DOMINION OF CANADA

REPORT OF THE DEPARTMENT

OF

MINES AND RESOURCES

FOR THE

FISCAL YEAR ENDED MARCH 31, 1947

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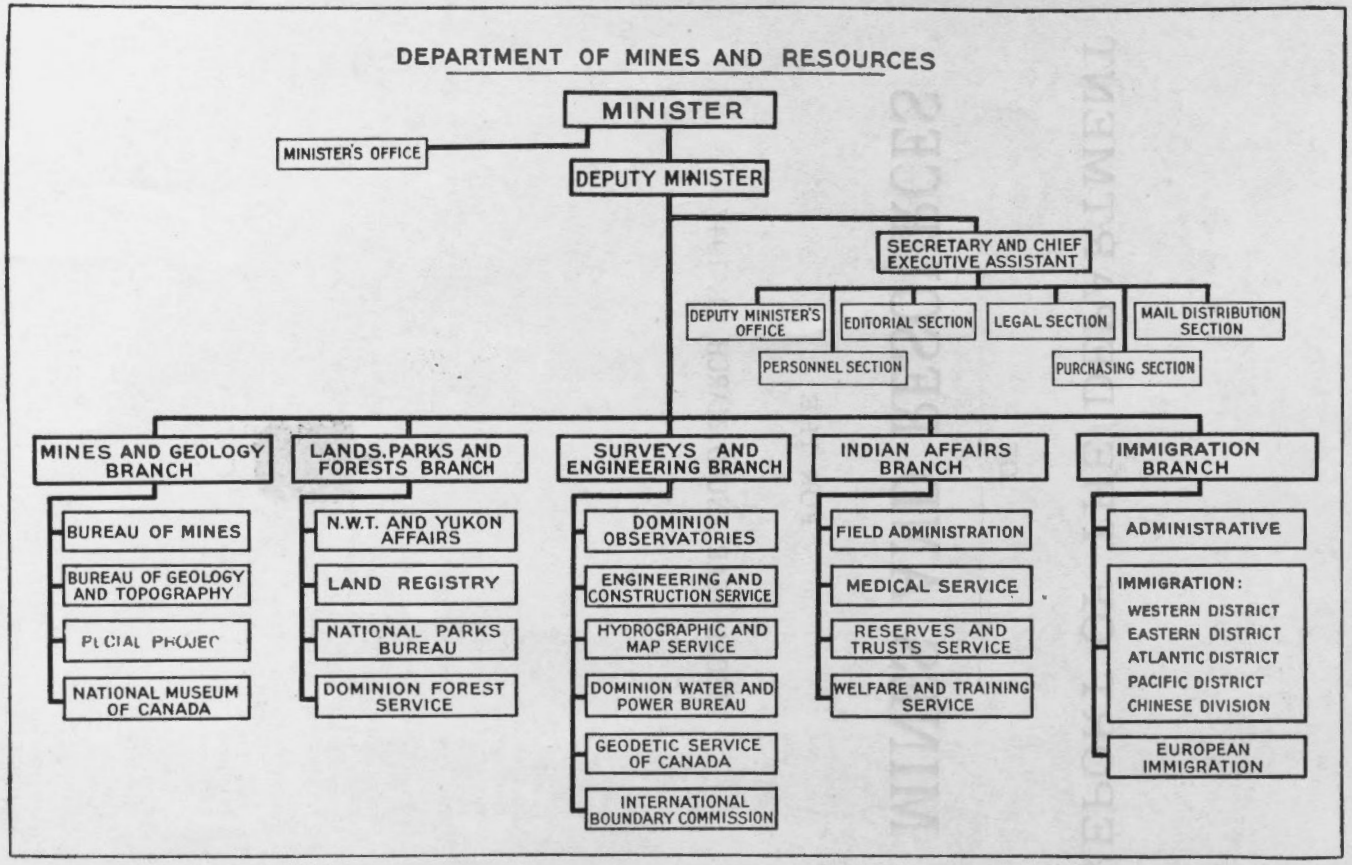

Organization Chart, Department of Mines and Resources.

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To His Excellency Field Marshal the Right Honourable Viscount Alexander of Tunis, K.G., G.C.B., G.C.M.G., C.S.I., D.S.O., M.C., Governor General and Commander-in-Chief 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, 1947.

Respectfully submitted,

J. ALLISON GLEN,
Minister of Mines and Resources.

The Honourable J. Allison Glen,
Minister of Mines and Resources,
Ottawa.

SIR:

I have the honour to submit the Eleventh Annual Report of the Department of Mines and Resources, which covers the fiscal year ended March 31, 1947.

Your obedient servant,

H. L. KEENLEYSIDE,
Deputy Minister.

Report of the Department of Mines and Resources for the Fiscal Year Ended March 31, 1947

INTRODUCTION

The past year has been both a challenging and difficult one for industries dependent, either in whole or in part, on the mineral, forest, water-power, and other natural resources of the Dominion. To the difficulties of post-war readjustment was added the disturbing effect of work stoppages with a consequent loss in production of much needed materials. Nevertheless, activity in the base metals industry remained high; gold production continued to rise, and the demand for structural materials greatly increased. With lumber and paper in strong demand both at home and on the export market, activity in the forests reached record levels. This placed a heavy responsibility on those charged with forest administration to intensify their efforts toward the fullest conservation and utilization of our forest resources. Consumption of hydro-electric power rose rapidly after its temporary decline in the reconversion period and during the past winter shortages developed in some areas. A greatly expanded program of new hydro development is being undertaken to increase the industry's productive capacity.

In view of the lively interest being shown by the mining industry in the search for new sources of mineral wealth and in the exploration of prospects, measures were taken to expand the 1946 season's program of field operations and twenty-five additional geological and topographical parties were sent out. Tests and investigations on gold and base metal ores increased considerably over last year and special attention was given the development of uses for recently disclosed sources of industrial minerals.

Work was resumed on fuel research on an extended basis, on an inventory of mineral resources, and on plans to enhance the rôle of the National Museum.

A substantial beginning was made on an enlarged program of fundamental forest research, the progress of which will depend to some extent on the availability of technical staff and facilities. This program has as its object the provision of essential data on which to base vigorous leadership in developing a forest policy aimed at growing and maintaining forests on all lands available in Canada for forest management and at evolving types of management that will assure maximum results in terms of wood products, stream-flow protection, and other forest values.

The examination and development of Canada's great northern regions occupied a foremost place in departmental activities. Work was begun on the Snare River power development and noteworthy progress was made on the construction and improvement of means of transportation and communication. The extension of health and educational facilities and the inauguration of a service to further wildlife and forest conservation are measures that will contribute to the general welfare of native and white residents.

There was a greatly accelerated movement of immigrants to Canada and figures for the year showed an increase of 116 per cent above the previous fiscal period. This increase was due mainly to the admission of a considerable number of dependants of members of the Armed Forces and to a marked improvement in the number of United States citizens coming to Canada. The Dominion's

decision to share in the re-settlement of refugees and displaced persons necessitated the posting of immigration teams to occupied territory. Regular inspectional offices were reopened at a number of European points in anticipation of the resumption of normal immigration functions.

Tourist travel to the National Parks showed a substantial increase. Special attention was devoted to the problem of providing accommodation for vacationists in low-income brackets.

Various survey units of the department conducted investigations and mapping operations in the Northwest and Yukon Territories and in other parts of the Dominion, the results of which will replenish the supply of information and maps available for the use of industry and the public in general.

The conditions among the Indians were, in the main, satisfactory. Those engaged in farming and lumbering continued to enjoy full employment at good wages. The operations of Indian fishermen and trappers were affected by periods of scarcity and by price recessions in some regions.

In the following tables a summary is given of the revenues and expenditures of the department for the fiscal year:

DEPARTMENT OF MINES AND RESOURCES

SUMMARY OF REVENUES AND EXPENDITURES FOR THE FISCAL YEAR 1946-47

	Revenue	Expenditures Ordinary	Expenditures Special including Demobilization and Reconversion	Total Expenditures
Administrative Offices	$	$ 166,318 02	$	$ 166,318 02
Mines and Geology Branch—				
Branch Administration	334,788 95[1]	32,697 23		
Bureau of Mines	17,352,95	548,991 37		
Bureau of Geology and Topography	9,293 95	1,191,578 37		
National Museum of Canada		74,476 61		
Demobilization and Reconversion			1,735,815 76	
	$ 361,435 85[2]	$ 1,847,743 58	$ 1,735,815 76	
				$ 3,583,559 34
Lands, Parks and Forests Branch—				
Branch Administration		23,707 07		
Northwest Territories	429,440 34[3]	1,865,114 43		
Yukon Territory	97,438 55	117,981 83		
Dominion Forest Service	24,770 59	740,655 54	9,884 04	
Land Registry	150,362 28[4]	126,933 15	11,006 71	
National Parks Bureau	423,697 96	2,143,770 22	22,320 28	
	$ 1,125,709 72	$ 5,018,162 24	$ 43,211 03	
				$ 5,061,373 27
Surveys and Engineering Branch—				
Branch Administration	$	$ 23,120 80	$ 3,738 69	
Dominion Observatories	130 50	173,524 36	16,679 11	
Dominion Water and Power Bureau	138,214 96	1,469,043 09	34,776 95	
Geodetic Service	63 10	165,476 08	157,133 89	
International Boundary Commission	281 87	36,347 62		
Engineering and Construction Service	198 72	647,478 12	180,878 97	
Hydrographic Service	15,739 96	646,313 74	27,540 47	
Legal Surveys and Map Service	39,889 47	283,945 72	130,906 85	
	$ 194,518 58	$ 3,445,249 53	$ 551,654 93	
				$ 3,996,904 46

SUMMARY OF REVENUES AND EXPENDITURES FOR THE FISCAL YEAR 1946-47—*Concluded*

	Revenue	Expenditures Ordinary	Expenditures Special including Demobilization and Reconversion	Total Expenditures
Indian Affairs Branch—				
Branch Administration		61,534 26		
Indian Agencies—Administration	8,350 47	1,097,302 90		
Reserves and Trusts—Administration	1,811 36	663,412 83	161,110 79	
Welfare of Indians	6,025 48	1,282,379 48		
Indian Education	2,532 23	2,547,858 26		
Miscellaneous Statutory Items (Annuities and Pensions)	480 00	297,466 46		
Miscellaneous Revenue—not including revenue accruing to Indian Band funds	5,160 11			
	$ 24,359 65	$ 5,949,954 19	$ 161,110 79	
				$ 6,111,064 98
Immigration Branch—				
Administration of the Immigration Act and the Chinese Immigration Act	$	$ 213,689 81	$	
Field and Inspectional Service—Canada		1,698,950 95		
Field and Inspectional Service—Abroad		134,159 85		
Miscellaneous Statutory Items		1,516 00		
Demobilization and Reconversion—Miscellaneous	211,450 65		167,274 01	
Miscellaneous Revenue	32,958 23			
	$ 244,408 88	$ 2,048,316 61	$ 167,274 01	
				$ 2,215,590 62
Totals for Department	$ 1,950,432 68	$18,475,744 17	$ 2,659,066 52	$21,134,810 69

NOTES—

[1] The main item is a refund of previous year's war expenditure amounting to $300,380.24.

[2] This does not include an item of $2,053,289.11 owing to the Crown by Abasand Oils Ltd. under agreement dated November 1, 1946. This item is reflected in the Public Accounts as Revenue.

[3] 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 $587,957.74.

[4] Includes $54,648.82 to offset similar amount reported as expenditure and covering amounts written off during year from outstanding advances for Seed Grain and Relief.

MINES AND GEOLOGY BRANCH

W. B. TIMM, DIRECTOR

Since the last report of the Branch was prepared Canada's mineral industry completed the first full calendar year of operation since the war on a peace-time basis. It was a year marked by the uncertainties of a period of readjustment and by disturbing, and in some cases near chaotic, economic conditions in war torn areas of the world. Yet despite the attending difficulties the industry established a peace-time record of $502,816,251 in the total value of its output in 1946. Its metal production reached a value of $290,424,689; its fuels a value of $102,516,888; and its non-metallic minerals a value of $109,874,674. Were it not for shortages of labour and the difficulty of obtaining supplies and equipment, production would have been much higher, for seldom in the history of the industry was there a greater demand for products of the mines. Slow to develop at first, this demand gained momentum as the year progressed, and by the end of the fiscal year it showed little evidence of slackening.

At the commencement of 1946 there were high hopes of a marked expansion of activities in the gold industry, but these hopes materialized only in part. Prospecting and exploratory work was exceptionally active most of the year, but labour shortages and rising wages and other costs in many instances prevented the carrying out of development and production programs on the scale intended. The restoration of the dollar to parity early in July 1946 reduced the price of gold paid to Canadian producers to $35 an ounce from its previous level of $38.50 an ounce. As a result of these adverse influences there was only a slightly higher output of gold in 1946, and an increase in the value of output from $103,823,990 in 1945 to $104,096,359 in 1946. At the close of the fiscal year the gold industry was entering a depressed phase, more especially in reference to exploratory drilling, which was showing a marked decline, and to prospecting. Nor was there any substantial improvement in production.

Throughout 1946, domestic sales of copper, lead, and zinc were subject to ceiling prices that were well below world prices, and producers were required to meet domestic needs before exporting. Late in January 1947 these ceiling prices were raised to levels not far short of the then prevailing world prices. (The price ceilings were removed in June 1947.) Production of nickel, copper, lead, and zinc reached a total of 692,328 short tons in 1946, and a total value of $152,665,928, the tonnage being 13 per cent and the value 11 per cent lower than in 1945. Although production was lower, domestic consumption was higher in continuation of an upward trend resulting from Canada's expansion as an industrialized country. Consequently, total exports of the four metals declined from 601,337 tons in 1945 to 565,091 tons in 1946, though the total value of these exports increased from $121,183,086 in 1945 to $134,633,560 in 1946.

