time sales totalling \$36,759.50, the total for the year being \$65,237.88.

The collections on land sale agreements amounted to \$147,360.39, of which \$110,895.34 represented payment on principal and \$36,465.05 payment on interest. Eighty-two land sale contracts were paid in full and letters patent issued. Six old contracts were cancelled for non-fulfilment of the conditions of sale and 6 reductions were made by consolidation on order of the Board of Review under the Farmers' Creditors Arrangement Act.

During the year rents collected under leases and permits amounted to \$223,122.46.

## ADJUSTMENTS UNDER FARMERS' CREDITORS ARRANGEMENT ACT

Thirteen land sale contracts were adjusted under the Farmers' Creditors Arrangement Act, resulting in a gross reduction of \$5,417.67, of which \$836.72 was principal and \$4,580.95 interest.

## PETROLEUM AND NATURAL GAS

Revenue from oil permits and leases amounted to \$15,342.82.

## MINING

The only activity in hard rock mining was on the Fort Hope Reserve, Ontario, where a certain amount of diamond drilling was done. One-half interest in three claims was recorded and 36 claims were cancelled. Revenue from mining rentals and sales of sand and gravel amounted to \$4,639.27 for the year.

## TIMBER

There were 36 current licences at the beginning of the year, 10 being completed and 26 renewed. Fourteen new licences were issued, making a total of 40 current licences at the close of the year. Revenue from timber sold under permits and licences amounted to \$135,378.97.

## FOREST PROTECTION

Fifty-one forest fires were reported, in connection with which \$8,457.62 was spent in suppression.

## INDIAN ENFRANCHISEMENTS

There were 314 persons enfranchised during the fiscal year.

## FUR REHABILITATION

The work of rehabilitation of fur-bearers originated in the stern necessity of providing a sustained standard of living for the portion of the Indian population who live by trapping.

This takes the form of developing muskrat-producing areas by water control methods, restocking selected beaver preserves and managing fur-bearers thereon, acquiring registered trap-lines on provincially owned lands and through these three channels providing assistance to the provinces in the management and production of fur resources in the areas where the population is predominantly Indian.

Although no new muskrat development project was undertaken during the year, the Indians shared in the financial returns from the areas developed in Manitoba with financial assistance from this Branch.

In the Province of Saskatchewan work was continued on the Sipanok Fur Development which is in partial production and which, during the year, produced a crop of muskrats and beaver valued at approximately \$40,000. In addition a small area at Onion Lake produced a crop valued at approximately \$25,000.

Several areas are under investigation and it is anticipated that as soon as the present shortages of labour and material have been overcome this phase of our work will be resumed.

Seven beaver preserves in the Provinces of Quebec and Ontario, with a total area of over 40,000,000 acres, continue to show marked progress and two of the older ones, both in the Province of Quebec, have reached production stage.

During the winter season just closed 1,800 beaver were taken by Indians from these two preserves and realized for the trappers an amount in excess of \$100,000. One of the Ontario projects is nearing production and it is anticipated that a partial crop will be taken during the 1946 season.



The policy of acquisition and registration of trap-lines by Indians was greatly accelerated by the organization under this plan of the entire northern part of the Province of Manitoba. This program takes in the hunting lands of over 2,000 Indians and is being organized in accordance with their traditional methods, placing upon the individual Indian the responsibility for the development of his area.

The year was also marked by the inauguration of registered trap-lines in the Province of Quebec, and of the 150 traplines which are at present allocated, over one-half have been taken up by Indians.

In the Province of Ontario special efforts have been made in the Cochrane, Chapleau, and Nipissing districts, where some 200 Indian trap-lines have been acquired.

Substantial increases have also been made in the acquisition of registered trap-lines under the existing organizations in Alberta and British Columbia.

The year has been marked by an increasing awareness on the part of the provinces of the value and benefits that accrue to this type of work and efforts to reach co-operative agreements with them are meeting with an increasing degree of success.

#### TRUSTS DIVISION

The balance in the Indian Trusts Funds as at March 31, 1946, amounted to \$17,096,489.68. This is the property of some 460 individual Indian bands throughout the Dominion and it should be noted that it is not owned in common by all the Indians of Canada.

This balance during the fiscal year just ended has increased by slightly less than \$400,000, which is less than half the increase occurring in the fiscal year 1944-45.

Items of receipts were: accrued interest, land sales, land rentals, mining dues, timber royalties, oil land rentals, repayments on band loans, and fines. Expenditures comprised: capital and interest distributions, relief expenditures, band loans, agricultural assistance, road improvements, and enfranchisements.

It is not the aim of the administration solely to build up band funds. Rather, the object has been to persuade the Indians to use their band funds to promote the welfare and progress of the band individually and collectively. Some difficulties are being encountered in persuading some bands to make wise use of their moneys. Therefore, the education of the Indians in economically sound uses of band funds is receiving more and more attention. Results are already becoming apparent. It is found that many Indian bands, instead of asking for increased distributions of cash, a non-constructive use, are now requesting increased aid to aged Indians and more funds for housing repair and new construction. The difficulty of procuring seasoned lumber and other building supplies is at present impeding extension of the latter use, but such uses of funds are readily approved and always encouraged. It is the desire of the Department to use the funds built up during the period of relative prosperity to better living conditions and raise the morale of the Indian.

#### ANNUITIES

The distribution of annuity moneys was carried out during the fiscal year in the usual manner. The following statement indicates the amounts expended in that connection:—

No. of Chiefs paid at .....	\$25.00.....	167.....	\$ 4,175.00
No. of Headmen paid at .....	15.00.....	380.....	5,700.00
No. of Indians paid at .....	5.00.....	49,762.....	248,810.00
No. of Indians paid at .....	4.00.....	161.....	644.00
No. of commutations of annuity paid at .....	50.00.....	92.....	4,600.00
No. of enfranchised Indians paid \$100 in lieu of annuity .....		125.....	12,500.00
Amount paid on account of arrears for previous years .....			5,096.00
			<hr/>
General advance <i>re</i> Robinson Treaty to be added .....			281,525.00
			<hr/>
Total .....			10,300.00
			<hr/>
			\$291,825.00

In addition to the above numbers receiving annuities from Federal funds, there are 6,997 Indians who also receive annuities under the Robinson Treaty and 5,771 Indians who receive annuities under Treaty No. 9 (James Bay).

This brings the total number of Indians in Canada receiving Treaty Annuity to 63,238.

#### PERSONAL SAVINGS ACCOUNTS

The balance on deposit in some 2,300 savings accounts at the end of the year was \$383,893.88. Deposits during the year totalled \$77,789.56. Withdrawals totalled \$68,412.63.

Moneys deposited in savings accounts to the credit of Indians on active service are now being released to assist in their rehabilitation. The total savings has substantially increased.

#### BAND LOANS—1945-46

During the fiscal year 199 Indians made application for loans from band funds. These applications totalled \$45,487 and in this connection the following is a recapitulation:

Applications approved, 147 totalling .....	\$30,652
Applications approved, later cancelled, 24 totalling .....	4,995
Applications rejected, 24 totalling .....	5,440
Applications in abeyance, 4 totalling .....	4,400

A total of \$30,652 from band funds was loaned to 147 individual band members, the average loan being \$208.52. The sum advanced was for the purposes and in amounts as follows:

The purchase of live stock and equipment .....	\$15,517
The purchase of property—land and buildings .....	1,175
Repairs to buildings—houses, barns, etc. ....	6,565
Construction of new buildings, and the sinking of wells .....	6,075
Miscellaneous purchases .....	1,320
	<hr/>
Total .....	\$30,652

It is to be noted that the borrowers received assistance in the purchase of 78 horses (32 teams included), 29 cows, 6 tractors, 2 mowers, 4 ploughs, 2 binders, 8 wagons, 2 seed drills, 1 fishing boat, 8 sets of harness, and other farm implements. Repairs were made to 37 houses and 3 barns; 15 houses and 2 barns were newly constructed, and 4 wells were sunk. Loans were also granted to 4 Indians for the purchase of property to enable them to become established. The foregoing illustrates the extent to which Indians are being assisted to use their own funds more effectively in making themselves self-reliant.

One hundred and thirty-eight band loans in the amount of \$27,390.99 were fully retired during the fiscal year.

Loan funds were set up from the capital funds of six additional bands during the fiscal year, thus making a total of 43 Indian bands across the Dominion who have loan funds set up ranging from \$1,000 to \$15,000.

## SUMMARY OF INDIAN AFFAIRS BY PROVINCES AND TERRITORIES

The local administration of Indian lands, on the reserves scattered throughout the Dominion, is conducted through the Department's agencies, of which there are in all 98. The number of bands included in an agency varies from one to more than thirty. The staff of an agency usually includes various officers, in addition to the agent, such as clerk, farm instructor, constable and stockman, according to the special requirements of the agency in question. Medical staff is provided for the various agencies as required by the Department of National Health and Welfare. At many of the smaller agencies in the older provinces where the Indians are more advanced, the work is comparatively light, requiring only the services of an agent. The work of the agencies is supervised by the Department's inspectors. There is an Indian Commissioner at Vancouver, acting in a supervisory capacity for British Columbia.

### PRINCE EDWARD ISLAND

*Agency.*—There is only one agency in the Province, located at Charlottetown. A large number of Indians live on Lennox Island, and others live at Rocky Point, near Charlottetown, Morell, St. Andrews, and Scotch Fort.

*Tribal Origin.*—The Indians belong to the Micmac tribe, which is of Algonkian stock.

*Occupations.*—Subsistence farming is engaged in by a number of Prince Edward Island Indians, with many of them owning their own live stock. During recent years outside work has been readily available with many of the Indians finding continuous employment in urban centres as well as in the lumbering and fishing industries. Basket-making, especially among the older Indians, has also been engaged in, with profitable results.

*Dwellings.*—The homes are fairly good and increased employment has resulted in improved living conditions generally.

### NOVA SCOTIA

*Agencies.*—There are two Indian agencies in Nova Scotia, namely, in Hants County (Shubenacadie) and in Cape Breton County (Eskasoni).

*Tribal Origin.*—The Indians are of Algonkian stock and like the Indians of Prince Edward Island bear the distinctive name of Micmac.

*Occupations.*—While many of the Indians raise their own gardens, any other agricultural pursuits that are engaged in are on a small scale. An increasing number of Indians are finding employment with white farmers and fruit growers. Their natural ability as guides and canoeemen is utilized during the tourist season, and their skill at making baskets and at wood-working is another important source of income. They also work in lumber camps and as labourers.

*Dwellings.*—The houses on most of the reserves consist of one and one-half story frame buildings, fairly well finished on the outside.

## NEW BRUNSWICK

*Agencies.*—There are three agencies in New Brunswick: The Northeastern, at Rexton; the Northern, at Perth, and the Southwestern, at Fredericton.

*Tribal Origin.*—Most of the Indians belong to the Micmac race, which is of Algonkian stock. There are also some bands of Maliseets, also of Algonkian stock.

*Occupations.*—Except for growing potatoes and vegetables for their own use, little farming is engaged in by the Indians of the Province of New Brunswick. The potato crop in the State of Maine, however, provides seasonal employment for many Indians every year. They also hunt and fish and act as guides. Many work in lumber camps and sawmills, while others earn a living as day labourers. In certain parts of the Province they are engaged commercially in the manufacture of axe and pick handles and baskets.