A particularly encouraging feature of the higher base metal prices on world markets was the stimulus they provided to exploratory and related work. There was little inducement for such work during the depression years as prices were too low, and there was little opportunity for it during the war as production had to receive primary consideration. Under much more favourable circumstances, this work was pressed to full advantage in 1946 and with encouraging results. At Lynn Lake in northern Manitoba, for instance, Sherritt Gordon Mines, Limited, by the end of the fiscal year, had disclosed by drilling upwards of 4,500,000 tons of copper-nickel ore in three deposits under development, and a considerable extension of the deposits at depth is expected. At the Quemont

property, which adjoins the Noranda mine in Quebec, large deposits of copper-zinc-gold ore were being disclosed and plans for a milling plant were being considered. At the East Sullivan property in Bourlamaque township, Quebec, large deposits of low and medium grade zinc-copper ore were being prepared for production. Nor were such developments confined to areas within easy reach of rail transportation. At Richmond Gulf far up on the east coast of Hudson Bay, interesting developments were under way on lead-zinc showings; and in the Mistassini area, 100 miles northeast of the Chibougamau area in Quebec, exploration companies and syndicates were actively prospecting and exploring other occurrences of lead and zinc. In other scattered sections of the country rock formations believed to be favourable for metal deposition were being examined.

The 63 per cent increase in the output of iron ore in Canada in 1946 compared with 1945 is of special significance in view of the increasing possibilities for a much greater production in due course. Most of the output came from the Steep Rock hematite deposits west of Port Arthur, and the remainder from the siderite deposits in the Michipicoten area, Ontario. In the meantime further exploratory drilling of the hematite deposits in the Labrador-Quebec boundary region continued to provide results supporting earlier views of the large dimensions of the deposits. Possible locations for a proposed railway to connect the deposits with a suitable terminal site on the Gulf of St. Lawrence were being surveyed at the close of the fiscal year.

In contrast with a marked rise in domestic consumption, output of crude petroleum was nearly 1,000,000 barrels lower than in 1945, though the value was more than $1,300,000 higher. To meet domestic needs the importation of 63,410,400 barrels of crude petroleum, valued at $89,546,900, was required. The greater part of it came from the United States, and most of the remainder from Venezuela. A major development toward the close of the fiscal year was the disclosure of crude petroleum in the Leduc field, 18 miles south of Edmonton. By the end of the year a few successful completions had already been made with yields of high quality oil, and ambitious plans were under way for further extensive drilling. Output from Turner Valley continued to decline, but the outlook for this field was brightened to some extent by favourable drilling results in the northern section.

The record of $109,874,674 established in the value of ouput of the non-metallics or industrial minerals in 1946 is noteworthy, for it emphasizes the increasing importance of this group of minerals to a country that is becoming highly industrialized. In fact, their importance scarcely requires emphasizing as it has become abundantly clear from the difficulties that have been experienced in obtaining supplies of the clay products and structural materials for use in housing and other constructional projects. Several minerals of the group comprise the raw materials essential to the continued expansion of Canada's chemical and metallurgical industries. Not only are larger quantities of the industrial minerals required by the consuming industries, but the specifications in many cases are becomng more rigid. Canada is well supplied with most of the principal industrial minerals, but much remains to be done toward their utilization to full advantage. To a considerable extent this is reflected in the fact that, inclusive of chemical and allied products, but exclusive of fuels and their products, Canada imported non-metallic minerals and their products to a total value of approximately $155,900,000 in 1946.

A development of interest in connection with Canada's supply of industrial minerals arises from the drilling for oil in Alberta and Saskatchewan. In many of the holes drilled in recent years salt beds have been intersected at depths varying from 2,700 feet in east-central Alberta to about 7,600 feet in southern Saskatchewan. From the information available, the indications are that vast reserves of

salt underlie large sections of the two provinces. In some of the holes, more particularly in west-central Saskatchewan, beds of potash were encountered, and though these had received only limited attention by the close of the fiscal year, they appeared to have interesting possibilities.

Following a 7-year period in which its full attention was given to furthering the war effort, the Mines and Geology Branch again directed its activities toward meeting the peace-time needs of the mineral industry. In view of the increasingly active attention that was given to the search for new sources of mineral wealth and the exploration of prospects by mining companies and syndicates, an extended program of gelogical and topographical mapping became a major requirement. To this end, a total of seventy-seven mapping parties were assigned to field work, an increase of twenty-five parties over the 1945 field season. In the program of field work geophysical methods of prospecting received special consideration. In co-operation with the National Research Council arrangements were made with the United States Geological Survey to give demonstrations of the use of the airborne magnetometer in the locating of mineral-bearing formations. In the course of the demonstration flights were made over known magnetic areas in Louvicourt township, Quebec, and in Sudbury district, Ontario. Valuable information was gained, and it is the intention to extend this field of endeavour.

Government agencies, public utilities, mining and engineering organizations, and educational institutions made greatly increased demands on the services provided by the Branch through its National Air Photographic Library. These aerial photographs are of partciular assistance to companies concerned with the development of Canada's natural resources, who are saved much time and effort by their use. Another service of increasing value is that provided to geologists employed by companies drilling for oil. These geologists frequently visit Ottawa for periods ranging from a few weeks to 2 months or more to study core records of wells and to make other use of the facilities of the Branch, and during their stay are provided with office accommodation.

Good progress was made in the long delayed plans to enhance the rôle of the National Museum of Canada. For years, through the urgency of other work, these plans were held in abeyance, with the result that the Museum lost much of its former importance and prestige as a natural science and educational institution. Under the able direction of F. J. Alcock, formerly of the Canadian Geological Survey, who was appointed Acting Curator of the Museum in February 1947, it will be the endeavour to bring these services up to a high standard.

As noted in the section immediately following, most of the special mineral projects undertaken for war purposes were largely closed out by the end of the fiscal year. Much the greater part of the money loaned by the Government for the development of strategic mineral properties was repaid by the end of the year.

The plant at Renfrew for the production of secret naval equipment was turned over to War Assets Corporation for disposal, and staff and equipment required for a very small continuing operation were transferred to Ottawa. Quarters were being provided in a storage building that was in course of erection at the Bureau of Mines Laboratories. This small unit will take care of the peace-time needs of the Royal Canadian Navy for new equipment and repairs to existing equipment.

Tests and investigation work on gold and base metal ores increased considerably over the previous year. The ores came chiefly from prospects throughout Canada that are being prepared for production, and the results of the test work will be incorporated in the design of flow sheets for milling plants that are being erected to treat the ores. Several companies interested in special new

mineral development projects made use of the laboratory facilities to conduct their own investigations in co-operation with engineers of the Branch. Investigations were continued on the supply of raw materials for atomic energy purposes. Operations at the Eldorado mine in the Northwest Territories were studied and endeavours were made to improve the recoveries and to simplify the flow sheet.

In the work on industrial minerals stress was given to the development of uses for recently disclosed sources of raw materials, more especially to magnesium oxychloride and oxysulphate cements for flooring materials and as a bond in new products being developed. Field investigations were made into the occurrence and utilization of salt, sodium sulphate, granite, clay, gypsum, silica, and potash minerals in western Canada, with special attention to recent discoveries of rock salt and potash underlying the Great Plains. Chief purpose of the work on the potash was to determine the possibility of Canada becoming self sufficient in this essential fertilizer material. Work on the industrial waters, which was largely dormant during the war, was actively resumed.

Fuel research programs that were disrupted by the war, owing to the seconding of senior members of the staff to other Government departments, were resumed on an extended basis and a start was made toward filling the vacancies on the staff. In co-operation with the Locomotive Development Committee of Bituminous Coal Research Incorporated, a project was initiated for the study of combustion of pulverized coal under pressure, the immediate aim of the joint project being the development of a locomotive powered by a coal-fuel gas turbine. If successful, however, pressurized combustion will probably have a wider application. A field study was made of natural gas resources in western Canada to estimate the possible use of the gas as a raw material for the production of synthetic fuels. Plans were made to continue the study of the technique of hydrogenation, especially as applied to bitumen and heavy crude oil.

Steps were taken to meet the increasing need for a comprehensive inventory of the mineral resources of Canada. In this work an index of all known occurrences of metallic and industrial minerals is being compiled and close co-operation has been established with provincial departments of mines, and mining organizations.

The difficult economic problems of the gold industry received special consideration and studies were made of various phases of the industry's operations for use of the Government in considering policies designed to assist in the rehabilitation of the industry.

The use made by the industry of the Branch's Physical Metallurgy Research Laboratories stressed the important rôle these facilities can play in peace-time endeavour. The services are of special benefit to the manufacturers of metal products and to foundrymen, and most of the projects are undertaken on a co-operative basis with industry. A few of the major projects, notably one dealing with the development of superior heat-resisting alloys, were being conducted jointly with the National Research Council.

Mainly as a result of experience gained during the war Parliament amended the Explosives Act, which the Branch administers, whereby all premises from which high explosives are sold come under the direct supervision of the Branch.

The position of Chief, Bureau of Mines, which had been vacant since 1941 was filled by the promotion of C. S. Parsons from his former position as Chief of the Metallic Minerals Division. R. J. Traill, formerly Senior Engineer of that Division, was appointed Chief of the Mineral Dressing and Metallurgy Division, which replaces the Metallic Minerals Division.

The Branch lost the services of three of its senior officials through retirement on superannuation. L. L. Bolton, who was General Executive Assistant since 1936, retired on March 14, 1947, following close to 31 years of service with the Government. He was succeeded in that position by J. R. Kirkconnell.

F. C. C. Lynch, who was Chief of the Bureau of Geology and Topography, retired on March 24, 1947, after more than 40 years in the Government service. No successor to him had been appointed by the close of the fiscal year. B. F. Haanel, who was Chief of the Fuels Division, retired on February 1, 1947, after serving nearly 42 years with the Government. On his retirement, R. E. Gilmore, formerly Senior Engineer of the Division, was appointed Chief of the Division.

SPECIAL MINERAL PROJECTS DIVISION

During the fiscal year 1946-47 the Division administered funds provided in Demobilization and Reconversion votes for exploration and development work in connection with the supply of strategic minerals; for investigations of petroliferous deposits and potential petroliferous areas; and for maintenance of the plant of Abasand Oils Limited, near Fort McMurray, Alberta. No new projects were undertaken and activities were concerned with the existing strategic mineral projects that had been initiated on the recommendation of the Metals Controller, and the petroliferous projects undertaken on the recommendation of the Oil Controller. Total expenditures for the fiscal year amounted to $185,197.88.

STRATEGIC MINERALS

A vote of $5,000 was provided for continuation of exploration and development work. Expenditures, however, were limited to the expenses of inspection and administrative work in connection with existing loan agreements. Four of the original eight agreements covering loans of War Appropriation funds for production of strategic minerals remained as subsisting agreements at March 31, 1946. During the fiscal year ended March 31, 1947, two of these agreements relating to production of tungsten in Yukon were terminated; one following completion of repayment of the loan, and the other by an Order in Council discharging the remaining indebtedness. A summary of the projects follows.

Fluorspar. The Bailey property in Madoc township, Hastings county, Ontario, 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 during 1946 amounted to over 2,400 tons, and agreement obligations in respect of loan repayments were fulfilled, the total repayments on a loan of $34,196.89 amounting to $30,747.09 to March 31, 1947. An agreement was signed by Fluoroc Mines, Limited, which company, as successor to Trent Mining Syndicate, Limited, undertakes to make payments out of production on a loan of less than $10,000 made in 1943. The new company proceeded with development of the Johnston property, Huntingdon township, Hastings county, in preparation for shipments of fluorspar in 1947.

Tungsten. There was no further production of tungsten concentrate from the placer claims on Dublin Gulch, near Mayo, Yukon, the development of which was assisted by Government loans in 1943 to Vilhelm Lunde and Hugo A. Seaholm, the operators. Marketing was completed, however, of approximately 3,000 pounds of tungsten concentrate from 1944-1945 production, the entire proceeds of which Mr. Lunde had made applicable to his loan. These proceeds and his cash remittance paid off the balance of a $3,600 loan and interest. In regard to the loan of $3,800 to Mr. Seaholm, for development of a property on which no substantial amounts of ore were found, repayments from production and out of sale of equipment amounted to $1,075.80 prior to March 31, 1946. After unsuccessful attempts to sell remaining equipment, an Order in Council was passed discharging the indebtedness, and the equipment was declared as surplus to the Crown Assets Allocation Committee.

OIL EXPLORATIONS

From votes amounting to $150,000, provided for investigation of petroliferous deposits and of potential petroliferous areas in Canada, the investigation of the bituminous sand deposits in northern Alberta was continued until January 1947, when the exploratory drilling, started in 1942, was brought to an end through exhaustion of funds. The reconnaissance drilling in the Muskeg River area, commenced in the previous fiscal year, was continued until July 1946. Altogether, this drilling extended over a distance of 13 miles along the east side of Athabaska River, between points approximately 36 and 49 miles north of Fort McMurray. The results were generally disappointing, although four holes gave indications that further drilling might disclose a substantial body of good grade sand in one locality. Meanwhile the continuance of reconnaissance drilling west of Athabaska River in Mildred-Ruth Lakes area disclosed, in June 1946, the existence of beds or pockets of bitumen in a thick deposit of good grade bituminous sand in two holes about 22 miles north of Fort McMurray. Provision of $100,000 to supplement the original $50,000 vote, made it possible to undertake an extensive program of more closely spaced holes in the area. The limits of the deposit had not been fully determined in January 1947 when drilling was discontinued, and the last group of nine holes, at half-mile spacing, can be regarded only as reconnaissance drilling. However, the seventy-three holes drilled in the area gave the best results in more than 4 years of drilling. These indicated that, after removal of relatively light overburden, depths of up to 200 feet of bituminous sand occur over a considerable area. The material, with enrichment by pockets or localized beds of bitumen (intersected in thirty-three holes) would probably average 15 per cent bitumen or more. During the fiscal year the total drilling in Muskeg River and Mildred-Ruth Lakes areas by the contractors, Boyles Bros. Drilling Company, Limited, under direct supervision of engineers of the Branch, amounted to 19,213 feet, and eighty-nine holes were completed.

Plant of Abasand Oils, Limited

Funds of $50,000 were provided to maintain the plant of Abasand Oils, Limited, near Fort McMurray. As a war project, this plant for recovery of bitumen from Alberta bituminous sand had been rehabilitated and operated at Government expense until the destruction of the separation plant unit, workshops, and warehouse in a fire on June 16, 1945, brought operations to a close. It was necessary to maintain the remaining plant facilities pending collection of insurance and disposal of the Government interest. Following conclusion of an insurance settlement, the maintenance expense was ended on November 1, 1946, by an agreement of sale concluded with Abasand Oils, Limited. Revenues received by the Government from rentals of equipment largely offset the maintenance expenses.

BUREAU OF GEOLOGY AND TOPOGRAPHY

Indicative of the increased activities of the Bureau was the expanded program of aerial photography, upon which much of the field work is based. More than 245,000 new photographic prints were received as compared with 145,000 in 1945-46 and about 60,000 in 1944-45. All the activities of the Bureau were directed to the furtherance of post-war planning and development.

Geological field work was devoted mainly to the mapping and investigation of potential sources of gold, strategic minerals, or base metals, and of structures favourable to the accumulation of oil and natural gas. Topographical field work was done in areas dictated by development requirements. Geophysical methods

of investigation were studied in collaboration with the National Research Council and the United States Geological Survey. Research was done on methods of topographical mapping of mountainous country from R.C.A.F. trimetrogon photographs.

Seventy-seven field parties were engaged in investigations and mapping, forty-one of which were geological parties and thirty-six topographical. Six of the Geological Survey parties operated in the Northwest Territories, three in Yukon, six in British Columbia, eight in Alberta, one in Alberta and Saskatchewan, two in Saskatchewan, three in Manitoba, three in Ontario, one in Ontario and Quebec, five in Quebec, one in New Brunswick, and two in Nova Scotia. Three of the topographical parties operated in the Northwest Territories, four in Alberta, one in Saskatchewan, three in Ontario, two in Quebec, thirteen in New Brunswick, and ten in Nova Scotia.

Sixty-one maps were published, of which forty-one were topographical, eighteen geological, one mineral, and one geographical. In addition, twenty-one miscellaneous maps, figures, plates, and charts were published, most of which were prepared to illustrate the Report of the Royal Commission on Coal.

Two memoirs, one Economic Geology series, six Geological Survey Bulletins, and twenty-three Papers were made available for public distribution. Including 733 publications in French that were distributed through the office of the Chief Editor, a total of 151,188 copies of reports, maps, and other publications were distributed to mining companies, prospectors, educational institutions, and other interested parties.

GEOLOGICAL SURVEY

Field work was devoted mainly to geological mapping and investigations on areas that are potential sources of gold, strategic minerals, or base metals, or in which structures favourable to the accumulation of oil and natural gas may occur. It also included work in coalfields of western Canada, and on the Pleistocene geology and ground-water supply of parts of Alberta, Manitoba, and Ontario. Standard geological mapping, on scales of either 1 mile or 4 miles to an inch, was done in twenty-two areas in various parts of Canada. Detail mapping, on scales of from 400 to 1,000 feet to an inch, was continued in the northwest of Quebec mineral belt and on the shores of Great Bear Lake, Northwest Territories, and Lake Athabaska, Saskatchewan, and were commenced in the Yellowknife greenstone belt at Yellowknife, Northwest Territories. Surface and subsurface stratigraphic studies, supplemented by palæontological collections, were made in western Canada to assist in the search for oil and gas, coal, and industrial minerals.

George Shaw commenced a study of geophysical methods that might be used by the Geological Survey. He acted as a liaison officer between the Survey and various governmental and private organizations interested in geophysics. Close contact was maintained with the United States Geological Survey, through whose curtesy test surveys were made in Canada in September with its airborne magnetometer. It is hoped that similar equipment will be used by the Geological Survey, in collaboration with the National Research Council, to map magnetically several thousand square miles during 1947. Two traverses, using gravimeter and magnetometer, were made from Winnipeg to the Foothills by the Dominion Observatory at the request of the Geological Survey. Mr. Shaw, acting on a request from the Associate Committee on Geophysics of the National Research Council, commenced a compilation of ground magnetic surveys that had been made in connection with geophysical prospecting. A grant to cover the expenses of a draughtsman for this work was provided by the committee.

T. L. Tanton, during the period December 20 to March 2, acted as a Canadian delegate to the Thirty-fourth Annual Meeting of the Indian Science Congress in Delhi. After the technical sessions held early in January, he visited the Geological Survey of India, in Calcutta, and subsequently made geological examinations of iron ore deposits in Singhbhum and Keonjhar districts; bauxite deposits at Lohardaga; manganese ore deposits near Nagpur; and gold deposits at Kolar.

W. A. Bell, from mid-June to September, conducted a stratigraphic investigation of the Carboniferous rocks in western Newfoundland to gather further information on the possibilities of oil in these rocks both there and in the Maritime Provinces. He spent part of September in northern Cape Breton Island for the same purpose.

J. S. Stewart continued to act as supervisory engineer for the Deputy Commissioner of Northwest Territories. He spent much of the summer investigating recent drilling operations at Hay River and in the Norman Wells region, and inspected the Canol pipe-line, equipment, and road conditions. He supervised the work of field parties in Manitoba and Alberta engaged in the collection of data on ground-water supplies.

In Ottawa, efforts were continued to assist in the work of visiting oil geologists employed in Canada, by providing them with office accommodation and placing at their disposal the records and facilities of the Palæontological and Water Supply and Borings Sections.

The temporary field staff was augmented during the summer season by several graduate students who since their discharge from Active Service have commenced or renewed post-graduate studies in geology at universities in Canada or the United States. Through resignation to accept other employment, the Survey lost the services of one associate and two assistant geologists. F. J. Alcock, Geologist, was appointed Acting Curator of the National Museum of Canada.

Field Work

NORTHWEST TERRITORIES

Y. O. Fortier and M. Feniak continued geological investigations in areas south, east, and northeast of Eldorado mine on the east shore of Great Bear Lake. The work is designed to aid the discovery of pitchblende deposits in this and neighbouring districts, and to provide additional information on the stratigraphy of the region.

C. S. Lord commenced the geological mapping of the Camsell River area (longitude 116° to 118°, latitude 65° to 66°). Some prospecting for gold has been done in the area, which may also contain deposits of radioactive minerals.

R. E. Folinsbee commenced the geological mapping of the Lac de Gras area (longitude 110° to 112°, latitude 64° to 65°). Gold occurs in quartz veins in shear zones, and the most favourable areas for prospecting are believed to be the greenstone belts of the Yellowknife group, and the sedimentary rocks of the same group east of Courageous Lake and west of MacKay Lake.

M. S. Stanton commenced the geological mapping of Chalco Lake area (longitude 115° to 115° 30′, latitude 64° 15′ to 64° 30′). The area is being actively explored by several mining companies, and significant gold discoveries have been made in sedimentary and volcanic rocks of the Yellowknife group, and in a later albite-rich dyke.

J. F. Henderson, assisted by I. C. Brown, commenced detailed geological mapping of the Yellowknife Bay greenstone belt, at Yellowknife on Great Slave Lake. Important gold deposits were discovered recently in this belt, and

development and exploratory work are in progress. The basic lavas of the greenstone belt in which the orebodies occur are intersected by many basic dykes, which in turn are cut by numerous faults. Detailed mapping of the complex structures should be of assistance in the development of mines and prospects along the belt.

YUKON

H. S. Bostock commenced geological mapping of McQuesten area (longitude 136° to 138°, latitude 63° to 64°). The area has important placer possibilities, and is a potential source of lode gold and a variety of strategic minerals.

E. D. Kindle commenced the geological mapping of Dezadeash area (longitude 136° to 138°, latitude 60° to 61°). The area contains placer properties on which work is being done, and is a region where geological conditions favour the occurrence of mineral deposits.

W. E. Cockfield and J. C. Fyles commenced geological remapping, on a more adequate base, of Whitehorse area (longitude 134° to 136°, latitude 60° to 61°). The area comprises one of the best known and more accessible parts of the Yukon, and one in which a variety of significant mineral discoveries have been made, and from which important production has been won. These include gold-silver quartz veins, antimony-silver veins, silver-lead veins, and contact metamorphic copper deposits.

BRITISH COLUMBIA

E. F. Roots continued geological mapping of the Aiken Lake area (longitude 125° to 126°, latitude 56° to 57°). Much interest is being taken in the area, which includes many lode prospects, including gold and silver-lead-zinc. Several discoveries were made during the course of field work.

J. E. Armstrong and J. W. Hoadley commenced and completed the geological mapping of Carp Lake area (longitude 123° to 124°, latitude 54° to 55°). Much of the area is drift covered, but it lies in the course of the Pinchi fault zone along which some occurrences of cinnabar have been discovered.

A. F. Buckham continued investigations throughout the year on the coal deposits of southeastern Vancouver Island. Detailed structural and stratigraphic studies made of the productive measures in the Nanaimo coalfield should prove of practical value in future developments there and in neighbouring areas.

S. Duffell and K. C. McTaggart completed geological mapping of the Ashcroft area (longitude 121° to 122°, latitude 50° to 51°). The area is widely and variously mineralized, and includes several copper and gold mines from which production has been won. It contains an important coal mine, and productive saline deposits.

H. M. A. Rice continued geological mapping of Salmon Arm area (longitude 119° to 120°, latitude 50° to 51°). The area includes many gold prospects and some of the base metals, as well as the important gypsum deposits at Falkland and other occurrences of industrial minerals, and construction materials.

H. M. A. Rice and R. T. D. Wickenden assisted the Dominion Water and Power Bureau, Department of Mines and Resources, in the selection of possible dam sites along the Columbia River drainage system. Mr. Rice reported on sites along upper Kootenay River, and Mr. Wickenden on others at the head of Kootenay Lake.

W. E. Cockfield made brief geological investigations in connection with governmental engineering projects, and others related to supplies of agricultural limestone.

ALBERTA

E. J. W. Irish commenced geological mapping of the Moon Creek area (longitude 118° 15′ to 118° 30′, latitude 53° 30′ to 53° 45′). The area lies along the western flank of the Foothills belt in which the significant oil structures are being tested and important coalfields have been developed.

A. H. Lang completed geological mapping of the Moberly Creek area (longitude 118° to 118° 15′, latitude 53° 30′ to 53° 45′). He mapped potential oil structures in this area, which also contains coal seams related to those being mined on a large scale on the "Coal Branch" of Canadian National Railways.

G. S. Hume, assisted by R. A. C. Brown, studied the thickness, character, and relationships of the later Palæozoic formations exposed along the east side of the Rocky Mountains as a basis for comparison in wells drilled for oil and gas in western Canada. They examined geological sections at Blairmore, Crowsnest Lake, and Green Creek on the west side of Livingstone Range; at the Gap of Oldman River, Highwood River, and Banff; and at Folding Mountain and Brûlé in the Entrance area of Athabaska River. For comparative purposes they studied the original type section of these formations at Logan in the Three Forks quadrangle of Montana. R. A. C. Brown collected fossils for study.

R. J. W. Douglas completed the geological mapping of the Langford Creek area (longitude 114° to 114° 15′, latitude 50° to 50° 15′), and commenced mapping the Gap area (longitude 114° 15′ to 114° 30′, latitude 49° 45′ to 50°). These areas lie in the southern Foothills belt between areas already mapped in which structures favourable to the accumulation of oil and gas occur.

B. A. Latour, assisted by A. M. Stalker, under the initial direction of R. T. D. Wickenden and subsequent supervision by J. S. Stewart, investigated the ground-water resources of the region in the vicinity of Red Deer.

J. S. Wonfor studied cores from wells in the Taber and Conrad oil fields and vicinity of southern Alberta to obtain further information on the subsurface structures and their correlation in this general region of Western Canada.

C. M. Sternberg studied late Upper Cretaceous geological sections carrying vertebrate remains in Red Deer and Little Bow River Valleys.

SASKATCHEWAN AND ALBERTA

R. T. D. Wickenden continued field examinations of drill cores obtained from deep wells, chiefly in the Lloydminster and Unity areas, and selected representative material for further examination at Ottawa. This work is designed to provide useful information on the subsurface geology of the Plains wherever drilling for oil and gas is in progress or contemplated.

SASKATCHEWAN

A. M. Christie continued detailed geological investigations near Goldfields on the north shore of Lake Athabaska to aid prospecting for pitchblende or other uranium-bearing minerals in this and neighbouring districts.

J. B. Mawdsley mapped in detail an area of about 40 square miles at the extreme east end of Lake Athabaska. The area is structurally complex and the rocks are intersected by three systems of faults along which quartz and sulphide-bearing veins have been found. Some of these veins are gold-bearing.

MANITOBA

J. M. Harrison commenced and completed the geological mapping of the Morton Lake (West Half of File Lake) area (longitude 100°15′ to 100°30′, latitude 54°45′ to 55°). Many gold and copper prospects have been found along or near shear zones, principally in greenstone and diorite.