*Dwellings.*—Housing is similar to that in other parts of the Maritime Provinces.

## QUEBEC

*Agencies.*—The 18 Indian agency offices in Quebec are located as follows: Amos (Abitibi), Bersimis, Cacouna (Viger), Caughnawaga, Gaspé, Gentilly (Becancour), Harrington Harbour (St. Augustine), Maniwaki, Mingan, Natashquan, Notre Dame du Nord (Timiskaming), Oka, Pierreville, St. Francis, Pointe Bleue, Lake St. John, Restigouche (including the former Maria Agency), St. Regis, Seven Islands, Village des Hurons (Lorette).

*Tribal Origin.*—The principal tribes found in Quebec are: Iroquois at Caughnawaga, Lake of Two Mountains, and St. Regis; the Hurons of Lorette, also of Iroquoian stock; the Montagnais, who are of Algonkian stock, at Bersimis, Mingan, Lake St. John, Seven Islands and Abitibi; the Têtes de Boule, of Algonkian stock, at Abitibi; the Abenakis, of Algonkian stock, at Becancour and St. Francis; the Micmacs, of Algonkian stock, at Maria and Restigouche; the Maliseets, of Algonkian stock, at Viger, and the Naskapis, also of Algonkian stock, in the northern area.

*Occupations.*—The Indians of Caughnawaga are noted steel workers and find highly remunerative employment in that trade. The native handicraft projects organized in this Province continue to prove successful. The Indians of the northern interior and the north side of the Gulf of St. Lawrence depend almost entirely on hunting, trapping, and fishing for their subsistence. In the Saguenay district some are employed as game wardens on established beaver preserves, while others act as guides and canoeemen. A number have been successful in securing employment in lumber camps and mills. The Indians in the organized central and southern portions engage in mixed farming. They raise fruit and dispose of it at nearby markets, and those who possess cows sell the milk to the creameries and cheese factories.

*Dwellings.*—Many of the Indians in the older settled districts own houses of stone, brick, or frame construction. In the more remote parts they live in tents during the greater part of the year. Because of increased employment housing conditions generally have improved.

## ONTARIO

*Agencies.*—The Indian agency offices in Ontario, 24 in number, are located as follows: Brantford (Six Nations), Chapleau, Chippawa Hill (Saugeen), Christian Island, Deseronto (Tyendinaga), Fort Frances, Golden Lake, Highgate (Moravian), Kenora, Longford Mills (Rama) Manitowaning (Manitoulin

Island), Moose Factory (James Bay), Muncey (Caradoc), Parry Sound, Peterborough (Rice and Mud Lake), Port Arthur, Sarnia, Sault Ste. Marie, Scugog, Sioux Lookout, Sturgeon Falls, Virginia (Georgina and Snake Islands), Wallaceburg (Walpole Island), Wiarton (Cape Croker).

*Tribal Origin.*—Most of the Indians of Ontario are Ojibwas, Chippewas, and Missisagua tribes which are of Algonkian stock. There is a band of Algonkians at Golden Lake. The Oneidas of the Thames, the Mohawks of the Bay of Quinte, the Mohawks of Parry Sound district, and the Six Nations of Grand River are of Iroquoian stock. There is a band of Pottawottamies at Walpole Island, and of Delawares at the Caradoc (Muncey) Agency; these are of Algonkian stock. Crees, also of Alkongian stock, are found in northern and northwestern Ontario.

*Occupations.*—In northwestern Ontario the Indians are dependent largely on fishing and the trap-line for their living. In eastern Ontario they engage in lumbering. All northern reserves are reasonably well stocked with merchantable timber. In the southern and southwestern parts of the Province farming is the chief source of revenue, although the Indians in these sections, close to industrial centres, are to a marked degree becoming absorbed into the industrial life of their respective communities. When advantageously located the Indians engage in guiding during the tourist season, in which they are particularly efficient, and in themselves actually constitute an attraction to tourists unfamiliar with the aboriginal races.

*Dwellings.*—As in other provinces, because of increased employment, housing conditions generally have improved. Many Indians own houses of brick, stone, or modern frame construction in the more settled districts. The Indians of the northern part of Ontario are nomadic and consequently live in tents most of the year.

## MANITOBA

*Agencies.*—There are nine Indian agency offices in Manitoba located as follows: Birtle, Griswold, Hodgson (Fisher River), Norway House, Portage la Prairie, Selkirk (Clandeboye), The Pas, Gillam (Port Nelson and York Factory), Churchill (Fort Churchill).

*Tribal Origin.*—The Indians are mostly Ojibwas and Crees who are of Algonkian stock. Bands of Swampy Crees are found at the Norway House and Fisher River Agencies and in the York Factory district; these are also of Algonkian stock. The Indians located at the Griswold Agency are Sioux; there are also Sioux at the Birtle and Portage la Prairie Agencies. There is a band of Chipewyans at Churchill; this tribe is of Athapaskan stock.

*Occupations.*—Fishing, hunting, and trapping constitute the main sources of livelihood for the Indians inhabiting the lake regions and northern sections of Manitoba. The large commercial fishing companies employ many Indians from the lake regions. Agriculture is confined chiefly to the Birtle, Griswold, Portage la Prairie, and Clandeboye Agencies, although Indians from other agencies work in the harvest fields in the farming communities. The new sugar beet industry is also providing work for Indians in the beet fields. Good herds of cattle, principally of the Shorthorn type, and other live stock are to be found on many reserves, and their products are a vital source of income to the Indians of southern Manitoba. Surplus hay is sold; the hay presses owned by some of the Indians enable them to ship their surplus in winter. Taking out wood for winter fuel requirements has always been an Indian occupation, and recently more and more Indians have been engaging in cutting pulpwood. Indian women find their native handicraft, particularly the manufacture and sale of gloves and moccasins, a profitable undertaking.

*Dwellings.*—On most of the reserves in Manitoba the houses are of log construction, one and one-half stories high, with single roofs. They are usually whitewashed every year which improves their appearance and makes for greater sanitation. There are also a number of houses of frame construction on all reserves. In the extreme north the habitations are more primitive.

### SASKATCHEWAN

*Agencies.*—The nine Indian agency offices in Saskatchewan are located as follows: Balcarres (File Hills), Battleford, Broadview (Crooked Lake), Duck Lake, Kamsack (Pelly), Leask (Carlton), Muscow (Qu'Appelle), Onion Lake, Punnichy (Touchwood).

*Tribal Origin.*—The most numerous tribes among the Saskatchewan Indians are Ojibwas, Swampy Crees and Plains Crees, which all belong to the Algonkian stock. In addition to these, Sioux Indians are found at the Crooked Lake, Qu'Appelle and Carlton Agencies, and on the Moose Woods Reserve. In the Onion Lake Agency there is a band of Chipewyans who are of Athapaskan stock. There are also a few Chipewyan Indians in the Ile à la Crosse district.

*Occupations.*—Farming and stock-raising comprise the chief occupations of Saskatchewan Indians. They are equipped with good implements and horses and employ the same modern farming methods as their white neighbours. Their cattle are of a good type, most of them being of the Shorthorn breed. In the north central sections of the Province they supplement their incomes by selling their surplus hay and taking out fuel-wood, and farther north they still depend almost entirely upon hunting, trapping, and fishing for their livelihood. They make good woodsmen. The recent shortage in the pulpwood industry has opened new opportunities for earning good wages to Indians from all parts of the Province, many of them finding work in the wooded sections of Saskatchewan and several hundred going as far away as Kapuskasing, Ontario, to alleviate the acute shortage in the timber areas.

*Dwellings.*—On most of the reserves the Indians are fairly well housed, the homes being usually of log construction with single roof; others are of frame construction. In the north when the Indian is out on his hunting grounds his home consists of a log cabin with sod roof in winter, and a tent in summer.

### ALBERTA

*Agencies.*—The ten Indian agency offices in Alberta are located as follows: Brocket (Peigan), Calgary (Sarcee), Cardston (Blood), Driftpile (Lesser Slave Lake), Fort Chipewyan (Athabaska), Gleichen (Blackfoot), Hobbema, Morley (Stony), Saddle Lake, Winterburn (Edmonton).

*Tribal Origin.*—The Alberta Indians are of Algonkian stock, with the exception of the Sarcees near Calgary and the Beavers and Slaves in the Lesser Slave Lake Agency, who are Athapaskan; the Paul's Band in the Edmonton Agency, who are Iroquoian, and the Stonies, who are of Siouan stock. The Algonkian Indians of Alberta are subdivided into Blackfoot Nation, comprising the Indians of the Blackfoot, Blood, and Peigan Agencies; and Plains Crees found in the Lesser Slave Lake, Saddle Lake, Edmonton, and Hobbema Agencies.

*Occupations.*—Stock-raising is the principal occupation of the Indians of the southern and foothills regions where they have large herds of horses, and cattle herds of excellent Hereford and Shorthorn types. They grow grain on up-to-date well equipped farms. Indians in the northern parts while mainly occupied in hunting and trapping also engage in fishing and selling fuel-wood. Those Indians who do not farm for themselves find employment with farmers

and ranchers, haying, harvesting, and working in the beet fields for several months during the summer. A number also work in lumber camps, sawmills, and as labourers. The Blackfoot Indians operate two coal mines of their own and obtain a substantial revenue from the sale of coal.

*Dwellings.*—The condition, on the whole, of the homes and farm buildings is good. Changes are gradually being made by enlarging some of the houses, or dividing large one-roomed houses into several rooms resulting in more healthful living conditions. The majority of the houses are well kept and increased employment has resulted in the purchase of additional furniture. Frame houses and barns are found on some of the more advanced reserves while on others houses are of log construction with shingle roofs.

### BRITISH COLUMBIA

*Agencies.*—The Indian agency offices in British Columbia are located at 18 different points as follows: Alert Bay (Kwawkewlth), Bella Coola, Cranbrook (Kootenay), Duncan (Cowichan), Fort St. John, Hazelton (Babine) Kamloops, Lytton, Massett (Queen Charlotte Islands), Merritt (Nicola), New Westminster, Port Alberni (West Coast), Prince Rupert (Skeena), Telegraph Creek (Stikine), Vancouver, Vanderhoof (Stuart Lake), Vernon (Okanagan), Williams Lake.

*Tribal Origin.*—The Indians of the Bella Coola, Cowichan, Kamloops, Lytton, New Westminster, Nicola, Vancouver, and Okanagan Agencies belong to the Salish tribes. The Kootenay tribe is located in the agency of the same name. The Kwakiutl-Nootka tribe is located at the Kwawkewlth and West Coast Agencies; the Haidas, in the Queen Charlotte Islands; the Tlingits, in the Stikine; and the Tsimshians in the Skeena Agency. The Indians of the Babine, Stuart Lake, Fort St. John, and Williams Lake Agencies belong mostly to the Athapaskan race. The Indians of the Peace River Block are Athapaskan, with the exception of a small group of Saulteaux and Crees at Moberly Lake who are Algonkian.

*Occupations.*—The coast Indians exhibit skill as salmon fishermen and the fishing industry has continued to be their chief source of occupation. Many own their own power-boats and up-to-date equipment and they either fish independently or under contract with the canneries. Herring canneries give work to a large number of Indians, especially Indian women who give excellent satisfaction as cannery workers along the coast. They also engage in clam digging, while others work at various occupations such as logging and as unskilled labourers. Indians of the central and northern interior regions make their living by trapping on registered trap-lines, while towards the south they are turning their attention more and more to agriculture and other pursuits. Many engage successfully in cattle- and horse-raising, while others are making a success of fruit-growing, some of them having orchards of their own. Whole families participate in the seasonal migratory labour movement to pick fruit, hops, etc., which frequently takes them into the United States in their wayfaring.