M. J. Frarey, under the supervision of C. H. Stockwell, continued the geological mapping of Crowduck Bay area (longitude 99°30′ to 99°45′, latitude 54°40′ to 55°). The area lies east of the Herb Lake-Snow Lake gold region, includes one gold property, and contains large bodies of sedimentary and volcanic rocks in which further discoveries may be made.

E. C. Halstead, assisted by E. Hall, under the supervision of J. S. Stewart, commenced a study of the Pleistocene geology and ground-water resources in the region southwest of Souris.

ONTARIO

J. F. Caley continued geological mapping of the Palæozoic sedimentary formations east of Lake Simcoe and south of the Precambrian contact. The stratigraphic sequence was established and will be of value in assisting correlations of strata containing oil and gas in this and other parts of the province. He also brought up to date the records of recent drilling in southwestern Ontario.

R. E. Deane, assisted by E. B. Owen and J. A. Elson, studied and mapped the Pleistocene deposits of the adjoining Sutton and Barrie areas (longitude 79°15′ to 79°45′, latitude 44°15′ to 44°30′) in the Lake Simcoe district. Data on all water wells were collected as a basis for the study of the ground-water resources of the area.

T. L. Tanton made geological examinations of iron ore deposits at Steeprock Lake and on iron properties that were being explored near Iron Bridge and Nipissing. He inspected gold-bearing veins near Hematite; a uranium-bearing anthraxolite deposit at Port Arthur; fluorspar-bearing veins at Silver Mountain; and rocks in the vicinity of a uraninite occurrence at Mica Lake, Butt township.

Y. O. Fortier and J. A. Elson, during most of October and November, supervised a field examination of occurrences of uranium-bearing minerals at Wilberforce in the Grenville geological sub-province of southeastern Ontario.

QUEBEC

T. L. Tanton made a geological examination of iron and manganese deposits on properties of Labrador Mining and Exploration Company, Limited, and Hollinger North Shore Exploration Company, Limited, in Labrador and New Quebec; and of a property that was being explored for iron ore in Hincks township, Gatineau county.

G. W. H. Norman, assisted by A. S. MacLaren, H. C. Norman, Marcel Tiphane, and K. R. Dawson, continued detailed geological mapping in the northwestern Quebec mineral belt. They mapped Vauquelin, Pershing, and Haig townships, Abitibi county, on a scale of 1 inch to 1,000 feet, and examined diamond drill cores from properties in nearby Louvicourt and Dubuisson townships.

C. H. Stockwell continued detailed geological mapping in western Beauchastel and Dasserat townships, which are crossed from west to east by the southern mining belt of northwestern Quebec.

L. P. Tremblay completed the geological mapping of Lacorne area (longitude 77°45′ to 78°, latitude 48°15′ to 48°30′) and commenced and completed mapping in the adjoining Barraute area (longitude 77°30′ to 77°45′, latitude 48°15′ to 48°30′). These areas together constitute the former Fiedmont map-area. They include various types of gold-bearing deposits, a productive molybdenite mine, and numerous occurrences of spodumene- and beryl-bearing pegmatite dykes.

M. E. Wilson completed detailed field investigations in southern Rouyn and southeast Beauchastel townships. His work included the examination of many thousands of feet of diamond drill core. He also conducted a 2-day geological excursion through the area, arranged in August by the Western Quebec Branch of the Canadian Institute of Mining and Metallurgy.

H. C. Cooke continued systematic geological mapping and investigations in the Eastern Townships, working mainly in Richmond area (longitude 72° to 72°30′, latitude 45°30′ to 45°45′), and correlating the stratigraphy and structure there with those of adjoining areas. The region contains a variety of metalliferous and non-metallic deposits and constructional materials.

NEW BRUNSWICK

F. J. Alcock continued systematic geological mapping in the Bay of Fundy region. He commenced and completed mapping of the area between latitudes 44°30′ and 45°00′ and longitudes 66°30′ and 67°00′, including Campobello, Grand Manan, and a part of Dear Islands.

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. Work has been largely completed on the Gabarus (longitude 60° to 60°15′, latitude 45°45′ to 46°), Salmon River (longitude 60°15′ to 60°30′, latitude 45°45′ to 46°), and Framboise (longitude 60°15 to 60°30′, latitude 45°30′ to 45°45′) areas and was extended into the Louisburg (longitude 59°45′ to 60°, latitude 45°45′ to 46°) and Grand River (longitude 60°30′ to 60°45′, latitude 45°30′ to 45°45′) areas.

H. L. Cameron commenced and completed geological mapping of the adjoining Margaree and Cheticamp areas (longitude 61° to 61°15′, latitude 46°15′ to 46°45′), Cape Breton Island. These include the St. Rose-Chimney Corner coalfield.

Office Work

M. E. Wilson and A. H. Lang were engaged during the winter in compiling and supervising the preparation of illustrations for a symposium volume to be published by the Canadian Institute of Mining and Metallurgy on Structural Relationships in Canadian Mineral Deposits, to which many members of the Survey staff have contributed papers.

G. S. Hume made a special study and reported on the results and significance of drilling by the Mines and Geology Branch of the bituminous sand in the Mildred-Ruth Lakes area on Athabaska River, 20 miles north of Fort McMurray.

F. J. Fraser continued spectographic analysis and examination of various rock and mineral samples submitted by members of the Survey staff. More than 1,800 exposures were made on 134 plates or films, and 11 reports were issued on 31 samples. Many additions were made to the current collection of standard reference photographs, notably of zirconium, gallium, and yttrium.

The "Paper" series of reports included one on the surface deposits of Orillia map-area, Ontario, the first of this sort attempted. Altogether, nine reports and thirty-five maps were prepared for publication in this series. Ten of these maps carried, or were accompanied by, descriptive notes. A new series of mimeographed water-supply papers, accompanied by blue-line maps, covering twenty-eight rural municipalities in west-central Saskatchewan, was prepared for publication and will be issued as rapidly as facilities permit.

Among the publications forwarded for printing was a third edition of the Geology and Economic Minerals of Canada, written by officers of the Geological Survey; a geological and a mineral map of Saskatchewan, on scales of 1 inch to 20 miles; and a geological and mineral map of the Maritime Provinces, on scales of 1 inch to 12 miles. Other maps and reports prepared for publication include three memoirs, two Geological Survey bulletins, and fifteen final editions of maps.

Palæontological Section

Reports were made on forty-three fossil collections submitted for identification and age determination. Of these, fourteen were submitted by officers of the Geological Survey, twenty-four by oil companies prospecting in western Canada, and six by provincial mining departments.

F. H. McLearn reported on Mesozoic collections from Richardson Mountains area, Northwest Territories; from Peel River area, Northwest Territories and Yukon; from Whitehorse and Dezadeash area, Yukon; from Fort St. John, Peace River, Pine River, Wapiti-Murray Rivers, Flatbed Creek, Fernie, Denman Island, Aiken Lake, and Ashcroft areas, British Columbia; from Monkman Pass and Wapiti River areas, British Columbia and Alberta; and from Moon Creek, Moberly Creek, and Taber areas, Alberta.

W. A. Bell reported on fossil plant collections from Peel River area, Northwest Territories and Yukon; from Kusawak Mountain area, Yukon; from Wapiti-Murray Rivers and Peace River areas, British Columbia; from Monkman Pass and Wapiti River areas, British Columbia and Alberta; from Moberly Creek, Highwood River, and Taber areas, Alberta; from Coral Rapids, Abitibi River, Ontario; from Fredericton area, New Brunswick; and from Gabarus area, Nova Scotia.

R. A. C. Brown reported on Palæozoic collections from Snake River, Peel River, and Richardson Mountain areas, Northwest Territories; from Summit Lake and Porcupine River areas, Yukon; from Fort St. John area, British Columbia; from Bullmoose Mountain, Flatbed Creek, and Wapiti River areas, British Columbia and Alberta; and from Brûlé and Moon Creek areas, Alberta.

L. D. Burling reported on Lower Palæozoic collections from Richardson Mountains area, Northwest Territories, and from Gabarus area, Nova Scotia.

Donations of fossil collections are gratefully acknowledged from Imperial Oil, Limited, Socony-Vacuum Exploration Company, Phillips Petroleum Company, Gulf Research and Development Company, the British Columbia Department of Mines, and Dr. J. D. Ferguson, Ottawa.

L. D. Burling was engaged late in 1946 to do research work on Cambrian geology and palæontology.

Water Supply and Borings Sections

The work includes the collection, organization, and filing of records dealing with the occurrence of oil and gas, ground water, and coal throughout Canada. A total of 1,037,542 samples of rock cuttings from wells drilled for oil and gas or water are available for study, of which 77,410 were prepared for examination during the year.

The following drill samples were received: Northwest Territories, 98 samples from 1 well; British Columbia, 60 samples from 9 wells; Alberta, 43,905 samples from 120 wells; Saskatchewan, 1,203 samples from 5 wells; Manitoba, 36 samples from 2 wells; Ontario, 17,943 samples from 116 wells; Quebec, 346 samples from 5 wells; and Nova Scotia, 646 samples from 4 wells.

Most of the samples from Alberta came from wells drilled to test production limits of known oil and gas fields, but some, notably from Roxana Oils and from Shell Oil Company exploratory wells in the Foothills, came from unproved

territory. Some of the samples from Saskatchewan were from wells in the increasingly important Lloydminster field. Samples from Ontario were mostly from areas in which oil or gas had previously been found. Those from Quebec were mainly from Ventures No. 1 well, drilled by Gaspe Oil Ventures, and from Peninsular Oil Corporation's No. 1 well, both in Gaspe county. Most of the samples from Nova Scotia were from the Sunoco No. 1A deep well drilled by Sun Oil Company in Cumberland county. All samples from Northwest Territories were from Frobisher Exploration Company's Hay River test. Pure Oil Company and Union Drilling and Producing Company provided a total of 581 samples from two wells drilled in the State of Michigan, these giving a standard of reference for comparison with deep wells of southwestern Ontario.

Thanks are due to the following firms and organizations through whose co-operation samples were received: Petroleum and Natural Gas Conservation Board, Calgary, for all samples received from wells in Alberta; E. Swain, Supervisor of Mines (now retired), Department of Natural Resources, Regina, and F. H. Edmunds, University of Saskatchewan, Saskatoon, for samples from Saskatchewan; R. B. Harkness, Natural Gas Commissioner for Ontario, Toronto, for Ontario samples; I. W. Jones, Geological Surveys Branch, Department of Mines, Quebec, for samples from wells in that province; Sun Oil Company for samples from Nova Scotia; and Frobisher Exploration Company for samples from the Northwest Territories.

Acknowledgment is made to officials of the Petroleum and Natural Gas Conservation Board, who supplied periodical reports on the progress of drilling of Alberta wells, as well as maps, electrologs, and interim reports; to F. H. Edmunds for many logs of oil wells, test holes, and shot holes put down in Saskatchewan; to the Department of Natural Resources of Saskatchewan for monthly statements of oil and gas activity in that province; to Paul Payette, Gaspe Oil Ventures, Limited, Montreal, for information concerning drillings in Gaspe county, Quebec, and to various oil companies for much valuable information.

Helen Belyea examined samples and compiled stratigraphic logs of wells drilled in Nova Scotia, Gaspe county, Quebec, Ontario, and Saskatchewan, and of older wells in Alberta.

Through the co-operation of Dr. George Cohee, United States Geological Survey, logs of many Ontario deep wells were prepared, using the actual sample material. This work was done by Dr. Cohee and others, who spent some time with the Section for this purpose.

Geologists of Shell Oil Company, Imperial Oil, Limited, Sun Oil Company, Pure Oil Company, and Phillips Petroleum Company made use of the services of the Section to collect records and examine well samples.

Inquiries on ground-water conditions were received from many parts of Canada. The collection of records of water wells in Saskatchewan is under control of the provincial government, but several hundred logs of water wells were received from F. H. Edmunds under whose supervision samples from these wells were examined. In Alberta, the Petroleum and Natural Gas Conservation Board has undertaken the work of collecting records of water wells. Copies of these records are periodically forwarded to the Geological Survey. Reports of analyses of a great many water samples from wells in the vicinity of Barrie and Orillia, Ontario, were received through the co-operation of R. E. Deane of the Geological Survey who has been conducting an investigation of ground-water conditions in that area for the past 2 years. Samples from several local Ottawa wells were also examined and reported on. Acknowledgments for water well samples received are particularly due to J. H. Rainsford, Royal Oak, British Columbia, and O. V. Kennedy, Bridgetown, Nova Scotia.

B. R. MacKay completed the compilation of all available information on the coal resources of Canada, together with maps showing distribution, geological age, and rank of Canadian coal, at the request of the Royal Commission on Coal.

Mineralogical Section

The volume of work continued to increase over that of previous years.

Eugene Poitevin and H. V. Ellsworth spent much of their time in examining mineral and rock material submitted from all parts of Canada by persons interested in their economic possibilities. Altogether 5,841 specimens were examined and 502 reports were issued to the public. They were also engaged in special research problems dealing with the petrology of some western ultrabasic rocks, and in chemical work related to radioactive minerals.

R. J. C. Fabry completed numerous analyses of syenites, picrites, tuffs, salts, etc., for the Geological Survey.

A total of 1,625 mineral and rock collections, comprising 56,905 specimens, were prepared and distributed to the public. There was a further marked increase in requests for minerals and rocks from the western provinces, especially for those available as prospectors' sets. J. R. Marshall reports that the 1,625 collections were made up of 740 sets of prospectors' minerals, 698 sets of prospectors' rocks, 64 sets of strategic minerals, 93 miscellaneous or special collections, 21 standard collections, and 9 shipments of material in bulk form. These were distributed as follows: British Columbia and Northwest Territories, 425; Alberta, 270; Saskatchewan, 103; Manitoba, 47; Ontario, 382; Quebec, 332; Maritimes, 35; and United States, 25.

British Columbia Office

A total of 4,702 visitors seeking information registered at the office, and many additional inquiries were handled by mail and telephone. A total of 4,409 reports and 2,756 separate maps were issued in response to requests from the public. Determinations were also made of a large number of rock and mineral specimens submitted for identification.

TOPOGRAPHICAL SURVEY

FIELD WORK

Control Surveys 1946

Officer in charge	Sheet name	Sheet number	Latitude and longitude	Scale of publication
	Northwest Territories			
H. N. Spence	Yellowknife	85 J/8 and 9	62° 20′- 62° 45′ / 114° 15′-114° 25′	1 in. to 800 ft.
Eric Fry	Hearne Lake	85 I/6	62° 15′- 62° 30′ / 113° 00′-113° 30′	1 in. to 1 mi.
	Buckham Lake	85 I/7	62° 15′- 62° 30′ / 112° 30′-113° 00′	1 in. to 1 mi.
	Prelude Lake	85 I/12	62° 30′- 62° 45′ / 113° 30′-114° 00′	1 in. to 1 mi.
C. M. Duncan	Chalco	86 B/6	64° 15′- 64° 30′ / 115° 00′-115° 30′	1 in. to 1 mi.
	Ranji Lake	86 B/3	64° 00′- 64° 15′	1 in. to 1 mi.
	[1]Ghost Lake	85 O/14	63° 45′- 64° 00′	1 in. to 1 mi.
	Alberta			
R. J. Parlee	Rycroft	83 M/NE.	55° 30′- 56° 00′ / 118° 00′-119° 00′	1 in. to 2 mi.
	Blueberry Mountain	83 M/NW.	55° 30′- 56° 00′ / 119° 00′-120° 00′	1 in. to 2 mi.
	Beaverlodge	83 M/SW.	55° 00′- 55° 30′ / 119° 00′-120° 00′	1 in. to 2 mi.
	Grand Prairie	83 M/SE.	55° 00′- 55° 30′ / 118° 00′-119° 00′	1 in. to 2 mi.
	McLennan	83 N/NE.	55° 30′- 56° 00′ / 116° 00′-117° 00′	1 in. to 2 mi.
R. J. Parlee	Eaglesham	83 N/NW.	55° 30′- 56° 00′ / 117° 00′-118° 00′	1 in. to 2 mi.
	Sturgeon Lake	83 N/SW.	55° 00′- 55° 30′ / 117° 00′-118° 00′	1 in. to 2 mi.
	High Prairie	83 N/SE.	55° 00′- 55° 30′ / 116° 00′-117° 00′	1 in. to 2 mi.
	Saskatchewan			
H. A. S. West	Crooked River	63 D/NW.	52° 30′- 53° 00′ / 103° 00′-104° 00′	1 in. to 2 mi.
	Hudson Bay Junction	63 D/NE.	52° 30′- 53° 00′ / 102° 00′-103° 00′	1 in. to 2 mi.
	Pasquia Hills	63 E/SE.	53° 00′- 53° 30′ / 102° 00′-103° 00′	1 in. to 2 mi.
	Carrot River	63 E/SW.	53° 00′- 53° 30′ / 103° 00′-104° 00′	1 in. to 2 mi.

[1] Field work not completed.

FIELD WORK—*Cont.*

Control Surveys 1946—Cont.

Officer in charge	Sheet name	Sheet number	Latitude and longitude	Scale of publication
	Ontario			
H. R. Grant	Brent	31 L/1	46° 00′- 46° 15′ / 78° 00′- 78° 30′	1 in. to 1 mi.
	Kiosk	31 L/2	46° 00′- 46° 15′ / 78° 30′- 79° 00′	1 in. to 1 mi.
	Mattawa	31 L/7	46° 15′- 46° 30′ / 78° 30′- 79° 00′	1 in. to 1 mi.
	Maganasibi	31 L/8	46° 15′- 46° 30′ / 78° 00′- 78° 30′	1 in. to 1 mi.
D. A. MacLean	Orr Lake	31 D/12	44° 30′- 44° 45′ / 79° 30′- 80° 00′	1 in. to 1 mi.
	[1]Beausoleil Island	31 D/13	44° 45′- 45° 00′ / 79° 30′- 80° 00′	1 in. to 1 mi.
	[1]Gravenhurst	31 D/14	44° 45′- 45° 00′ / 79° 00′- 79° 30′	1 in. to 1 mi.
	[1]Lafontaine	41 A/16, E.½	44° 45′- 45° 00′ / 80° 00′- 80° 15′	1 in. to 1 mi.
	Quebec			
F. P. DuVernet	Barraute	32 C/5	48° 15′- 48° 30′ / 77° 30′- 78° 00′	1 in. to 1 mi.
	LaMotte	32 D/8	48° 15′- 48° 30′ / 78° 00′- 78° 30′	1 in. to 1 mi.
	Kanasuta River	32 D/6	48° 15′- 48° 30′ / 79° 00′- 79° 30′	1 in. to 1 mi.
R. W. Clark	Bruce Lake	31 K/11	46° 30′- 46° 45′ / 77° 00′- 77° 30′	1 in. to 1 mi.
R. W. Clark	Lac des Brules	31 K/14	46° 45′- 47° 00′ / 77° 00′- 77° 30′	1 in to 1. mi.
	Gardner Lake	31 K/13, E.½	46° 45′- 47° 00′ / 77° 30′- 77° 45′	1 in. to 1 mi.
	Aumond Lake	31 K/12, E.½	46° 30′- 46° 45′ / 77° 30′- 77° 45′	1 in. to 1 mi.
	New Brunswick			
D. A. MacKay / R. T. Gajda	Juniper	21 J/11	46° 30′- 46° 45′ / 67° 00′- 67° 30′	1 in. to 1 mi.
R. T. Gajda	Coldstream	21 J/6	46° 15′- 46° 30′ / 67° 00′- 67° 30′	1 in. to 1 mi.
	Millville	21 J/3	46° 00′- 46° 15′ / 67° 00′- 67° 30′	1 in. to 1 mi.
	Aroostook	21 J/13	46° 45′- 47° 00′ / 67° 30′-U.S. boundary	1 in. to 1 mi.

[1] Simcoe county only.

FIELD WORK—*Cont.*

Control Surveys 1946—Cont.

Officer in charge	Sheet name	Sheet number	Latitude and longitude	Scale of publication
	New Brunswick (cont'd)			
	Kilburn	21 J/12	46° 30′- 46° 45′ 67° 30′-U.S. boundary	1 in. to 1 mi.
	Florenceville	21 J/5	46° 15′- 46° 30′ 67° 30′-U.S. boundary	1 in. to 1 mi.
	Woodstock	21 J/4	46° 00′- 46° 15′ 67° 30′-U.S. boundary	1 in. to 1 mi.
H. D. Worden...	Canterbury	21 G/14	45° 45′- 46° 00′ 67° 00′- 67° 30′	1 in. to 1 mi.
R. F. Brooks....	Fosterville	21 G/13	45° 45′- 46° 00′ 67° 30′-U.S. boundary	1 in. to 1 mi.
	Forest City	21 G/12	45° 30′- 45° 45′ 67° 30′-U.S. boundary	1 in. to 1 mi.
	McAdam	21 G/11	45° 30′- 45° 45′ 67° 00′- 67° 30′	1 in. to 1 mi.
W. R. Honeywell.	Fredericton Junction..	21 G/10	45° 30′- 45° 45′ 66° 30′- 67° 00′	1 in. to 1 mi.
J. R. Barnes.....	Hampstead	21 G/9	45° 30′- 45° 45′ 66° 00′- 66° 30′	1 in. to 1 mi.
	Cody	21 H/13	45° 45′- 46° 00′ 65° 30′- 66° 00′	1 in. to 1 mi.
A. E. Schneller...	Charlo	21 O/16	47° 45′- 48° 00′ 66° 00′- 66° 30′	1 in. to 1 mi.
A. R. Goddard...	Wild Cat Brook	21 O/9	47° 30′- 47° 45′ 66° 00′- 66° 30′	1 in. to 1 mi.
	Point Verte	21 P/13	47° 45′- 48° 00′ 65° 30′- 66° 00′	1 in. to 1 mi.
	Bathurst	21 P/12	47° 30′- 47° 45′ 65° 30′- 66° 00′	1 in. to 1 mi.
	Clifton	21 P/11, W.½	47° 30′- 47° 45′ 65° 15′- 65° 30′	1 in. to 1 mi.
J. D. Roy.....	Kedgewick	21 O/11	47° 30′- 47° 45′ 67° 00′- 67° 30′	1 in to 1 mi..
R. J. Brehler....	McCormick Brook....	21 O/10	47° 30′- 47° 45′ 66° 30′- 67° 00′	1 in. to 1 mi.
	Oliver Siding	21 O/14	47° 45′- 48° 00′ 67° 00′- 67° 30′	1 in. to 1 mi.
	Campbellton	21 O/15	47° 45′- 48° 00′ 66° 30′- 67° 00′	1 in. to 1 mi.

Field Work—*Cont.*

Control Surveys 1946—Cont.

Officer in charge	Sheet name	Sheet number	Latitude and longitude	Scale of publication
	New Brunswick (cont'd)			
G. A. Leonards...	Tabusintac River.....	21 P/6	47° 15′- 47° 30′ / 65° 00′- 65° 30′	1 in. to 1 mi.
C. E. Hoganson..	Bartibog.....	21 P/5	47° 15′- 47° 30′ / 65° 30′- 66° 00′	1 in. to 1 mi.
	Maple Glen.....	21 P/4	47° 00′- 47° 15′ / 65° 30′- 66° 00′	1 in. to 1 mi.
	Chatham.....	21 P/3	47° 00′- 47° 15′ / 65° 00′- 65° 30′	1 in. to 1 mi.
	Wishart Point.....	21 P/7, W.½	47° 15′- 47° 30′ / 64° 45′- 65° 00′	1 in. to 1 mi.
	Point Escuminac.....	21 P/2, W.½	47° 00′- 47° 15′ / 64° 45′- 65° 00′	1 in. to 1 mi.
	Richibucto.....	21 I/10	46° 30′- 46° 45′ / 64° 30′- 65° 00′	1 in. to 1 mi.
	Sapin Point.....	21 I/15, W.½	46° 45′- 47° 00′ / 64° 45′- 65° 00′	1 in. to 1 mi.
	Nova Scotia			
J. F. MacLean...	Margaree.....	11 K/6	46° 15′- 46° 30′ / 61° 00′- 61° 30′	1 in. to 1 mi.
P. G. Campbell..	St. Anns.....	11 K/7	46° 15′- 46° 30′ / 60° 30′- 61° 00′	1 in. to 1 mi.
	Baddeck.....	11 K/2	46° 00′- 46° 15′ / 60° 30′- 61° 00′	1 in. to 1 mi.
	Grand Narrows.....	11 F/15	45° 45′- 46° 00′ / 60° 30′- 61° 00′	1 in. to 1 mi.
	Whycocomagh.....	11 F/14	45° 45′- 46° 00′ / 61° 00′- 61° 30′	1 in. to 1 mi.
G. M. Armstrong..	Cape George.....	11 F/13, W.½	45° 45′- 46° 00′ / 61° 45′- 62° 00′	1 in. to 1 mi.
	Malignant Cove.....	11 E/16, E.½	45° 45′- 46° 00′ / 62° 00′- 62° 15′	1 in. to 1 mi.
	Merigomish.....	11 E/9	45° 30′- 45° 45′ / 62° 00′- 62° 30′	1 in. to 1 mi.
	Antigonish.....	11 F/12	45° 30′- 45° 45′ / 61° 30′- 62° 00′	1 in. to 1 mi.
	Cape Canso.....	11 F/7, W.½	45° 15′- 45° 30′ / 60° 45′- 61° 00′	1 in to 1 mi..
	Canso.....	11 F/6	45° 15′- 45° 30′ / 61° 00′- 61° 30′	1 in. to 1 mi.

FIELD WORK—*Cont.*

Control Surveys 1946—Cont.

Officer in charge	Sheet name	Sheet number	Latitude and longitude	Scale of publication
	Nova Scotia—(cont'd)			
G. M. Armstrong..	Guysborough.....	11 F/5	45° 15′- 45° 30′ / 61° 30′- 62° 00′	1 in. to 1 mi.
	Country Harbour.....	11 F/4	45° 00′- 45° 15′ / 61° 30′- 62° 00′	1 in. to 1 mi.
	Larry River.....	11 F/3	45° 00′- 45° 15′ / 61° 00′- 61° 30′	1 in. to 1 mi.
R. C. Weller.....	Cape Lahave.....	21 A/1, W.½	44° 00′- 44° 15′ / 64° 15′- 64° 30′	1 in. to 1 mi.
	Liverpool.....	21 A/2	44° 00′- 44° 15′ / 64° 30′- 65° 00′	1 in. to 1 mi.
	Lake Rossignol.....	21 A/3	44° 00′- 44° 15′ / 65° 00′- 65° 30′	1 in. to 1 mi.
	Bridgewater.....	21 A/7	44° 15′- 44° 30′ / 64° 30′- 65° 00′	1 in. to 1 mi.
	Lunenburg.....	21 A/8	44° 15′- 44° 30′ / 64° 00′- 64° 30′	1 in. to 1 mi.
L. E. Willis.....	Wentworth Lake.....	21 A/4	44° 00′- 44° 15′ / 65° 30′- 66° 00′	1 in. to 1 mi.
G. M. Donohoe..	Weymouth.....	21 A/5	44° 15′- 44° 30′ / 65° 30′- 66° 00′	1 in. to 1 mi.
	Kejimkujik Lake.....	21 A/6	44° 15′- 44° 30′ / 65° 00′- 65° 30′	1 in. to 1 mi.
	Milford.....	21 A/11	44° 30′- 44° 45′ / 65° 00′- 65° 30′	1 in. to 1 mi.
	Metaghan.....	21 B/1	44° 00′- 44° 15′ / 66° 00′- 66° 30′	1 in. to 1 mi.
	Church Point.....	21 B/8	44° 15′- 44° 30′ / 66° 00′- 66° 30′	1 in. to 1 mi.
	Centreville.....	21 B/9	44° 30′- 44° 45′ / 66° 00′- 66° 30′	1 in. to 1 mi.
C. G. Rogers....	Chester.....	21 A/9	44° 30′- 44° 45′ / 64° 00′- 64° 30′	1 in. to 1 mi.
P. J. Dunsworth.	New Germany.....	21 A/10	44° 30′- 44° 45′ / 64° 30′- 65° 00′	1 in. to 1 mi.
	Gaspereau Lake.....	21 A/15	44° 45′- 45° 00′ / 64° 30′- 65° 00′	1 in. to 1 mi.
	Windsor.....	21 A/16	44° 45′- 45° 00′ / 64° 00′- 64° 30′	1 in. to 1 mi.