*Dwellings.*—Special attention continues to be given to the improvement of Indian homes. All new houses are built upon modern lines of the small compact type used by white labouring classes, and greater interest is paid to ventilation, heating, and sanitation than formerly.

The best Indian houses are found on the northwest coast among the Haidas of Queen Charlotte Islands, the Tsimshians of Port Simpson, Metlakatla, and Port Essington, and Kwakiutls of Bella Bella.

## NORTHWEST TERRITORIES

*Agencies.*—The Indian Affairs Branch has three agencies in the Northwest Territories, namely, Fort Simpson, Fort Resolution, and Fort Norman.

*Tribal Origin.*—The principal tribes found in the far north are the Slaves, Hares, Loucheux, Dogribs, Sekani, Yellow Knives, Chipewyans, and Caribou-Eaters. All these tribes are of Athapaskan stock. The most northerly tribes are the Takudah, whose territory extends to the Mackenzie Delta, and the Copper Mines, who are located along the Coppermine River. The territory occupied by these two last-named tribes is contiguous to that inhabited by the Eskimos.

*Occupation.*—The Indians depend almost entirely upon hunting and trapping for a livelihood, and a few cultivate potatoes and garden vegetables. They do not own cattle or horses. Large quantities of fish are caught and preserved for their own use and for dog feed during winter. Wild berries are also picked and dried for winter use.

*Dwellings.*—These Indians live in log cabins in winter and in tents and teepees in the summer.

## YUKON TERRITORY

*Tribal Origin.*—The Forty-Mile, Blackstone, and Moosehide bands belong to the Takudah tribe. There is a band of Slaves at Lancing Creek who migrated from Good Hope on Mackenzie River; another band of Slaves, called Nahani, is located at the headwaters of Pelly River. All these Indians are of the Athapaskan stock. At Mayo, Selkirk, Little Salmon, and Carmacks there are bands belonging to the tribe known as Stick Indians. Bands belonging to the Tlingit tribe are found at Whitehorse, Teslin Lake, Champagne Landing, and Carcross.

*Occupations.*—Hunting, trapping, and fishing are the chief occupations of the Yukon Indians. The women derive some revenue from the sale of moccasins and curios of various kinds, and the men are expert at making toboggans and snowshoes. Little farming is carried on owing to climatic conditions, but some of the Indians cultivate patches of potatoes and other vegetables for their own use.

*Dwellings.*—The Indians of the Yukon live in log cabins.



TABLE NO. 1  
Census of Indians: Arranged Under Provinces and Territories, 1946

Province	Number in Band	Religion						Under 7 years		From 7 to 16 inclusive		From 17 to 21 inclusive		From 22 to 65 inclusive		From 65 years upwards		
		Anglican	Baptist	United Church	Presbyterian	Roman Catholic	Other Christian Beliefs	Aboriginal Beliefs	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Alberta.....	12,441	1,518		1,537		6,347	72	1,380	1,439	1,551	1,515	581	571	2,495	2,224	309	376	
British Columbia.....	25,515	5,831		4,425	62	14,465	694	38	2,350	2,573	3,056	3,171	1,238	1,127	5,548	4,808	825	819
Manitoba.....	15,933	5,791	52	3,438	528	5,388	438	298	1,663	1,665	1,828	1,711	1,020	1,005	3,102	2,923	461	555
New Brunswick.....	2,047					2,047			210	202	244	238	109	105	445	414	46	34
Northwest Territories.....	3,816	667				3,149			374	403	434	436	212	209	775	745	90	138
Nova Scotia.....	2,364	6			1	2,357			259	259	231	240	130	131	534	457	65	58
Ontario.....	32,421	10,404	1,281	5,925	307	10,338	1,147	2,029	2,630	2,739	3,189	3,351	2,094	2,101	7,283	6,904	1,042	1,088
Prince Edward Island.....	266					266			27	22	28	34	14	15	57	57	5	7
Quebec.....	15,194	2,932		557	1	11,517	98	94	1,319	1,360	1,760	1,718	804	878	3,471	3,010	463	421
Saskatchewan.....	14,158	4,804		1,499	163	6,934	42	716	1,572	1,611	1,683	1,646	642	639	2,828	2,779	355	403
Yukon.....	1,531	1,224				307			147	157	180	195	74	71	331	278	54	44
Total Indian Population.....	125,656	33,267	1,333	17,381	1,062	63,115	2,414	4,147	11,931	12,430	14,174	14,255	6,918	6,852	26,869	24,599	3,715	3,943

TABLE No. 2  
Crops Sown and Harvested, Land Broken, Etc.

Provinces	Tons of Wild Hay	Acres Newly Broken	Acres Fall-Lowed	Wheat		Oats		Barley		Corn, Flax, Rye, Etc.		Roots, Potatoes and Gardens		Green Feed and Tame Hay		Total Acres under Cultivation
				Acres	Bushels	Acres	Bushels	Acres	Bushels	Acres	Bushels	Acres	Bushels	Acres	Tons	
Prince Edward Island.....	7	7	10			40	720					10	1,200	30	30	97
Nova Scotia.....	67	25	25			8				2	15	50	2,475	105	115	215
New Brunswick.....	26	8	6			11	110					141	4,850	96	95	262
Quebec.....	162	44	381	49	559	1,894	24,190	47	900	109	843	649	15,516	3,356	6,185	6,529
Ontario.....	1,417	350	1,452	1,581	32,978	8,298	172,976	877	17,583	1,803	59,873	3,075	102,183	12,026	14,113	29,462
Manitoba.....	20,215	485	3,221	2,284	48,097	3,100	87,566	2,161	49,344	192	6,695	608	33,254	373	483	12,514
Saskatchewan.....	29,930	3,029	14,899	12,674	160,835	14,647	304,744	3,685	69,461	402	4,459	439	27,137	2,805	2,926	52,580
Alberta.....	15,614	867	17,475	13,827	199,262	10,177	183,491	2,271	30,379	890	5,944	431	7,050	3,927	4,359	49,885
British Columbia.....	8,430	124	1,122	3,100	61,175	3,047	72,240	168	2,500	37	1,265	5,006	316,783	23,247	47,025	35,851
Northwest Territories.....	48	1	5	1	28	12	224					54	1,107	9	47	82
Totals.....	75,916	4,940	38,596	33,516	502,934	41,324	846,261	9,209	170,167	3,435	79,114	10,463	511,555	45,974	75,378	187,457

TABLE NO. 3  
Land: Private and Public Buildings and Property

Provinces	Total Area of Reserve (Acres)	Acres Under Weed	Acres Cleared but not Cultivated	Acres Under Actual Cultivation	Acres Fenced	Private Property										Public Property				
						Stone, Brick and Frame Dwellings	Other Dwellings	Outbuildings, etc.	Ploughs, Harrows, Drills, etc.	Mowers, Reapers, Binders, Threshers, etc.	Carts, Wagons and Vehicles	Automobiles	Tools and small Implements	Churches	Council Houses	School Houses	Sawmills	Other Buildings	Engines and Machinery	
Prince Edward Island.....	1,667	520	200	97	500	32	1	14	6	6	.....	2	300	1	1	1	.....	.....	2	
Nova Scotia.....	19,787	6,400	532	215	835	277	23	102	28	7	26	12	575	5	.....	7	2	5	4	
New Brunswick.....	37,753	32,740	1,125	262	1,087	360	7	225	41	14	24	17	1,200	6	4	11	.....	3	5	
Quebec.....	183,375	124,109	15,437	6,529	14,209	1,692	515	2,416	600	277	1,321	143	6,450	26	11	22	1	26	38	
Ontario.....	1,303,485	956,130	105,187	29,462	104,201	3,159	2,209	5,352	4,203	1,162	2,851	610	47,856	101	43	83	15	180	70	
Manitoba.....	483,130	244,376	115,075	12,514	52,765	174	2,997	1,774	777	572	1,290	54	8,127	68	13	47	8	131	118	
Saskatchewan.....	1,193,452	518,775	622,097	52,580	337,698	161	2,390	2,911	2,811	1,583	3,069	34	16,127	52	22	28	3	56	72	
Alberta.....	1,403,851	300,890	800,201	49,865	458,077	433	1,685	2,386	2,143	1,506	2,530	91	9,523	21	9	8	1	64	300	
British Columbia.....	832,085	449,699	247,288	35,851	268,233	4,340	2,901	4,797	2,713	947	2,267	568	47,335	155	75	60	6	63	180	
Northwest Territories.....	5,918	.....	37	82	82	163	210	194	3	1	3	.....	498	.....	1	.....	.....	.....	.....	
Totals.....	5,464,503	2,633,639	1,907,179	187,487	1,237,687	10,791	12,998	20,171	12,855	6,075	13,381	1,531	137,991	435	179	267	36	528	789	

TABLE NO. 4  
Live Stock and Poultry: General Effects

Provinces	Horses			Cattle				Other Stock	Poultry	General Effects					
	Stallions	Calldings and Mares	Foals	Bulls	Steers and Work Oxen	Milch Cows	Young Stock	Pigs, Sheep, Etc.		Motor and Sail Boats	Row Boats and Canoes	Rifles and Shot Guns	Steel Traps	Nets	Tents
Prince Edward Island.....	.....	6	2	1	5	10	10	4	600	7	7	4	20	10	.....
Nova Scotia.....	.....	37	.....	1	.....	58	13	33	1,820	.....	14	122	1,260	5	10
New Brunswick.....	.....	19	2	1	2	10	9	11	177	58	106	176	2,853	99	40
Quebec.....	3	568	71	75	7	1,592	824	846	11,133	175	1,624	2,962	32,770	957	1,172
Ontario.....	24	2,030	156	89	477	2,238	1,454	5,671	47,210	549	3,958	6,631	135,996	6,343	3,477
Manitoba.....	10	2,623	51	28	458	1,335	995	293	5,725	123	1,816	4,104	66,705	7,131	2,148
Saskatchewan.....	13	6,484	255	60	1,928	3,478	2,261	377	13,135	91	421	2,542	35,476	1,154	1,914
Alberta.....	156	11,544	1,634	158	2,967	8,074	4,360	1,135	6,749	179	494	2,476	21,151	1,109	2,105
British Columbia.....	142	7,511	1,254	296	8,867	3,830	3,911	2,255	45,392	1,888	2,811	8,592	77,785	2,301	1,790
Northwest Territories.....	2	29	4	.....	.....	2	.....	.....	.....	117	709	1,482	24,070	910	546
Totals.....	350	30,851	3,429	709	14,711	20,627	13,837	10,625	131,941	3,187	11,960	29,091	398,086	20,019	13,202

TABLE No. 5  
Sources and Value of Income

Provinces	Value of Farm Products including Hay	Value of Beef Sold also of that used for Food	Wages Earned	Received from Land Rentals	Received from Timber	Received from Mining Royalties including Sand, Gravel and Stone	Earned by Fishing	Earned by Hunting and Trapping	Earned by other Industries and Occupations	Annuities paid and Interest on Indian Trust Funds	Total Income of Indians
	\$	\$	\$	\$ cts.	\$ cts.	\$ cts.	\$	\$	\$	\$ cts.	\$ cts.
Prince Edward Island.....	3,000	600	1,400				650	750	4,500	0 18	10,900 18
Nova Scotia.....	7,150	220	98,500	15 00	112 68		900	1,300	8,000	2,864 51	119,062 19
New Brunswick.....	4,450	900	72,800	474 99	48 00		4,400	3,100	26,700	2,597 24	115,470 23
Quebec.....	132,210	22,882	979,795	15,727 79	7,766 41	264 00	6,922	528,887	166,100	24,433 24	1,882,987 44
Ontario.....	295,340	56,910	1,771,000	44,078 92	37,842 61	2,111 99	342,933	960,085	571,380	391,525 48	4,473,202 00
Manitoba.....	245,648	42,840	153,600	6,719 86	2,053 31		141,640	260,575	105,494	116,034 20	1,074,604 37
Saskatchewan.....	527,908	124,174	429,191	37,243 24	11,986 47	173 10	37,258	115,038	292,167	186,847 27	1,761,981 08
Alberta.....	470,087	263,140	257,156	59,953 85	485 08	20 50	11,130	386,294	165,271	284,360 61	1,897,898 04
British Columbia.....	842,666	222,560	2,197,600	58,823 81	80,273 64	2,069 68	1,866,670	439,730	404,400	77,816 97	6,192,610 10
Northwest Territories.....	5,476		19,970	40 00			14,975	471,000	5,665	19,100 00	536,226 00
Totals.....	2,533,930	734,226	5,981,012	223,072 46	140,568 20	4,639 27	2,427,478	3,164,759	1,749,877	1,105,679 70	18,064,941 63

Statement of Ordinary Expenditure Year 1945-46

74009-16

INDIAN AFFAIRS BRANCH

	Branch Administration	Indian Agencies	Reserves and Trusts Admin.	Welfare	Education	Grants to Residential Schools	Grants to Exhibitions	Total
	\$	\$	\$	\$	\$	\$	\$	\$
Nova Scotia.....		34,558	157	125,939	50,557	32,644	40	243,895
Prince Edward Island.....		4,576		11,143	1,230		25	16,974
New Brunswick.....		10,487		30,263	18,503		88	59,341
Quebec.....	35	60,332	6,048	130,927	68,814	11,596	77	277,829
Ontario.....	15	196,534	680	124,658	160,590	280,889	1,221	764,567
Manitoba.....	41	105,012		140,635	87,937	196,655	462	530,742
Saskatchewan.....	500	134,005	38	87,816	67,776	325,174	1,000	616,309
Alberta.....		116,377	1,017	69,832	18,850	340,287	1,034	547,397
British Columbia.....	929	150,486	1,447	98,340	101,521	369,404	747	722,874
Northwest Territories.....		22,324		17,579	1,776	46,172		87,861
Yukon.....		721		10,791	4,973	13,202		29,687
Headquarters and Miscellaneous.....	48,510	17,863	33,316	29,685	91,454		50	220,878
British Columbia Special.....		18,590		29,908	8,317			56,815
	50,030	871,865	42,683	907,516	682,298	1,616,023	4,744	4,175,159
Pensions and Gratuities.....								1,916
Statutory—Indian Annuities.....								291,825
Statutory—Pensions.....								600
Total Ordinary Expenditures.....								4,460,500

Statement of Special Expenditure Year 1945-46

FUR CONSERVATION

Quebec.....	\$ 18,279
Ontario.....	6,888
Manitoba.....	29,454
Saskatchewan.....	20,685
Alberta.....	24,203
British Columbia.....	125
Head Office.....	4,554
Total.....	\$ 104,188
Total Special Expenditure.....	104,188
Grand Total Ordinary and Special Expenditure....	4,578,688

## DEPARTMENT OF MINES AND RESOURCES

*Open Account—Advances for Assistance to Indians 1945-46*

## EXPENDITURE

Saskatchewan .....	\$4,913 09
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## REPAYMENTS

Alberta .....	\$573 95
Saskatchewan .....	77 54
British Columbia .....	582 82
	<u>1,234 31</u>
Expenditure over repayments .....	<u>\$3,678 78</u>

*Annuities paid and Interest on Indian Trust Funds 1945-46*

Alberta .....	\$ 284,360 61
British Columbia .....	77,816 97
Manitoba .....	116,034 20
New Brunswick .....	2,597 24
Northwest Territories .....	19,100 00
Nova Scotia .....	2,864 51
Ontario .....	391,525 48
Prince Edward Island .....	18
Quebec .....	24,433 24
Saskatchewan .....	186,847 27
Yukon Territory .....	26 81
	<u>\$1,105,606 51</u>

*Indian Trust Fund*

Showing transactions in connection with the fund during the fiscal year ended March 31, 1946.

Balance April 1, 1945 .....	\$ 16,637,651 37
Collections on land sales, timber and stone dues, rents, fines, fees, etc. ....	1,002,406 81
Interest for the year ended March 31, 1946 .....	842,623 53
Credit transfers during the year .....	19,528 91
Expenditure during the year .....	\$ 1,392,263 17
Transfers by Warrant, etc. ....	13,457 77
Balance March 31, 1946 .....	17,096,489 68
	<u>\$18,502,210 62</u>
	<u>\$18,502,210 62</u>

## SUMMARY OF SCHOOL STATEMENT

Statement showing enrolment by Provinces in the different classes of schools for the Fiscal Year ended March 31, 1946.

## RESIDENTIAL SCHOOLS

Province	Number of Schools	Denomination				Number on Roll			Average Attendance	Percentage of Attendance	Grades									
		Church of England	Presbyterian	Roman Catholic	United Church	Boys	Girls	Total			I	II	III	IV	V	VI	VII	VIII	IX	
Nova Scotia.....	1			1		75	78	153	149	97.38	44	10	13	28	25	15	7	11	.....	
Quebec.....	2	1			1	19	38	57	50	87.72	36	6	8	5	2				.....	
Ontario.....	13	5	1		6	1	766	859	1,625	1,490	91.69	531	200	200	184	202	128	93	67	20
Manitoba.....	9	1	1		4	3	473	622	1,095	994	90.77	325	156	153	140	161	72	51	18	19
Saskatchewan.....	14	3			9	2	869	1,017	1,886	1,727	91.57	570	296	263	239	204	166	95	33	20
Alberta.....	19	5			12	2	914	1,044	1,958	1,758	89.78	722	290	273	246	199	117	63	44	4
Northwest Territories.....	4	1			3		104	140	244	169	69.26	144	30	35	10	10	8	3	4	.....
British Columbia.....	13	2			9	2	971	1,098	2,069	1,876	90.67	544	365	303	261	227	199	104	51	15
Yukon.....	1	1					31	31	62	51	82.25	35	13	7	7				.....	
Total—Residential Schools.....	76	19	2		45	10	4,222	4,927	9,149	8,264	90.32	2,951	1,366	1,255	1,120	1,030	705	416	228	78



## DAY SCHOOLS

Province	Number of Schools	Number on Roll			Average Attendance	Percentage of Attendance	Grades								
		Boys	Girls	Total			I	II	III	IV	V	VI	VII	VIII	IX
Prince Edward Island.....	1	13	15	28	23	82-14	11	4	4	4	.....	4	1	.....	.....
Nova Scotia.....	9	176	204	380	275	72-36	180	55	48	47	27	16	5	2	.....
New Brunswick.....	10	165	192	357	290	81-23	94	65	54	36	50	24	20	13	1
Quebec.....	30	711	764	1,475	1,106	74-98	539	222	224	173	125	91	50	30	21
Ontario.....	76	1,318	1,421	2,739	1,995	72-84	1,003	393	370	319	228	202	119	100	5
Manitoba.....	43	729	785	1,514	936	61-82	858	278	153	97	71	32	22	1	2
Saskatchewan.....	28	393	368	761	560	73-59	365	132	107	69	51	20	11	5	1
Alberta.....	1	15	14	29	13	44-83	2	6	3	4	8	6	.....	.....	.....
Northwest Territories.....	2	10	18	28	18	64-29	7	7	3	2	4	.....	4	1	.....
British Columbia.....	56	1,034	1,057	2,091	1,409	67-38	979	360	262	196	155	62	38	36	3
Yukon.....	6	65	65	130	66	50-77	77	32	9	10	1	1	.....	.....	.....
Total—Day Schools.....	262	4,629	4,903	9,532	6,691	70-19	4,115	1,554	1,237	957	720	458	270	188	33

## COMBINED WHITE AND INDIAN SCHOOLS

Province	Number of Schools	Number on Roll			Average Attendance	Percentage of Attendance	Grades								
		Boys	Girls	Total			I	II	III	IV	V	VI	VII	VIII	IX
Quebec.....	1	9	7	16	12	75-00	3	2	7	2	1	1	.....	.....	.....
Ontario.....	3	36	26	62	51	82-25	18	10	8	5	8	2	2	7	2
Manitoba.....	3	20	21	41	22	53-65	28	6	5	1	.....	.....	1	.....	.....
Saskatchewan.....	1	3	2	5	3	60-00	3	1	1	.....	.....	.....	.....	.....	.....
Total—Combined White and Indian Schools.....	8	68	56	124	88	70-97	52	19	21	8	9	3	3	7	2

SUMMARY OF SCHOOL STATEMENT

Province	Classes of Schools			Total Number of Schools	Number on Roll			Average Attendance	Percentage of Attendance	Grades								
	Day	Residential	Combined		Boys	Girls	Total			I	II	III	IV	V	VI	VII	VIII	IX
Prince Edward Island.....	1			1	13	15	28	23	82.14	11	4	4	4		4	1		
Nova Scotia.....	9	1		10	251	282	533	424	79.55	224	65	61	75	52	31	12	13	
New Brunswick.....	10			10	165	192	357	290	81.23	94	65	54	36	50	24	20	13	1
Quebec.....	30	2	1	33	739	809	1,548	1,168	75.45	578	230	239	180	128	92	50	30	
Ontario.....	76	13	3	92	2,120	2,306	4,426	3,536	79.89	1,552	603	578	508	438	332	214	174	27
Manitoba.....	43	9	3	55	1,222	1,428	2,650	1,952	73.66	1,211	440	311	238	232	104	74	19	21
Saskatchewan.....	28	14	1	43	1,265	1,387	2,652	2,290	86.35	938	429	371	308	255	186	106	38	21
Alberta.....	1	19		20	929	1,058	1,987	1,771	89.13	724	296	276	250	207	123	63	44	4
Northwest Territories.....	2	4		6	114	158	272	187	68.75	151	37	38	12	14	8	7	5	
British Columbia.....	56	13		69	2,005	2,155	4,160	3,285	78.97	1,523	725	565	457	382	261	142	87	18
Yukon.....	6	1		7	96	96	192	117	60.93	112	45	16	17	1	1			
Totals.....	262	76	8	346	8,919	9,886	18,805	15,043	79.99	7,118	2,939	2,513	2,085	1,759	1,166	689	423	113

# IMMIGRATION BRANCH

A. L. JOLLIFFE, DIRECTOR

The number of immigrants admitted to Canada during the year ended March 31, 1946, was 31,081 as compared with 15,306 in the previous year, this representing an increase of 103 per cent. The increase is due largely to the admission to Canada from the British Isles of more than 16,000 dependants of members of the Canadian Armed Forces who served overseas and about 6,000 United States citizens. Immigrants arriving at ocean ports numbered 23,627 and from the United States, 7,454. Their racial origins were:—British 24,550, French 1,507, the remaining 5,024 representing 41 other racial groups. Classified by nationality 22,817 were British subjects, 6,083 United States citizens, the remaining 2,181 comprising 32 other nationalities. Classified by sex there were 10,458 males and 20,623 females.