FIELD WORK—*Cont.*

Control Surveys 1946—Cont.

Officer in charge	Sheet name	Sheet number	Latitude and longitude	Scale of publication
	Alberta			
A. M. Floyd	Hat Mountain	83 L/5, E.½	54° 15′- 54° 30′ / 119° 30′-119° 45′	1 in. to 1 mi.
	Mount Torrens	83 L/5, W.½	54° 15′- 54° 30′ / 119° 45′-120° 00′	1 in. to 1 mi.
	Chicken Creek	83 L/6, W.½	54° 15′- 54° 30′ / 119° 15′-119° 30′	1 in. to 1 mi.
M. E. Nidd	Pierre Greys Lakes	83 E/15, E.½	53° 45′- 54° 00′ / 118° 30′-118° 45′	1 in. to 1 mi.
	A la Peche Lake	83 E/15, W.½	53° 45′- 54° 00′ / 118° 45′-119° 00′	1 in. to 1 mi.
	Grand Cache	83 E/14, E.½	53° 45′- 54° 00′ / 119° 00′-119° 15′	1 in. to 1 mi.
B. L. Anderson	Donald Flats	83 E/16, E.½	53° 45′- 54° 00′ / 118° 00′-118° 15′	1 in. to 1 mi.
	Joachim Lakes	83 E/16, W.½	53° 45′- 54° 00′ / 118° 15′-118° 30′	1 in. to 1 mi.
	Ontario			
J. A. Macdonald	Orr Lake	31 D/12	44° 30′- 44° 45′ / 79° 30′- 80° 00′	1 in. to 1 mi.
	[1]Beausoleil Island	31 D/13	44° 45′- 45° 00′ / 79° 30′- 80° 00′	1 in. to 1 mi.
	[1]Gravenhurst	31 D/14	44° 45′- 45° 00′ / 79° 00′- 79° 30′	1 in. to 1 mi.
	Lafontaine	41 A/16, E.½	44° 45′- 45° 00′ / 80° 00′- 80° 15′	1 in. to 1 mi.
	Nova Scotia			
J. V. Butterworth	Lake Ainslie	11 K/3	46° 00′- 46° 15′ / 61° 00′- 61° 30′	1 in. to 1 mi.

[1] Field work not completed for contouring.

A. C. Tuttle was senior officer in charge of Nova Scotia work.
J. W. Spence visited parties in Nova Scotia and supervised the work in New Brunswick.

OFFICE WORK

Air Survey Section

The areas where compilations were made are listed below, together with the approximate number of square miles in each area.

I. Compilation from oblique and vertical trimetrogon photography now in manuscript stage on a scale of 1 mile to 1 inch in Northwest Territories and Yukon:

Sheet No.	Publication scale	Approximate area in square miles
95 M	1 in. to 4 mi.	1,280
104 O	1 in. to 4 mi.	200
105 A	1 in. to 4 mi.	2,085
105 B	1 in. to 4 mi.	3,275
105 G	1 in. to 4 mi.	1,145
105 H	1 in. to 4 mi.	1,090
105 O	1 in. to 4 mi.	950
105 P	1 in. to 4 mi.	1,080
	Total	11,105

II. Compilation from vertical air photography: cleared to Topographical or Map Compilation Sections:

Sheet No.	Publication scale	Approximate area in square miles
Northwest Territories:		
85 I/10	1 in. to 1 mi.	280
85 I/11	1 in. to 1 mi.	280
85 I/12	1 in. to 1 mi.	280
86 B/3	1 in. to 1 mi.	260
86 B/6	1 in. to 1 mi.	260
Yellowknife area blocks A and C	1 in. to 800 ft.	50
Alberta:		
83 B/3, E.½	1 in. to 1 mi.	185
83 B/6	1 in. to 1 mi.	365
83 B/11	1 in. to 1 mi.	365
83 B/14	1 in. to 1 mi.	365
83 E/10, E.½	1 in. to 1 mi.	180
83 E/14, E.½	1 in. to 1 mi.	180
83 L/1, W.½	1 in. to 1 mi.	175
83 L/2	1 in. to 1 mi.	350
83 L/3	1 in. to 1 mi.	350
83 L/4, W.½	1 in. to 1 mi.	175
83 L/6	1 in. to 1 mi.	350
83 L/7, W.½	1 in. to 1 mi.	175
83 M/7	1 in. to 2 mi.	340
83 M/8	1 in. to 2 mi.	340
83 M/13	1 in. to 2 mi.	340
83 M/14	1 in. to 2 mi.	340
83 N/7	1 in. to 2 mi.	340
83 N/8	1 in. to 2 mi.	340
83 N/9	1 in. to 2 mi.	340
83 N/10	1 in. to 2 mi.	340

OFFICE WORK—*Cont.*

Air Survey Section—Cont.

Sheet No.	Publication scale	Approximate area in square miles
Saskatchewan:		
63 D/11	1 in. to 2 mi.	365
63 D/13	1 in. to 2 mi.	365
63 E/4	1 in. to 2 mi.	355
63 E/5	1 in. to 2 mi.	355
Manitoba:		
63 J/11, W.½	1 in. to 1 mi.	175
63 J/12	1 in. to 1 mi.	350
63 J/13	1 in. to 1 mi.	350
63 J/14, W.½	1 in. to 1 mi.	175
Quebec:		
32 C/5	1 in. to 1 mi.	400
Vauquelin tp.	1 in. to 1,000 ft.	100
Pershing tp.	1 in. to 1,000 ft.	100
Haig tp.	1 in. to 1,000 ft.	100
W.½ Beauchastel tp.	1 in. to 1,000 ft.	50
New Brunswick:		
21 B/10	1 in. to ½ mi.	90
21 B/15	1 in. to ½ mi.	70
21 I/12, W.½	1 in. to ½ mi.	205
21 J/1	1 in. to ½ mi.	410
21 J/2, E.½	1 in. to ½ mi.	205
21 J/7	1 in. to ½ mi.	410
21 J/8	1 in. to ½ mi.	410
Nova Scotia:		
21 B/9	1 in. to ½ mi.	15
11 E/16	1 in. to ½ mi.	30
11 F/13	1 in. to ½ mi.	45
11 F/9	1 in. to ½ mi.	70
11 F/10	1 in. to ½ mi.	300
	Total	12,845

Flight maps were prepared for R.C.A.F. vertical photography, requested by the Department of Mines and Resources and the Department of Agriculture, covering areas in Yukon, Northwest Territories, British Columbia, Alberta, Saskatchewan, Manitoba, Quebec, and Labrador.

Research was done in the use of the Canadian modified Wilson photoalidade and stereoblique plotter for topographic mapping of mountainous country from R.C.A.F. trimetrogon photography in Whitehorse area, Yukon.

Twenty-one new personnel were instructed and trained in compilation from air photography.

Map Compilation Section

The Map Compilation Section forwarded sixteen topographical maps for reproduction, one of which was of an area in British Columbia, two in Northwest Territories, five in Alberta, one in Manitoba, five in New Brunswick, and two in Nova Scotia. Eight of these map sheets were contoured, the remainder being planimetric.

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. Twenty-six of these maps were produced in addition to maps for water supply papers covering thirty-eight municipalities in Saskatchewan and seventeen districts in Alberta. Toward the end of the year the urgency of other work made it necessary to transfer the production of these preliminary maps to the Draughting and Reproducing Division. One hundred and fifty-six projections were drawn, and numerous manuscripts inked, 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 and mechanical reproduction processes, and library and information services.

An increased interest in mining development is indicated by the substantial increase in the demands by the public for geological information and maps. Similarly, the greatly increased number of aerial photographs purchased by government services, public utilities, mining and engineering organizations and educational institutions indicates the quickening trend toward the development of all natural resources.

National Air Photographic Library

Aerial photographs are an essential part of modern mapping and of resources development, as they embody comprehensive information on the areas they cover. They not only serve the map-maker but constitute a permanent source of reference for the scientist and the layman in the fields of mining, forestry, water power, and agriculture. The National Air Photographic Library serves as a central reference library of aerial photography in Canada. Copies of prints are available for study, and expert assistance is provided in the selection and application of photographs to development problems. For those who wish to purchase copies, the library arranges for the reproduction of the necessary prints.

More than 245,000 new prints were added to the library files, a number almost double that of the previous year and about four times that of 1944-45. This rapid increase is indicative of the scale of post-war plans for mapping and other forms of resources development. Of the 1946-47 total, 5,137 were low-altitude scenic views illustrating towns, cities, training camps, airports, etc.; 28,422 were trimetrogen photographs of parts of Quebec, Ontario, Manitoba, Saskatchewan, and Northwest Territories; and the remainder were vertical photographs of sections of the various provinces and territories. At the close of the year approximately 1,491,000 prints were on file, covering a total photographed area of about 1,500,000 square miles.

Representatives of Dominion and Provincial Government services, of engineering, commercial, and educational organizations, as well as many individuals, made use of the facilities of the library. Altogether, 195,336 copies of prints were supplied on orders placed with the library.

Photographic Section

Much of the work was devoted to kodalith, Van Dyke, and linen negatives, which have almost totally replaced the wet plate negatives for reproduction of geological and topographical maps. The staff was also engaged in the development, printing, cataloguing, and filing of exposures made in the field by

geological, topographical, and Museum parties; in the photographing of fossils, minerals, and many miscellaneous items; and in the preparation of suitable negatives and prints. To maintain a steady, free-flowing, and organized production line, an enlarging room was added to the plant. This permits photography, processing, printing, and enlarging to be carried on simultaneously. An addition to plant equipment facilitated the photography of fossils, minerals, and other specimens. The work included:

Bromide enlargements, 3 x 4 to 32 x 40	4,005
Contact prints, 1¼ x 2½ to 36 x 40	10,147
Kodalith negatives, 8 x 10 to 24 x 30	335
Dry plate negatives, 4 x 5 to 24 x 30	657
Van Dyke negatives, 8 x 10 to 35 x 47	109
Van Dyke prints, 5 x 7 to 30 x 40	1,067
Linen negatives, 8 x 10 to 35 x 47	5
Linen prints, 8 x 10 to 35 x 47	23
Aero mapping prints, 5 x 7 to 24 x 30	8
Celluloid scales	123
Dry mounting maps and photographs	1,051
Exposures developed, field work	4,635
Negatives retouched	549
Lantern slides	353

Library

The year was marked by an increased acquisition of European publications previously held up owing to transportation difficulties. Although these exchanges are not yet up to date, much valuable material was received. An appreciably larger number of outside readers made use of the library, but this service was handicapped by a shortage of staff.

Cataloguing of maps was not completely brought up to date, but current maps were catalogued as received. One hundred and thirty-four maps were backed, the back-log of lantern slides was disposed of, and the cataloguing was completed.

Many valuable books and monographs from the library of Dr. D. Jenness were received. The reports of the Sino-Swedish expedition, in twenty-seven volumes, a second set of Rhodora in forty-six volumes, and twelve volumes of the Danish Ingolf-Expedition were among the sets acquired by gift or purchase. Among foreign institution gifts were seventeen volumes of the Bulletins and Mémoires of the Académie Royale des Sciences de Belgique, nine volumes of the Annales of the Societa Zoologica-botanica Fennica Vanamo, twenty volumes of the Revista of the Museo de la Plata, and eleven volumes of the Bulletins of the Service de la Carte Géologique d'Algérie. The Société Géologique de France has brought its various series up to date, and the K. Danske Videnskabernes Selskab presented nine volumes of its Meddeleser. Splendid contributions were also received from K. Svenska Vetenskapsakademiens. The Geological Society of America and the Carnegie Institution of Washington continued to present many valuable monographs. Eighty-four new serials were received and catalogued.

Recorded loans were 4,606 higher than in 1945-46, and inter-library and occasional loans increased by 439. Reference work continued to absorb a large amount of time.