## TOURIST MOVEMENT

With the easing of restrictions on travel following the cessation of hostilities the number of tourists entering Canada showed a marked increase over corresponding months of the previous year. During the year ended March 31, 1946, a total of 28,958,245 persons applied for entry to Canada and were individually examined at border and ocean ports. Of these 28,920,430 entered as non-immigrants and 6,734 were refused admission. The non-immigrant movement increased over 7,000,000 in comparison with the previous year. The figures quoted do not mean that over 28,000,000 different individuals entered Canada during the year, as some persons crossed the International Boundary many times; they do record a 36 per cent increase in the number of people entering Canada, tourists comprising a substantial proportion of the increase.

The statements appearing below furnish comparative figures of non-immigrant entries for nine years, including the war period:—

### *Non-Immigrants Entering Canada, from Abroad*

Fiscal year ended March 31,	Via		Totals
	Ocean Ports	From U.S.A.	
1938	47,832	31,179,807	31,227,639
" " " 1939	53,822	29,099,356	29,153,178
" " " 1940	42,126	28,295,332	28,337,458
" " " 1941	34,035	18,381,660	18,415,695
" " " 1942	28,395	17,983,877	18,012,272
" " " 1943	31,530	15,109,056	15,140,586
" " " 1944	24,665	16,356,484	16,381,149
" " " 1945	25,311	21,236,327	21,261,638
" " " 1946	29,645	28,890,785	28,920,430

### *Residents of Canada Returning After Visits Abroad*

Fiscal year ended March 31,	Via		Totals
	Ocean Ports	From U.S.A.	
1939	30,446	12,098,397	12,128,843
" " " 1940	18,757	11,590,952	11,609,709
" " " 1941	10,687	5,224,356	5,235,043
" " " 1942	14,113	4,047,167	4,061,280
" " " 1943	15,294	4,394,613	4,409,907
" " " 1944	11,551	5,860,609	5,872,160
" " " 1945	13,127	8,547,051	8,560,178
" " " 1946	13,941	11,076,564	11,090,505

The following statement records by immigration districts the number of persons examined upon application for entry to Canada and their disposition:—

	Admitted as immigrants	Admitted as non- immigrants	Rejected
Atlantic district.....	23,500	6,927,057	1,143
Eastern district.....	3,608	19,128,410	4,777
Western district.....	938	1,412,085	149
Pacific district.....	1,063	1,452,872	606
Via U.S. ocean ports.....	1,782		45
Not otherwise specified.....	190	6	14
<b>Totals.....</b>	<b>31,081</b>	<b>28,920,430</b>	<b>6,734</b>

### RETURNING CANADIANS

Every year a number of Canadians who had left Canada for permanent residence abroad return to again make their homes in the Dominion. Recognizing the importance of this movement the Department has for the past twenty-two years recorded the number of Canadians so returning. Figures covering the years from April, 1924, to March, 1934, will be found on page 181 of the report for the year ended March, 1944. The subsequent years are recorded in the following statement:—

### RETURNING CANADIANS

	Canadian Born	British Born Outside Canada	Canadians Naturalized	Totals
Fiscal year, 1934-35.....	5,811	937	870	7,618
Fiscal year, 1935-36.....	4,854	418	542	5,814
Fiscal year, 1936-37.....	4,522	319	223	5,064
Fiscal year, 1937-38.....	4,524	356	329	5,209
Fiscal year, 1938-39.....	3,825	360	386	4,571
Fiscal year, 1939-40.....	3,687	505	369	4,561
Fiscal year, 1940-41.....	4,010	177	53	5,140
Fiscal year, 1941-42.....	3,123	143	52	3,318
Fiscal year, 1942-43.....	3,056	167	30	3,253
Fiscal year, 1943-44.....	2,090	93	19	2,202
Fiscal year, 1944-45.....	2,156	130	18	2,304
Fiscal year, 1945-46.....	2,653	207	35	2,895
<b>Totals.....</b>	<b>45,211</b>	<b>3,812</b>	<b>2,926</b>	<b>51,949</b>

### STUDENTS

During the year 3,803 students were admitted to Canada to attend preparatory schools, to obtain degrees and take post-graduate courses in Canadian universities. Of this number 752 were British subjects, 2,665 United States citizens, 330 came from Central and South America and 56 from other countries. The number of students entering Canada for educational purposes is increasing each year.

## REGULATIONS

The Annual Report for the year ended March 31, 1945, recorded on page 195 particulars of regulations which concern the Immigration Service enacted subsequent to September 1, 1939. The following regulations also relating to immigration were enacted during the years 1945-1946:—

1. Orders in Council P.C. 4561 of June 26, 1945, and P.C. 7254 of December 7, 1945, provide for the repatriation of Canadian seamen who served in United Kingdom or Allied ships under United Kingdom Charter, and confer upon the dependents acquired by such seamen while serving overseas, when admitted to Canada, the same immigration status as that held by the seamen.
2. Order-in-Council P.C. 5210 of July 24, 1945, amended the regulations governing the issuance of exit permits to women and children sailing from a Canadian port to a destination outside the Western Hemisphere, by including in the classes to which a permit could issue "women and children proceeding abroad for permanent residence".
3. Order-in-Council P.C. 6687 of October 26, 1945, provides for the granting of permanent admission to Canada of refugees who entered Canada as such subsequent to September 1, 1939.

## ADMINISTRATION AND INSPECTIONAL WORK

Earlier in this report reference has been made to the increase in travel between Canada and the United States, which is rapidly returning to pre-war proportions. This has necessitated increasing the inspection staffs at a number of ports of entry. During the year additional inspectional facilities were provided to deal with expanding air services, both from overseas and from the United States. During the period under review 12,666 planes transporting 141,388 persons to Canada were examined. This represents an increase of 51 per cent over the previous year.

Persons refused admission to Canada at ports of entry totalled 6,734 and of these only 862 appealed against the decision of the port officers. Appeals dismissed by the Minister numbered 414, as compared with 354 the previous year.

Of 298 persons deported subsequent to entering Canada, 164 had effected illegal entry and 88 were returned to their own country after conviction for criminal offences on completion of sentences. Five persons were prosecuted and convicted for deliberate contravention of provisions of the Immigration Act, and in each instance deportation was subsequently effected.

During the year 15,889 ships' manifests recording the arrival and dispositions of 360,864 seamen, comprising the crews of 7,654 vessels, were filed at ocean ports. These manifests enabled port officers to check crews and to follow up deserters and the cases of seamen left in hospital.

The London, England, office reports, "a tremendous increase in applications from persons resident in Great Britain who wish to proceed to Canada". With the return of service personnel and the bringing of their dependants to Canada, steamship accommodation has not been available for an immigrant movement. It is unlikely there will be any appreciable improvement in this situation during the balance of 1946.

It is planned to re-establish immigration inspectional facilities at European ports for the civil and medical examination of immigrants prior to embarkation, as soon as regular steamship schedules are resumed, and thus admissible immigrants can proceed from their places of residence to ports of embarkation.

## EXIT PERMITS

The regulations restricting the sailing from Canadian ports of women and children proceeding to destinations outside the Western Hemisphere were continued in effect throughout the year, but were modified in July, 1945, to permit the sailing of such persons leaving Canada for permanent residence abroad.

## REPATRIATION OF DEPENDANTS OF CANADIAN SERVICE PERSONNEL

The movement to Canada from overseas of the dependants of service personnel continued throughout the year with 16,133 persons, comprising 11,160 adults and 4,973 children, being admitted. The total number of dependants brought to Canada from the commencement of the movement to March 31, 1946, was 24,018, comprising 16,169 adults and 7,849 children. The establishment of satisfactory settlement arrangements is required in each instance prior to sailing of the families. This has necessitated the conducting of approximately 30,000 investigations in Canada by Immigration officers. It is anticipated that the movement will be completed during 1946.

## BRITISH EVACUEE CHILDREN

In the report of 1940-41 and in subsequent reports reference was made to the British children who were evacuated to Canada in 1940, in particular the group of 1,532 who came under the assisted scheme sponsored by the British and Canadian Governments. At the beginning of this fiscal year 874 of this group were still in Canada. A number of the older boys and girls now able to support themselves are remaining here for permanent residence. The remainder of the group returned to the United Kingdom during the year, with the exception of 114. Some of these are completing educational courses while others will be joined by their parents as settlers when ocean passage is available. Meanwhile they are continuing as guests in private homes and the same supervision and care as previously provided are being extended by the provinces in co-operation with the Dominion.

The boys and girls who spent most of the war period here and have returned to the United Kingdom are enthusiastic ambassadors of Canada. In many cases a very strong bond exists between these young people and their "host parents" in Canada and already there is indication that many of them will be returning in time to make their homes here.

The National Advisory Committee for Children from Overseas, set up in 1940 to advise the Minister of Mines and Resources on matters relating to the evacuees and continuing to function through its executive, will now be terminated. The Committee has rendered valuable service under the chairmanship of Dr. R. C. Wallace, C.M.G., Principal of Queen's University. The expenditures incurred by the provinces and co-ordinating societies have been paid by the Committee from donations received from residents and organizations in Canada, amounting to \$80,114.95, supplemented by grants from the Dominion Government. The Independent Order of Oddfellows, Grand Lodge of Ontario, whose contribution to the work was mentioned in a previous report, have continued their interest, their total donations amounting to the splendid figure of \$50,208.16.

## REFUGEES

By Order in Council dated October 26, 1945, provision was made for the granting of permanent status to refugees from enemy countries and enemy-occupied territory who entered Canada subsequent to the outbreak of war. Many of these refugees had become stateless and escaped from the country of their birth and citizenship prior to the commencement of hostilities; others succeeded in leaving their homes prior to invasion by enemy forces, the majority having

been deprived of their property and possessions. Those qualified to do so rendered valuable service to Canada in the prosecution of the war. By March 31, 1,772 persons had obtained permanent status under the above referred to authority.

## CHINESE IMMIGRATION

While there were no immigrant admissions during the year, 59 persons entered under permit for varying periods. Of these 15 were students and 18 were engineers and technicians who came to Canada to study Canadian methods and obtain training with Canadian organizations. During the year 635 persons registered their departure at ports of embarkation, thus establishing their right to readmission. Of these 486 were proceeding abroad for business or pleasure and 149 were seamen employed on vessels operating between Canadian and foreign ports.

TABLE 1

*Immigration to Canada from 1900 to 1946*

	Via Ocean Ports			From U.S.A.			Grand Totals
	British Nationals	Others	Totals	U.S.A. Citizens	British Nationals	Others	
Six months ended June 30, 1900	5,141	10,211	15,352				8,543
Fiscal year ended June 30, 1901	11,813	19,349	31,162				17,987
" " 1902	17,270	23,721	40,991				26,388
" " 1903	42,200	36,691	78,891				49,473
" " 1904	51,050	34,110	85,160	12,648	4,145	23,946	40,739
" " 1905	65,967	36,756	102,723	15,477	2,263	22,190	39,930
" " 1906	88,174	43,094	131,268	33,013	2,108	17,675	52,796
Nine months ended March 31, 1907	59,272	30,736	90,008	20,479	1,309	10,369	32,157
Fiscal year ended March 31, 1908	126,783	77,374	204,157	31,411	2,674	19,067	53,152
" " 1909	55,463	31,613	87,076	33,474	2,894	17,926	54,294
" " 1910	63,757	41,239	104,996	65,190	3,662	22,196	91,048
" " 1911	126,170	63,463	189,633	77,353	5,007	22,524	104,884
" " 1912	141,504	79,023	220,527	91,840	6,236	16,250	114,326
" " 1913	152,373	111,050	263,423	92,061	7,398	19,959	119,418
" " 1914	144,513	132,835	277,348	74,745	6,374	8,773	89,892
" " 1915	44,117	40,893	85,010	34,745	3,541	3,482	41,768
" " 1916	9,032	2,568	11,600	21,370	2,796	1,687	25,853
" " 1917	9,980	4,005	13,985	43,261	3,324	4,558	51,143
" " 1918	4,879	2,881	7,760	47,818	3,444	6,923	58,185
" " 1919	10,701	6,286	16,987	28,280	1,725	1,950	31,955
" " 1920	60,659	7,021	67,680	36,628	2,250	1,850	40,728
" " 1921	75,783	24,635	100,418	33,891	2,768	1,651	38,310
" " 1922	39,606	21,048	60,654	18,782	1,825	1,063	21,670
" " 1923	36,360	14,520	50,880	14,095	1,641	830	16,566
" " 1924	78,740	49,299	128,039	14,928	1,478	805	17,211
" " 1925	54,943	40,601	95,544	13,171	1,794	853	15,818
" " 1926	37,569	39,717	77,286	15,442	2,251	1,085	18,778
" " 1927	50,378	72,586	122,964	17,820	2,239	966	21,025
" " 1928	51,552	75,041	126,593	21,260	2,696	1,051	25,007
" " 1929	59,497	77,666	137,163	26,539	3,061	960	30,560
" " 1930	64,962	67,599	132,561	26,751	3,121	855	30,727
" " 1931	28,144	35,799	63,943	20,723	2,938	619	24,280
" " 1932	7,332	4,123	11,455	12,277	1,815	205	14,297
" " 1933	3,283	3,303	6,586	11,172	1,806	218	13,196
" " 1934	2,454	3,709	6,163	6,545	1,032	163	7,740
" " 1935	2,408	3,768	6,176	5,104	769	87	5,960
" " 1936	2,264	3,718	5,982	4,322	709	90	5,121
" " 1937	2,521	4,389	6,910	4,301	742	70	5,113
" " 1938	3,351	6,651	10,002	4,727	852	64	5,643
" " 1939	3,831	7,634	11,465	4,685	917	61	5,663
" " 1940	3,962	6,495	10,457	4,383	1,234	131	5,748
" " 1941	3,428	625	4,053	5,295	2,064	84	7,443
" " 1942	2,353	201	2,554	5,075	1,180	56	6,311
" " 1943	2,524	94	2,618	3,457	1,344	26	4,827
" " 1944	4,519	80	4,599	3,302	1,101	38	4,441
" " 1945	10,564	118	10,682	3,687	907	30	4,624
" " 1946	21,463	2,164	23,627	6,051	1,354	49	7,454

TABLE 2

Immigration to Canada for the Period July 1, 1900, to March 31, 1910

	Fiscal Years										Totals
	1900-1	1901-2	1902-3	1903-4	1904-5	1905-6	Nine Months Ended March 31, 1907	1907-8	1908-9	1909-10	
English.....	9,331	12,783	32,087	36,003	48,847	65,135	41,156	90,380	37,019	40,416	413,157
Irish.....	933	1,311	2,236	3,128	3,998	5,018	3,404	6,547	3,609	3,940	34,124
Scotch.....	1,476	2,853	7,046	10,552	11,744	15,846	10,729	22,223	11,810	14,706	108,985
Welsh.....	70	312	423	691	770	797	502	1,032	463	728	5,788
Totals.....	11,810	17,259	41,792	50,374	65,359	86,796	55,791	120,182	52,901	59,790	562,054
African, South.....				21	35	46	23	76	53	97	351
Arabian.....	98	70	46	58	48	19	31	50	4	14	438
Armenian.....	62	112	113	81	78	82	208	563	79	75	1,453
Australian.....	3	11	46	58	204	322	185	180	171	203	1,383
Austro-Hungarian.....	5,692	8,557	13,095	11,137	10,089	10,170	4,045	21,376	10,798	9,757	104,716
Brazilian.....				2	1	2	5	1	4		15
Bulgarian.....		1	7	14	2	71	179	2,529	56	557	3,416
Chinese.....	7	2				18	92	1,884	1,887	2,156	6,046
Doukhobor.....		12			24	204					240
Dutch.....	25	35	223	169	281	389	394	1,212	495	741	3,964
East Indian.....					45	387	2,124	2,623	6	10	5,195
Egyptian.....	1	3	1	3	2	18	10	8		2	50
Finnish.....	682	1,292	1,734	845	1,323	1,103	1,049	1,212	669	1,457	11,366
French and Belgian.....	492	654	1,240	2,392	2,539	2,754	1,964	3,885	2,658	2,637	21,215
German.....	984	1,048	1,887	2,985	2,759	1,796	1,903	2,377	1,340	1,533	18,612
Greek.....	81	161	193	191	98	254	545	1,063	192	452	3,220
Hebrew.....	2,765	1,015	2,066	3,727	7,715	7,127	6,584	7,712	1,636	3,182	43,529
Italian.....	4,710	3,828	3,371	4,445	3,473	7,959	5,114	11,212	4,228	7,118	55,458
Japanese.....	6				354	1,922	2,042	7,601	495	271	12,691
Malay.....		5									5
Maltese.....			2								2
Mennonite.....		52	38	11							101
Negro.....					5	42	108	136	73	7	371
Newfoundland.....			335	519	190	340	1,029	3,374	2,108	3,372	11,267
New Zealand.....			2	23	57	89	30	70	65	82	418
Persian.....		1	40	5	8	7	31	7	1	5	105
Polish.....	162	230	274	669	745	725	1,033	1,593	376	1,407	7,214
Portuguese.....					1	6	2	2		2	15
Roumanian.....	152	551	438	619	270	396	431	949	278	293	4,377
Russian.....	1,044	2,467	5,505	1,955	1,887	3,152	1,927	6,281	3,547	4,564	32,329
Scandinavian.....	1,750	2,451	5,448	4,203	4,118	3,859	2,296	4,073	2,082	3,782	34,063
Serbian.....	23		2	10	7	19	4	48	31	76	220
Spanish.....	14	1	7	5	10	12	29	61	32	42	213
Swiss.....	30	17	73	128	150	172	112	195	129	211	1,217
Syrian.....	464	1,066	847	369	630	336	277	732	189	195	5,105
Turkish.....	37	17	43	29	30	357	232	489	236	517	1,987
U.S.A. citizens, via ocean ports.....	68	73		58	109	123	89	133	94	186	933
West Indian.....			23	55	77	194	90	278	159	203	1,079
Total, Continental, etc.....	19,352	23,732	37,099	34,786	37,364	44,472	34,217	83,975	34,175	45,206	394,378
From the United States.....	17,987	26,388	49,473	40,739	39,930	52,796	32,157	53,152	54,294	91,048	457,964
Total immigration.....	49,149	67,379	128,364	125,899	142,653	184,064	122,165	257,309	141,370	196,044	1,414,396





TABLE 4

Immigration to Canada for the Period April 1, 1920, to March 31, 1925

	Fiscal Years					Totals
	1920-21	1921-22	1922-23	1923-24	1924-25	
English.....	47,687	23,225	19,188	37,030	26,466	153,596
Irish.....	6,384	3,572	3,668	9,719	9,379	32,722
Scottish.....	19,248	11,596	11,071	26,057	16,174	83,146
Welsh.....	943	627	581	1,113	1,159	4,423
Totals.....	74,262	39,020	34,508	72,919	53,178	273,887
African, South.....	63	32	41	60	37	233
Albanian.....	6	6	1	7	2	22
Arabian.....	8	5	2			15
Argentinian.....	4		4			8
Armenian.....	85	70	59	486	364	1,004
Australian.....	90	76	67	112	162	507
Austrian.....	26	14	23	82	75	220
Belgian.....	1,645	508	316	1,662	1,300	5,426
Bermudian.....	8	2	7	4	4	25
Brazilian.....					1	1
Bulgarian.....	4	27	19	267	60	386
Chilean.....					3	3
Chinese.....	2,435	1,746	711	674		5,566
Cuban.....				1		1
Czecho-Slovakian.....	308	152	101	2,757	2,064	5,402
Dutch.....	595	183	119	1,149	1,637	3,683
East Indian.....	10	13	21	40	46	130
Egyptian.....	9	2		3	3	17
Estonian.....			12	51	49	112
Finnish.....	1,401	274	1,171	7,640	4,261	14,747
French.....	861	332	281	379	326	2,170
German.....	137	178	216	1,769	2,215	4,515
Greek.....	357	209	177	292	287	1,272
Hebrew.....	2,763	8,404	2,793	4,255	4,459	23,674
Hungarian.....	23	48	23	264	1,052	1,510
Italian.....	3,680	2,413	2,074	6,379	2,349	17,095
Jamaican.....	18	13	30	24	8	93
Japanese.....	532	471	369	448	501	2,321
Jugo-Slavian.....	89	180	136	1,206	1,620	3,331
Latvian.....			1	11	20	32
Lettish.....				6	2	8
Lithuanian.....		19	106	236	125	486
Luxemburg.....	16	5	3	85	35	144
Maltese.....	140	34	57	148	26	405
Mexican.....	1			1		2
Negro.....	144	42	42	42	39	309
Newfoundland.....	1,042	367	1,552	5,346	1,288	9,595
New Zealand.....	40	25	33	50	107	255
Persian.....	1	9	1	5	18	34
Polish.....	4,061	2,707	2,921	4,211	2,734	16,634
Portuguese.....	4		2		3	9
Roumanian.....	969	759	427	1,431	2,056	5,642
Russian.....	1,077	321	222	3,058	5,411	10,089
Scandinavian—						
Danish.....	511	541	382	1,355	1,820	4,019
Icelandic.....	50	31	21	27	49	178
Norwegian.....	429	480	507	2,424	2,550	6,390
Swedish.....	715	442	948	3,636	2,138	7,779
Spanish.....	202	6	15	39	3	265
Swiss.....	235	187	152	1,585	690	2,839
Syrian.....	443	123	91	286	210	1,153
Turkish.....	8	3	3	27	29	70
Ukrainian.....	491	89	36	832	26	1,474
U.S.A. citizens, via ocean ports.....	110	67	32	134	96	439
Venezuelan.....			1	6		7
West Indian.....	110	24	44	37	37	252
Total, Continental, etc.....	26,156	21,634	16,372	55,120	42,366	161,648
From the United States.....	38,310	21,670	16,566	17,211	15,818	109,575
Total immigration.....	138,728	82,324	67,446	145,250	111,362	545,110