Acquisitions by the library were 2,848 more than for the previous year and were as follows:

Books acquired by purchase	151
Books (complete unbound volumes, by purchase)	190
Books by transfer, exchange, and gift	893
Canadian Government documents—individual issues (by gift and exchange)	2,759

British and Foreign Government documents—individual issues (by gift and exchange)	2,417
Canadian periodicals, individual issues	864
British and Foreign periodicals, individual issues	2,334
Scientific societies' bulletins, proceedings and transactions—individual issues (by gift and exchange)	4,216
Total	13,824

Other data:

Recorded loans of books, pamphlets, periodicals	14,737
Inter-library and occasional loans	1,651
Books borrowed from other libraries	505
Maps and charts added to the library	881
Maps and charts borrowed from the library	420
Lantern slides borrowed	426
Lantern slides added to the library	362
Photographs loaned (exclusive of albums)	1,846
Volumes bound	401
Volumes accessioned	1,254
Cards added to general catalogue	8,302
Cards added to map catalogue	436
Cards added to slide catalogue	702
Letters and cards received	1,549
Letters and cards sent	2,204

Mechanical Section

The production of 36,504 square feet of Océ prints was 100 per cent greater than in the previous year. A total of 451,528 square feet of blueprints were made compared with 337,618 square feet during 1945-46. Photostat material showed a slight decrease at 13,638 sheets. The 988,240 mimeographed impressions made was almost double that of the preceding year.

The lapidary shop produced 1,935 thin sections and 118 cut and polished specimens, most of which were used by the Geological Survey for mineralogical determinations and research. Sections and specimens were prepared for the Bureau of Mines.

Arrangements were made for a total of 137 engagements in the lecture hall of the Museum, and projectionist services were supplied as required.

Geological Information and Distribution

In response to written and personal requests, 92,168 maps and 58,287 other publications of the Bureau, and of the National Museum, were distributed. In addition, 733 French publications were distributed through the office of the Chief Editor, Department of Mines and Resources.

DRAUGHTING AND REPRODUCING DIVISION

Maps Published April 1, 1946, to March 31, 1947

Publication Number	Title	Remarks
	CANADA	
870A	Index map of Canada, according to the National Topographical System; scale, 1 inch to 130 miles	For separate distribution.
	Coal Deposits and Coal Resources of Canada (English and French editions); scale, 1 inch to 230 miles	For Canada Year Book and separate distribution.
	YUKON	
890A	Mayo; scale, 1 inch to 4 miles	Geology. For memoir by H. S. Bostock, and separate distribution.
2071	Whitehorse Sheet; scale, 1 inch to 4 miles. Reprint	Geology. For separate distribution.
	NORTHWEST TERRITORIES	
558A	Canadian Eastern Arctic; scale, 1 inch to 100 miles. Reprint	Geography. For bulletin by N. Polunin.
859A	Dahadinni River, District of Mackenzie; scale, 1 inch to 4 miles	Topography. For separate distribution.
860A	Wrigley, District of Mackenzie; scale, 1 inch to 4 miles	Topography. For separate distribution.
861A	Carcajou Canyon, District of Mackenzie; scale, 1 inch to 4 miles	Topography. For separate distribution.
868A	Prosperous Lake, District of Mackenzie; scale, 1 inch to 1 mile	Geology. For separate distribution.
891A	Ross Lake, District of Mackenzie; scale, 1 inch to 1 mile	Topography. For separate distribution.
898A	Tumpline Lake, District of Mackenzie; scale, 1 inch to 1 mile	Topography. For separate distribution.
	BRITISH COLUMBIA	
237A	Big Bend Area, Columbia River; scale, 1 inch to 4 miles. Reprint	Geology. For separate distribution.
255A	Quatsino-Nimpkish, Northern Vancouver Island; scale, 1 inch to 2 miles. Reprint	Geology. For separate distribution.

Maps Published April 1, 1946, to March 31, 1947—Continued

Publication Number	Title	Remarks
2103	Tatla-Bella Coola Area, Coast District; scale, 1 inch to 4 miles. Reprint	Geology. For separate distribution.
876A	Manson Creek, Cassiar District; scale, 1 inch to 4 miles	Geology. For separate distribution.
882A	Zeballos, Vancouver Island; scale, 1 inch to 1 mile	Topography. For separate distribution.
	ALBERTA	
855A	Gregg Lake, West of Fifth Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
866A	Barbara Creek, West of Fifth Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
873A	Blairmore, West of Fifth Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
878A	Dalehurst, West of Fifth Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
879A	Sunwapta, West of Fifth Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
880A	Nose Creek, West of Sixth Meridian; scale, 1 inch to 1 mile	Topography. For separate distibution.
881A	Moberly Creek, West of Sixth Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
883A	Fall Creek, West of Fifth Meridian; scale, 1 inch to 1 mile	Geology. For separate distribution.
884A	Alexo, West of Fifth Meridian; scale, 1 inch to 1 mile	Geology. For memoir by A. O. Erdman, and separate distribution.
885A	Saunders, West of Fifth Meridian; scale, 1 inch to 1 mile	Geology. For memoir by A. O. Erdman, and separate distribution.
	SASKATCHEWAN	
856A	Cypress Lake structure contours; scale, 1 inch to 4 miles	Geology. For memoir by G. M. Furnival, and separate distribution.

Maps Published April 1, 1946, to March 31, 1947—Continued

Publication Number	Title	Remarks
863A	Wiley Lake, West of Third Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
864A	Lowe Lake, West of Third Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
896A	Mineral map of Saskatchewan; scale, 1 inch to 20 miles	Minerals. For separate distribution.
	MANITOBA	
858A	Batty Lake, West of Principal Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
862A	Sherridon, West of Principal Meridian; scale, 1 inch to 1 mile	Geology. For separate distribution.
865A	Tramping Lake, West of Principal Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
869A	Elbow Lake, West of Principal Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
875A	Iskwasum Lake, West of Principal Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
892A	Herb Lake, West of Principal Meridian; scale, 1 inch to 1 mile	Topography. For separate distribution.
	ONTARIO	
871A	Chelmsford, Sudbury District; scale, 1 inch to 1 mile	Geology. For separate distribution.
872A	Falconbridge, Sudbury District; scale, 1 inch to 1 mile	Geology. For separate distribution.
	ONTARIO AND QUEBEC	
686A	Chalk River, Pontiac and Renfrew Counties; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
701A	Point Alexander, Nipissing District, Renfrew and Pontiac Counties; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
852A	Ottawa-Cornwall; scale, 1 inch to 4 miles	Geology. For memoir by A. E. Wilson, and separate distribution.

Maps Published April 1, 1946, to March 31, 1947—Continued

Publication Number	Title	Remarks
	QUEBEC	
680A	St. Michel, Maskinonge, Berthier, St. Maurice, and Joliette Counties; scale, 1 inch to 2 miles. Reprint	Topography. For separate distribution.
	NEW BRUNSWICK	
475A	Waterford, Kings and Saint John Counties; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
877A	Newcastle, Northumberland County; scale, 1 inch to 1 mile	Topography. For separate distribution.
901A	Burtts Corners; scale, 1 inch to 1 mile	Topography. For separate distribution.
902A	Boiestown; scale, 1 inch to 1 mile	Topography. For separate distribution.
903A	Napadogan; scale, 1 inch to 1 mile	Topography. For separate distribution.
	NOVA SCOTIA	
511A	Owls Head, Halifax County; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
512A	Liscomb, Guysborough, and Halifax Counties; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
513A	Melopseketch, Guysborough and Halifax Counties; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
515A	Lake Mulgrave, Halifax and Guysborough Counties; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
516A	Upper Musquodoboit, Halifax and Colchester Counties; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
517A	Lochaber, Guysborough, Pictou, and Antigonish Counties; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
518A	Moose River, Pictou and Guysborough Counties; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
519A	Ecum Secum, Guysborough and Halifax Counties; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
520A	Port Dufferin, Halifax County; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.

Maps Published April 1, 1946, to March 31, 1947—Continued

Publication Number	Title	Remarks
521A	Tangier, Halifax County; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
522A	Ship Harbour, Halifax County; scale, 1 inch to 1 mile. Reprint	Topography. For separate distribution.
854A	Tatamagouche-River John; scale, 1 inch to 1 mile	Topography. For separate distribution.
867A	Bass River, Colchester and Hants Counties; scale, 1 inch to 1 mile	Geology. For memoir by L. J. Weeks, and separate distribution.
874A	Londonderry, Colchester and Hants Counties; scale, 1 inch to 1 mile	Geology. For memoir by L. J. Weeks, and separate distribution.
	MISCELLANEOUS	
Figure 1	Map of Maritime Provinces and part of Quebec showing 1944 gravimetric traverses; scale, 1 inch to 25 miles	For bulletin by A. H. Miller.
45-28 46-1	Lower Triassic of Liard River, British Columbia (half-tone plates of fossils)	Palæontology. To accompany Papers 46-1, 45-28.
46-25	Upper Triassic Faunas of Halifax, Sikanni Chief, and Prophet River basins, British Columbia (half-tone plates of fossils)	Palæontology. To accompany Paper 46-25.
	Chart showing Ducks and Geese (half-tone illustrated chart)	Ornithology. For separate distribution by National Museum of Canada.
	FOR REPORT OF ROYAL COMMISSION ON COAL	
Map 1	Coalfields in Canada and United States (English and French editions)	Also for Canada Year Book, and separate distribution.
Map 3	Coalfields of Nova Scotia and New Brunswick	Also for separate distribution.
Map 4	Sydney Coalfield, Cape Breton Island, Nova Scotia	Also for separate distribution.
Map 5	Coalfields of Inverness County, Cape Breton Island, Nova Scotia	Also for separate distribution.
Map 6	Minto Coalfield, New Brunswick	Also for separate distribution.
Map 7	Coalfields of southern Saskatchewan	Also for separate distribution.
Map 8	Coal areas of Alberta	Also for separate distribution.

Maps Published April 1, 1946, to March 31, 1947—Continued

Publication Number	Title	Remarks
Map 9	Coal mining operations in Alberta	Also for separate distribution.
Map 10	Coalfields and coal areas of British Columbia	Also for separate distribution.
Map 11	Coalfields of southeastern British Columbia	Also for separate distribution.
Map 12	Coalfields of Canada and Principal United States coalfields shipping to Canada.	
Map 13	Greater Winnipeg, showing central heating areas.	
Chart A	Canadian National Railways, maximum trainload.	
Chart B	Canadian Pacific Railway, maximum trainload.	
Chart C	Dominion Steel and Coal Corporation structure.	
Chart D	Energy and employment.	
Chart E	Relative importance of Energy Sources.	

At the end of the fiscal year, Map 895A, "Geological Map of Saskatchewan," on the scale of 1 inch to 20 miles, and Map 900A, "Canada Mining Areas," on the scale of 1 inch to 125 miles, were about to be published. One physiographic map of Yukon, thirteen maps of areas in British Columbia, four in Alberta, one in Manitoba, four in Quebec, one in Nova Scotia, and one in New Brunswick, were in progress. Geological and mineral maps of the Maritime Provinces and of British Columbia were in progress of compilation.

The compilation and production of preliminary geological maps, which make available to the public the results of recent geological surveys, was taken over by the Division.

Two hundred and ninety maps and scientific figures were drawn for reproduction by zinc-cut process for illustrating memoirs, reports, articles, and papers; one hundred and eighty-seven of these were to illustrate the Canadian Institute of Mining and Metallurgy symposium: "Structural Controls of Canadian Ore Deposits." Other draughting and miscellaneous projects necessary for staff, mineral development, and public use amounted to more than eleven hundred items.

Geographic Board of Canada

To conform to changed conditions and alterations in the functions of the various departments of the Government, the membership of the Geographic Board was changed and enlarged by P.C. 823, 6th March, 1947. It now consists of fifteen members, seven of whom are officers of the Dominion Government representing the Departments of Mines and Resources and National Defence, the Post Office and the Public Archives. 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.

Meetings of the Board were resumed in May and names for forty-seven maps and ten charts were adopted. Names for sixteen other maps and nineteen charts were dealt with by the Executive Committee prior to the resumption of meetings. Many inquiries from Government departments and the public were investigated and information supplied. Four Provincial members attended the February meeting of the Board, at which various aspects of its work were given consideration.

NATIONAL MUSEUM OF CANADA

The past year was one of exceptional change and progress for the National Museum. Increased activity was directed toward the promotion of post-war plans for the renovating and re-opening of the various exhibition halls, which were closed to the public during the war. The vacating of offices on the second floor late in the year has permitted the re-opening of extensive biological and anthropological collections for study by the public.

Field parties in search of archæological, botanical, zoological, and ethnological information carried out investigations in northern Yukon, in the Alberta foothills, in the St. Lawrence River valley, and in the Roberval area, Quebec. As a result of these and of local field work, much valuable information and accessions were accumulated.

In February 1947 F. J. Alcock, Ph.D., F.R.C.S., of the Canadian Geological Survey was appointed Acting Curator of the Museum.

Four museum bulletins, one special contribution, and one report on the Canadian Expedition 1913-18 were published. Thirty-seven papers and articles prepared by members of the staff appeared in the press, and four books were published. One hundred and seventy-five addresses and lectures were delivered over the radio and before educational and other organizations, of which one hundred and thirty-nine were given in the lecture series at Laval and Montreal Universities.

The Museum was visited by 197,209 persons, and films and slides loaned for educational purposes were viewed by a reported 67,323 persons.

Contributions and other assistance given to the National Museum are gratefully acknowledged.

ANTHROPOLOGICAL DIVISION

C. Marius Barbeau, ethnologist, conducted summer field studies, mostly southwest from Quebec City in the lower St. Lawrence region. He was ably assisted in the field by Professor Luc Lacourcière, l'abbé Félix-Antoine Savard, Miss Madeleine Doyon, Mme. Juliette Caron-Dupont, and Marcel Rioux, all of Laval University. Through Mr. Barbeau's work the already large folk-lore collections of the National Museum were increased by 745 folk-song texts, of which 312 melodies were recorded, bringing the total folk-song collection to 9,370 folk-song texts, of which 5,312 have been recorded with melodies. Also, 80 folk tales and legends, 75 games and roundelays, about 500 rhymes, ditties, and proverbs, more than 800 nicknames or "Blason populaire," about 75 reminiscences and stories, and 450 photographs were added to the collection during the year. Photographic and textual material consisted of information on costume, personalities or characters, recipes and folk remedies, technology, arts and crafts, language, old silver, and parish archives.