TABLE 7

*Immigration to Canada, by Origins, via Ocean Ports and from the United States, for the Fiscal Year ended March 31, 1946*

Racial Origin	Via Ocean ports	From U.S.A.	Totals
English.....	15,781	2,416	18,197
Irish.....	1,410	936	2,346
Scotch.....	2,642	934	3,576
Welsh.....	329	102	431
<b>Totals.....</b>	<b>20,162</b>	<b>4,388</b>	<b>24,550</b>
Belgian.....	33	28	61
Danish.....	34	57	91
Dutch.....	97	235	332
Finnish.....	6	20	26
French.....	571	936	1,507
German.....	234	580	814
Icelandic.....	3	12	15
Norwegian.....	125	124	249
Swedish.....	27	110	137
Swiss.....	18	37	55
<b>Totals.....</b>	<b>1,148</b>	<b>2,139</b>	<b>3,287</b>
Armenian.....	3	3	6
Bohemian.....	10	10	20
Bulgarian.....	1	1	1
Chinese.....	1	1	1
Croatian.....	1	2	3
Czech.....	43	12	55
East Indian.....	1	1	1
Esthonian.....	8	1	9
Greek.....	32	23	55
Hebrew.....	1,345	368	1,713
Italian.....	58	125	183
Jugo-Slavian.....	10	18	28
Lettish.....	1	1	1
Lithuanian.....	4	5	9
Magyar.....	38	49	87
Maltese.....	5	1	6
Mexican.....	3	2	5
Moravian.....	1	3	3
Negro.....	75	52	127
North American Indian.....	1	20	20
Persian.....	1	1	1
Polish.....	528	95	623
Portuguese.....	12	4	16
Roumanian.....	5	15	20
Russian.....	59	53	112
Ruthenian.....	18	30	48
Serbian.....	1	4	5
Slovakian.....	4	13	17
Spanish.....	28	3	31
Spanish American.....	5	3	8
Syrian.....	14	11	25
Turkish.....	4	1	5
<b>Totals.....</b>	<b>2,317</b>	<b>927</b>	<b>3,244</b>
<b>GRAND TOTALS.....</b>	<b>23,627</b>	<b>7,454</b>	<b>31,081</b>





TABLE 8—Concluded  
Immigration via Ocean Ports, Showing Country of Birth by Racial Origin, for the Fiscal Year 1945-46

Country of Birth	Totals	Armenian	Belgian	Bohemian	English	Irish	Scottish	Welsh	Chinese	Croatian	Czech	Dutch	East Indian	Esthonian	Finnish	French	German	Greek	Hebrew	Italian	Jugo-Slavian	Lettish	Lithuanian	Magyar	Maltese	Mexican	Negro	Persian	Polish	Portuguese	Roumanian	Russian	Ruthenian	Danish	Icelandic	Norwegian	Swedish	Serbian	Slovak	Spanish	Spanish American	Swiss	Syrian	Turkish				
Newfoundland.....	4,022				3,155	561	136	6				7			126				5	4			1					5			1		1				4	2			1				7			
New Zealand.....	22				11		8								3																																	
Norway.....	91																																						91									
Palestine.....	6				1	1																																									1	
Peru.....	14				11		1								1																																	
Philippine Islands.....	17				6		10																																									
Poland.....	699																3		248		2							444				1	1															
Portugal.....	7																																															
Roumania.....	23																																															
Russia.....	50				4							1			1																																	
Scotland.....	2,382		2		222	72	1,963	8		1	4				57	13					3	4	1	1																								
South America N.E.S.....	10				2	2	3				1				1																																	
Spain.....	24				5																			1																								
Sweden.....	6				1																																											
Switzerland.....	26				3																																											
Trinidad.....	39				23	2	3								3	1																																
Turkey.....	7	1																																														
United States.....	67				46	1	7	1								3																																
Wales.....	424				127	7	14	263				1				8	1																															
West Indies (British) N.E.S.....	52				15	1	3																				30																					
Others.....	47				16	1	1	1				4				6	1																															
Totals.....	23,627	3	33	10	15,781	1,410	2,642	329	1	1	43	97	1	8	6	571	234	32	1345	58	10	1	4	38	5	3	75	1	528	12	5	59	18	34	3	125	27	1	4	28	5	18	14	4				



TABLE

*Origin, Sex, Occupation and Destination of Immigrant Arrivals*

Racial Origin	Sex				Totals	Trade or								
	18 Years and Over		Under 18 Years			Farming Class			Labouring Class			Mechanics		
	Males	Females	Males	Females		Males	Females	Children	Males	Females	Children	Males	Females	Children
Armenian	1	1		1	3									
Belgian	4	17	4	8	33	1		1				1	1	
Bohemian	2	4	2	2	10									
British—														
English	1,568	9,765	2,248	2,200	15,781	54	18	13	464	74	41	559	104	58
Irish	250	788	170	202	1,410	10	2	1	106	10	4	72	11	6
Scotch	158	1,740	383	361	2,642	5	1	1	32	3	6	44	5	6
Welsh	22	272	16	19	329	3			3	1		8	1	1
Chinese		1			1									
Croatian		1			1									
Czech	17	16	6	4	43							7	1	
Dutch	9	26	33	29	97	3	1	3	1			1	1	
East Indian		1			1									
Estonian	1	4	3		8	1						1		
Finnish	1	2	2	1	6							1	1	
French	50	85	223	213	571	2	1		27	2	1	15	2	3
German	127	55	27	25	234	2			5	1		18	1	3
Greek	17	6	7	2	32				4			1		
Hebrew	937	271	78	59	1,345	15	1	1	59	10	6	270	43	28
Italian	15	21	6	16	58				5		1			
Jugo-Slavian	6	2		2	10							1		1
Lettish		1	1		1									
Lithuanian		1		3	4									
Magyar	9	17	6	6	38				1			2	2	2
Maltese	3	2			5				2			1		
Mexican	1	2			3							1		
Negro	51	17	4	3	75				11	1		23		
Persian		1			1									
Polish	360	101	32	35	528	8	1		6	3	1	230	25	5
Portuguese	8	4			12				2			2		
Roumanian		1	3	1	5									
Russian	6	15	19	19	59	1	1	6		1		1		
Ruthenian	1	1	8	8	18									
Scandinavian—														
Danish	12	10	9	3	34	2			6			2	1	
Icelandic			1	2	3									
Norwegian	82	10	17	16	125	3			19			46		1
Swedish	4	2	11	10	27				2			2		
Serbian			1		1									
Slovakian	1	2		1	4									
Spanish	9	14	2	3	28							2	2	
Spanish American	1	4			5									
Swiss	1	15	1	1	18				1					
Syrian	2	3	2	7	14				1				1	
Turkish	1		2	1	4									
Totals	8,737	13,300	3,327	3,263	23,627	110	26	26	757	106	60	1,310	202	114

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at Ocean Ports, for the Fiscal Year ended March 31, 1946

Occupation										Destination											
Trading and Clerical Classes			Mining Class			Female Domestic Servants		Other Classes			Nova Scotia	New Brunswick	Prince Edward Island	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon Territory	
Males	Females	Children	Males	Females	Children	18 Years and Over	Under 18 Years	Males	Females	Children											
1									1	1			1	1	1						
2	2	2						2	16	11	1		9	15	2	3			3		
									2	2									1		
252	244	89	40	4	2	326	71	199	8,995	4,174	1,976	643	123	1,981	6,336	982	1,022	1,223	1,495		
28	39	5	4			76	7	30	650	349	270	70	18	201	548	67	57	75	104		
39	34	22	3		3	11	4	35	1,686	702	219	126	14	291	1,061	185	190	214	342		
3	1					1		5	268	34	19	13		31	142	32	29	37	26		
									1												
8	3	2						2	12	8		1	1	14	16	2	1	6	2		
2						1		2	23	59	15	3		8	35	16	6	8	6		
	1																		1		
									4	3		4			4						
									1	3				1	5						
3	6	2	1			16	1	2	58	429	82	41	7	232	130	21	18	20	20		
30	7	4				1		72	45	45	3	4		73	103	20	9	11	11		
10								2	6	9	3	2		10	4	2	8	2	1		
320	71	42				1		273	145	60	7	2	1	705	531	38	13	13	35		
2			2					6	21	21	2			12	22	3	1	7	11		
3								2	2	1					10						
									1	1					1						
									1	3					2	1	1				
3	1	2						3	14	8		1		3	18	2	4	7	3		
									2						2	1			2		
									2					1	1	1					
8	1							9	15	7	8			58	8				1		
									1						1						
23	17	4						93	55	57	2			245	245	13	6	3	14		
4									4		1			6	4				1		
									1	4				1	1	1			2		
3	4	1						1	9	31				13	19	13	3	5	6		
1									1	16				2	5	1	6	2	2		
1	1	2						1	8	10	5			9	13		1	3	3		
										3						1	1	1			
12								2	10	32	25	11		11	51	4	8	6	9		
									2	21	1	2		2	8		8	1	4	1	
										1						1					
1	1	1							1						4						
2	4					1		5	7	5	4	1		10	10	2		1			
1	1								3					2	1				2		
									15	2		1		7	7	1			2		
1		1							2	8				3	10	1					
1		3													4						
764	438	182	50	4	5	434	83	746	12,090	6,120	2,643	925	164	3,942	9,388	1,415	1,395	1,645	2,109	1	

TABLE

## Origin, Sex, Occupation and Destination of Immigrant Arrivals

Racial Origin	Sex				Totals	Trade or								
	18 Years and Over		Under 18 Years			Farming Class			Labouring Class			Mechanics		
	Males	Females	Males	Females		Males	Females	Children	Males	Females	Children	Males	Females	Children
Armenian		2		1	3									
Belgian	8	14	4	2	28	4		1	1	1				
Bohemian	5	5			10	1	1					3		
British—														
English	781	1,035	297	303	2,416	135	67	62	71	30	23	166	38	26
Irish	302	365	144	125	936	59	19	41	57	8	12	64	12	16
Scotch	297	397	127	113	934	59	31	25	28	9	6	57	17	14
Welsh	38	29	26	9	102	2	1		6	4	3	7	1	2
Bulgarian		1			1									
Croatian		2			2		1							
Czech	3	8	1		12				1	1			1	
Dutch	68	97	39	31	235	13	6	6	6	2	2	11	4	7
Estonian	1				1	1								
Finnish	3	13	2	2	20		2					2		2
French	298	350	146	142	936	56	28	44	50	17	24	74	21	27
German	169	270	66	75	580	47	22	33	10	7	1	31	10	7
Greek	9	11	1	2	23				1				1	1
Hebrew	138	149	39	42	368	3	3	2	8	1		25	7	5
Italian	34	59	19	13	125	2	3		5	2	4	14	5	3
Jugo-Slavian	5	9	2	2	18	1			1	1	2	3	2	
Lithuanian	4	1			5				1			2		
Magyar	14	23	6	6	49	4	5	2	3	3	1	2		
Maltese	1				1							1		
Mexican	2				2				1			1		
Moravian		2	1		3									
Negro	19	15	13	5	52	4	3	2	2	1		8	1	7
North American Indian		5	9	6	20					2				
Polish	31	50	6	8	95	5	2	1	3	1		8	2	3
Portuguese	1	3			4							1		
Roumanian	3	6	2	4	15	2								
Russian	17	24	7	5	53	6	1	2	2	2		2		
Ruthenian	6	15	5	4	30		4	3	1		1	2		
Scandinavian—														
Danish	22	19	9	7	57	6	4	5	2		3	4	1	
Icelandic	2	5	4	1	12									
Norwegian	48	44	15	17	124	19	3	5	2	3		13	1	3
Swedish	38	45	13	14	110	12	3	2	2	1		5	1	
Serbian	1	2	1		4				1					
Slovakian	4	7		2	13		1		1					
Spanish		3			3									
Spanish American	2	1			3	1						1		
Swiss	11	15	4	7	37	3	3	8				1	1	
Syrian	1	10			11									
Turkish		1			1									
Totals	2,386	3,112	1,008	948	7,454	445	213	244	266	97	82	508	126	123

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from the United States, for the Fiscal Year ended March 31, 1946

Occupation										Destination												
Trading and Clerical Classes			Mining Class			Female Domestic Servants		Other Classes			Nova Scotia	New Brunswick	Prince Edward Island	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon Territory	Northwest Territories	Not given
Males	Females	Children	Males	Females	Children	18 Years and over	Under 18 Years	Males	Females	Children												
										2	1											
								3	13	5			5	18				2	3			
1	1								3					6	1		2	1				
194	137	58	8			14		207	749	431	143	197	32	227	1,190	45	51	134	389	2	3	3
60	35	20	2			4	1	60	287	179	41	60	10	91	511	18	25	59	119	1	1	
71	53	28	2			7	1	80	280	166	94	55	13	66	457	23	13	45	165	1	2	
7	3	1	1		1			15	20	28	4	5		2	44	2		4	39	2		
									1					1								
								2	6	1				8	1	2			1			
24	11	7						14	74	48	5	9		10	120	16	5	40	30			
								1	10	2				1	16				1	2		
55	34	26				7	1	63	243	166	49	77	3	491	244	8	3	34	27			
38	30	12		1		2		43	198	88	14	10	1	42	302	38	35	75	60	3		
7								1	10	2				3	8	2		2	8			
86	26	17						16	112	57	11	5	2	124	179	18	3	12	14			
10	6	4						3	43	21	5			21	82	3		4	10			
									6	2				2	16							
	1							1						2	3							
3	1	1						2	14	8	1			3	37	4	1	1	2			
															1				1			
									2	1					3							
								5	10	9	1			5	46							
								3	3	15		1		7	5	1			6			
6	6	3	2			2		7	37	7		1		8	63	7	2	8	5			1
									3					2	1			1				
	2							1	4	6				1	13				1			
4	6	1						3	15	9		2		3	16	5	4	13	10			
	1							3	10	5					16	7	4	1	2			
5	1	6	1					4	13	2	2	2		7	19	1	3	16	7			
1	1	4						1	4	1						7	1		4			
5	3	3	1					8	34	21	4			3	28	7	18	35	27	2		
7	3	2						12	37	23		5	1	7	29	7	16	28	17			
									2	1					2				2			
2	1	1						1	5	1	2			1	9	1						
	1								2		1			1	1							
									1						2			1				
2								5	11	3		1		2	25	2		1	6			
1									10		2			1	8							
									1						1							
589	363	194	17	1	1	36	3	561	2,276	1,309	379	427	65	1,139	3,533	224	186	520	960	11	6	4







TABLE 13

Immigration, Showing Nationality and Sex, for the Fiscal Year Ended March 31, 1946

Nationality	Via Ocean Ports					From the United States					Grand Totals	
	Totals	18 Years and Over		Under 18 Years		Totals	18 Years and Over		Under 18 Years			
		M.	F.	M.	F.		M.	F.	M.	F.		
Austrian.....	4	2	1		1							4
Belgian.....	22	4	10	3	5	3	1	2				25
Brazilian.....	2	1	1									2
British.....	21,463	2,142	12,926	3,221	3,174	1,354	253	822	140	139		22,817
Chilian.....	1		1									1
Cuban.....	4	2	2									4
Czecho-Slovakian.....	64	29	24	4	7	4	1	3				68
Danish.....	14	11	3			3	3					17
Danzig.....	1	1										1
Dutch.....	15	5	10			5	2	2	1			20
Esthonian.....	5	1	2	2								5
Finnish.....	3		2	1								3
French.....	50	14	12	12	12	2	1	1				52
German.....	947	858	65	17	7	2	2					949
Greek.....	13	12	1			2	1	1				15
Hungarian.....	41	21	12	6	2	1	1					42
Icelandic.....						6	1	1	3	1		6
Italian.....	16	15			1	3	3					19
Jugo-Slavian.....	25	11	10	1	3	1	1					26
Latvian.....						1	1					1
Luxemburg.....	2	1	1									2
Mexican.....	16	3	2	8	3	2	1	1				18
Norwegian.....	97	82	9	4	2	4	3	1				101
Peruvian.....	1	1										1
Polish.....	737	489	182	37	29	3	1	2				740
Portuguese.....	4	1		2	1							4
Roumanian.....	18	10	5	1	2	1		1				19
Russian.....	3	1	2			5	3	2				8
South American, N.E.S.....	1		1									1
Spanish.....	7	3	3	1								7
Swedish.....	5	5				1	1					6
Swiss.....	11	3	4	3	1							11
Turkish.....	2	2										2
Ukrainian.....	1	1										1
U.S. Citizens.....	32	6	9	4	13	6,051	2,106	2,273	864	808		6,083
<b>Totals.....</b>	<b>23,627</b>	<b>3,737</b>	<b>13,300</b>	<b>3,327</b>	<b>3,263</b>	<b>7,454</b>	<b>2,386</b>	<b>3,112</b>	<b>1,008</b>	<b>948</b>		<b>31,081</b>

**TABLE 14**  
*Rejections, at Ocean Ports, by Causes and Nationalities, from 1902-3 to 1945-46*

	Fiscal Years																							Totals		
	1902-3 to 1912-3	1913-4 to 1922-3	1923- 1924	1924- 1925	1925- 1926	1926- 1927	1927- 1928	1928- 1929	1929- 1930	1930- 1931	1931- 1932	1932- 1933	1933- 1934	1934- 1935	1935- 1936	1936- 1937	1937- 1938	1938- 1939	1939- 1940	1940- 1941	1941- 1942	1942- 1943	1943- 1944		1944- 1945	1945- 1946
<i>By Causes</i>																										
Medical causes.....	4,162	1,029	130	83	40	95	104	94	78	39	26	16	17	9	13	11	8	7	10	11	20	16	16	16	24	6,074
Civil causes.....	5,094	5,604	862	948	226	594	215	266	243	444	298	213	177	206	183	236	202	170	167	225	129	122	169	130	314	17,437
Totals.....	9,256	6,633	992	1,031	266	689	319	360	321	483	324	229	194	215	196	247	210	177	177	236	149	138	185	146	338	23,511
<i>By Nationalities</i>																										
British.....	1,240	978	187	199	109	209	150	154	160	251	180	126	123	150	123	138	86	94	124	95	90	89	141	110	246	5,552
American.....	175	134	6	11	.....	5	2	3	8	6	4	13	11	13	7	7	4	9	5	4	1	1	1	5	.....	435
Other countries.....	7,841	5,521	799	821	157	475	167	203	153	226	140	90	60	52	66	102	120	74	48	137	58	48	43	31	92	17,524
Totals.....	9,256	6,633	992	1,031	266	689	319	360	321	483	324	229	194	215	196	247	210	177	177	236	149	138	185	146	338	23,511

TABLE 15

*Deportations, After Having Been Admitted, by Causes, Nationalities, and Provinces, from 1902-3 to 1945-46*

	Fiscal Years																				Totals					
	1902-3 to 1912-3	1913-4 to 1922-3	1923- 1924	1924- 1925	1925- 1926	1926- 1927	1927- 1928	1928- 1929	1929- 1930	1930- 1931	1931- 1932	1932- 1933	1933- 1934	1934- 1935	1935- 1936	1936- 1937	1937- 1938	1938- 1939	1939- 1940	1940- 1941		1941- 1942	1942- 1943	1943- 1944	1944- 1945	1945- 1946
<b>By Causes</b>																										
Medical causes.....	2,296	2,213	649	420	410	470	519	650	600	789	697	476	301	144	81	47	42	36	29	12	14	20	15	21	24	10,975
Public charges.....	2,853	4,517	775	543	506	354	430	444	2,106	2,245	4,507	4,916	2,991	464	125	110	46	45	18	8	1	.....	2	3	1	28,010
Criminality.....	1,083	3,989	511	520	453	447	426	441	591	868	1,066	836	493	267	207	117	101	114	110	83	69	100	111	99	95	13,137
Other civil causes...	590	793	93	58	189	149	257	194	107	200	270	277	250	172	163	240	203	229	237	322	371	121	101	55	178	5,762
Accompanying deported persons...	145	262	78	145	155	165	254	235	550	274	545	626	439	81	34	57	21	10	5	3	3	3	1	.....	.....	4,103
Totals.....	6,907	11,774	2,106	1,686	1,716	1,585	1,886	1,964	3,963	4,376	7,025	7,131	4,474	1,128	610	571	413	434	399	428	458	244	230	181	298	61,987
<b>By Nationalities</b>																										
British.....	4,358	5,226	1,377	985	899	808	1,047	1,083	2,983	3,099	4,248	4,251	2,718	385	157	202	134	135	127	108	135	82	74	62	165	34,948
American.....	1,066	4,566	417	321	330	351	297	294	228	279	290	331	319	199	146	167	138	145	147	124	107	104	96	82	61	10,575
Other countries.....	1,483	1,982	312	380	487	426	542	587	752	998	2,517	2,549	1,437	544	307	202	141	154	125	196	216	58	60	37	72	16,564
Totals.....	6,907	11,774	2,106	1,686	1,716	1,585	1,886	1,964	3,963	4,376	7,025	7,131	4,474	1,128	610	571	413	434	399	428	458	244	230	181	298	61,987
<b>By Provinces</b>																										
Maritime Provinces.	147	409	38	32	43	48	48	70	93	148	252	244	260	62	42	61	27	40	61	136	150	96	85	67	150	2,809
Quebec.....	1,589	2,197	301	206	233	233	240	255	480	509	984	1,343	596	163	106	129	102	112	103	139	178	48	48	35	68	10,397
Ontario.....	2,896	4,243	547	675	620	581	646	600	1,115	1,788	2,828	2,626	1,827	347	167	127	123	121	96	80	82	59	43	41	35	22,313
Manitoba.....	.....	1,310	802	242	195	177	279	403	1,296	625	1,014	858	408	71	43	32	21	22	8	14	4	5	6	3	6	.....
Saskatchewan.....	1,783	691	110	115	113	118	197	173	277	414	767	490	261	91	36	26	14	28	9	.....	1	9	9	3	5	18,875
Alberta.....	.....	1,041	102	134	178	169	260	187	396	511	631	738	467	184	79	77	40	19	32	9	9	7	6	8	7	.....
British Columbia...	491	1,876	206	282	334	259	216	276	308	381	549	832	655	210	137	119	86	92	90	50	34	20	33	24	27	7,585
Yukon Territory....	1	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8
Totals.....	6,907	11,774	2,106	1,686	1,716	1,585	1,886	1,964	3,963	4,376	7,025	7,131	4,474	1,128	610	571	413	434	399	428	458	244	230	181	298	61,987