Four of his books were published: *Ceinture Fléchée* (Paysana); *Saintes artisanes III, mille petites adresses* (Fides); *Alouette* (Collection Humanitas, Editions Lumen); and *Alaska Beckons* (Caxton in U.S., and Macmillan in

Canada). *Come-a-singing—Canadian folk-songs*, is to appear as a museum bulletin. Two of his books were made ready for publication, namely: *Krieghoff Discovers Canada* (The Art Series, Ryerson Press), and *Sirens of the North*, a companion book to *Alaska Beckons*. Several other manuscripts for books prepared in former years are awaiting their turn at publishers. Among his other contributions to folk-lore was collaboration in the foundation of the Corporation des Folkloristes.

Mr. Barbeau assisted Dr. E. P. Richardson in organizing an important exhibition of Arts of French Canada 1613-1850, which was inaugurated in September 1946 at the Detroit Art Institute. He gave 133 lectures on folk-lore and anthropology at Montreal and Laval Universities, and 14 lectures before other organizations in Canada and in the United States.

Douglas Leechman continued the study of the Cape Dorset Eskimo culture, to which he has devoted several years and which is approaching its final stages. He spent some time in the study of archæological specimens collected in Yukon in 1945 while tracing the old migration routes from Siberia into North America.

On his way to Yukon for a second season he visited museums at Banff, Vancouver, Prince Rupert, and at Juneau, Alaska. He spent 6 weeks in Old Crow, the most northerly settlement in Yukon, collecting archæological and ethnological material. He visited an archæological site and the museum at Fairbanks, Alaska; worked near Whitehorse, and then proceeded to Carcross, Yukon, on his way to Ottawa. In his field work he collected a series of fresh-water shells which with those collected in 1945 have been sent to a specialist for study and report. He made small collections of archæological material from the prehistoric Iroquois site at Roebuck, and from Cobden, Constance Bay, and Tar Island, all in Ontario.

He prepared several papers for publication, including one on Pre-historic Migration Routes. Five folk-tales from the Loucheux, collected at Old Crow during the summer are to be published in the Journal of American Folk-lore.

Gutrun Gjessing, an eminent archæologist from Oslo, Norway, spent several weeks studying the petroglyphs and pictographs recorded in the archæological files of the Museum, and a number of other visitors and scientists made use of the collections of material and information.

List of Accessions

Specimens purchased:

Collection of Prairie and of British Columbia Indian specimens. Three Indian baskets.

Specimens collected:

Archæological specimens from Tar Island, Roebuck, Constance Bay, and Cobden, Ontario; Banff, Alberta; Yukon; and Eagle, Alaska; and ethnological specimens from Yukon, by Douglas Leechman.

Specimens presented:

Series of gold fish-hooks from Colombia, South America, by Hon. Charles Arthur Banks, C.M.G., Victoria, B.C.

Pair of Indian snow-shoes from Moisie, Que., by Walter B. Cole, Ottawa, Ont.

Piece of mineralized bone from Nansen Creek, Yukon, by Karl Paulsen, Carmacks, Yukon.

Small collection of Nascapi Indian specimens, by Richard White, Nain, Labrador.

Eskimo archer's bracer from Pelly Bay, N.W.T., by Miss Margaret Oldenburg, St. Paul, Minn.

Chipped stone specimens from Taye Lake, Yukon, by E. D. Kindle, Ottawa, Ont.

Rubbed slate "ice-chisel" from Luskville, Que., by H. Groh, Ottawa, Ont.

Bow and six arrows from northern British Columbia, by the estate of the late F. Lambert.
Chipped stone point from Legend, Alta., by Mrs. Raymond Kilpatrick, Legend, Alta.
Crude stone hammer from Old Crow, Yukon, by Balaam Jhudi, Old Crow, Yukon.

BIOLOGICAL DIVISION

A bird and mammal survey was conducted during the summer in Lake St. John area, Quebec, under the leadership of A. L. Wilk, who collected many valuable specimens, especially of birds. Intermittent field work was carried on locally by the staff, and six volunteer collectors were supplied with traps and miscellaneous equipment. A total of 116 specimens were received from these collectors.

Many requests from the public for identification of specimens and information on various aspects of natural history were answered, and a comprehensive survey of game and fur animals was made for the National Parks Bureau. Loans of specimens and specially prepared habitat groups of the more common mammals and birds were continued to educational institutions as a direct aid to the furtherance and understanding of natural history.

Excellent progress was made in exhibition work by the construction of one subjective idea group panel, and of one minature and three large display booths. The minature depicts a red fox group in natural environment, and the subjective idea panel, "Birds are Solar Machines," demonstrates the dependency of plant and animal life on sun and earth. Both these groups are on exhibit in the Museum. Progress was made in the preparation of a larger booth depicting Canadian Beaver in appropriate setting.

A. L. Rand completed "Some Canadian Fur Bearers"; "The 1945 status of the Pronghorn Antelope, *Antilocapra americana* (Ord), in Canada"; and "List of Yukon Birds and Those of the Canol Road," which were published. He completed "The Mammals of Alberta", which was submitted for publication, and prepared a report on the mammals of central Manitoba, and one on the status of Canadian mammals for publication. The manuscripts of "Synopsis of Canadian Mammals" and of "The Birds of Southern Alberta" were nearing completion. He investigated various taxonomic problems and reported the results of several of these in short articles awaiting publication. He spent 2 days at the Redpath Museum in Montreal surveying the bird collections and prepared a report on the survey for McGill University.

C. L. Patch completed renovating the collection of large skins and rearranging the skulls and liquid-preserved specimens in storage in the basement. He planned and supervised the construction of the four cases for display habitat groups, conducted field work for additional material for the beaver group, and supervised the installation of the groups under way.

C. E. Johnson prepared many line and colour illustrations for the publication "Mammals of Alberta" and for the pamphlet on "Some Canadian Fur Bearers". He completed field sketches for the beaver group background, and painted this background in the group.

National Herbarium

A. E. Porsild, Chief Botanist, was engaged chiefly in the preparation of a monograph on the flora of southeastern Yukon. He continued the botanical survey of Banff National Park commenced the previous year. His field work resulted in a collection of 6,000 plant specimens, numerous ecological and taxonomical notes, and colour photographs.

Herbarium specimens received by exchange totalled 5,089 and by donation 1,038; 1,570 specimens were loaned and 287 borrowed from other herbaria. About 5,000 plants were named. At the end of the fiscal year the number of filed specimens in the National Herbarium amounted to 181,266. Notable accessions by exchange include Nos. 1001 to 2081 *"Plantae Finlandiae Exsiccatae"*, of which Nos. 1 to 1000 were previously received; and Century xiv of the *"Plantae Exsiccatae Grayanae"*. Notable accessions from private sources include a gift of 226 plants from W. H. Bryenton, Edmonton, Alberta, collected in northern Manitoba.

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

Banfield, Frank, Aklavik, N.W.T.	14
Bryenton, Island Lake, Sask.	62
Curtiss, M. W., Beckett's Landing, Ont.	1
Dunbar, M. J., McGill University, Montreal, Que.	29
Edwards, R. L., Hamilton, N.Y.	8
Fraser, F., Ottawa, Ont.	1
Heaslip, O. E., Wasagaming, Man.	1
Hirtle, F. C., Fredericton, N. B.	1
Jamesson, E. W., Ithaca, N.Y.	1
Johnson, Revell, Ottawa, Ont.	1
Manning, T. H., Ottawa, Ont.	1
Martell, E. R., Fallowfield, Indiana	2
Norris-Elye, Oliver, Winnipeg, Man.	11
National Parks, Banff, Alta.	4
National Parks, Jasper, Alta.	3
National Parks, Waterton, Alta.	3
Outhet, R. A., Mt. Tremblant, Que.	2
Richardson, Wm., South March, Ont.	1
Windsor, J., Ottawa, Ont.	4

Birds

Bourguignon, A. E., Britannia, Ont.	3
Burling, L. D., Ottawa, Ont.	1
Cameron, A. W., Amyot Lake, Sask.	8
Chisholm, Mr., Westboro, Ont.	1
Curtiss, Mr., Ottawa, Ont.	1
DeLury, Dr., Ottawa, Ont.	1
Endstone, Mr., Ottawa, Ont.	1
Fairbairn, H., Wakefield, Que.	1
Findlay, G. E., Carleton Place, Ont.	1
Glenny, Fred H., Blue Sea Lake, Que.	1
Groves, J. W., Billings Bridge, Ont.	1
Hendrick, E., Miss, Lanark, Ont.	1
Hewitt, O. H., Ottawa, Ont.	3
Lang, A. H., near Entrance, Alta.	1
Mark, James, Eastmain, Que.	1
Manning, T. H., Ottawa, Ont.	28
MacLennan, F., Sheldon Lake, southern Yukon	1
Munro, J. A., Okanagan Landing, B.C.	1
Nixon, Marion, Mrs., Bank End, Sask.	1
Ommanney, G. G., Hudson Heights, Que.	1
Proulx, E., Ottawa, Ont.	1
Stalford, K., Ottawa, Ont.	1
Stewart, Ronald M., Massett, B.C.	1
Royal Ontario Museum, Toronto	6
Taverner, P. A., Ottawa, Ont.	2
Watkins, H. B., near MacLeod, Alta.	1
Weir, B., Miss, Ottawa, Ont.	1

Amphibians and Reptiles

Bidwell, Roger, Halifax, N.S.	6
Daly, W. P., Gauvreau Lake, Que.	1
Hall, C. E., Iron Hill and Knowlton, Que.	3
Hunter, Robert, High Lake, Man.	1
Johnson, Revell, Danford Lake, Que.	2
Lee, H. R., Chelsea, Que.	1
Orkin, P. A., Roberval, Que.	1
Ramsey, R., Aylmer, Que.	1
Rosewarne, P. V., Ottawa, Ont.	1

Plants

Brenckle, J. F., Mellette, S. Dakota, *Polygonum* (exchange)	43
Bryenton, W. H., Edmonton, plants from northern Manitoba (donation)	226
Eyerdam, W., Seattle, Wash., plants from Alaska (exchange)	176
Gray Herbarium, Harvard University, *Exsiccatae Grayanae* and plants from Alaska (exchange)	243
Garton, C. E., Port Arthur, Ont., plants from Lake Superior (donation)	221
Heimburger, C. H., Toronto, Ont., misc. woody plants (donation)	50
Helsinki Botanical Museum, University of Helsinki, Finland, *Pl. Finlandae Exsiccatae* (exchange)	1,081
Iowa State College, Ames, Iowa (J. P. Anderson), plants from Yukon and Alaska (exchange)	254
LeGallo, Rev. Father, St. Pierre and Miquelon, plants from St. Pierre (donation)	14
LePage, E., Rev. Father, Rimouski, Que., plants from James Bay (donation)	291
Lloyd, H., Ottawa, misc. plants from Ontario (donation)	97
New York Botanical Garden, Bronx Park, New York, misc. plants from Nevada (exchange)	388
National Museum, Stockholm, Sweden, Scandinavian plants (exchange)	1,621
Oka Agricultural College, Oka, Que. (Rev. Father Louis-Marie) (exchange)	254
Porsild, R. T., Whitehorse, Yukon, plants of Yukon (donation)	20
Turner, Geo. H., Fort Saskatchewan, Alta., plants of Alberta (donation)	68
U.S. National Herbarium, Washington, D.C., misc. plants (exchange)	380
University of Washington, Pullman, Wash., Rocky Mts. plants (exchange)	696

EDUCATIONAL WORK

The educational activities of the National Museum were maintained at a high level and every effort was made to permit students and others to make full use of the material in the sections of the exhibition halls open to the public. Steps were taken toward the reorganizing of the halls that were closed during the war. Special educational exhibits, mostly on nature study, were arranged by the scientific staff for organized study groups, one of which had an attendance of approximately 6,200. The exhibition halls were visited by 154,531 persons, including teachers, students, and others. Additional Museum activities were attended by 42,678 persons, making a total attendance of 197,209.

Much 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. Visual aids have become a regular part of the teaching system, and authentic information on these subjects was provided by means of motion pictures and lantern slides, which were lent to Canadian educational institutions and museums free of charge, except for cost of transportation one way. Replacements were made of those 16 mm. prints in the film loan library that were too worn for further use, and seven new films were added to the Museum library. Museum slides and films were viewed by 67,323 persons. This is not a complete record as many borrowers fail to report attendances.

The library contains a large collection of photographs on such subjects as geology, palæontology, physiography and topography, natural history, and Indian and Eskimo life, taken by officers of the National Museum and Geological Survey. Selections were made from this collection to meet the large

number of requests for photographs to illustrate scientific journals, textbooks, and magazine and newspaper articles published in Canada, England, and the United States. The staff devoted much time to the identification of specimens and to the loan of natural history specimens.

GEOLOGY AND MINERALOGY (Geological Survey)

The mineral exhibit is arranged on the mezzanine floor 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. There was an increase in the number of requests received from the western provinces for specimens and collections of minerals and rocks, especially for those available as prospectors' sets. In all, 1,625 mineral and rock collections, comprising 56,905 specimens, were prepared and distributed to the public.

PALÆONTOLOGY (Geological Survey)

Lack of exhibition space does not permit a complete exhibit of fossil specimens. In the Vertebrate Hall western Canada is represented by dinosaurs and other vertebrate remains; central Canada, mainly by fish remains, and the Maritime section is represented by a fossil forest from the coalfields.

NATIONAL MUSEUM LECTURES

The National Museum presented its 35th anniversary series of children's lectures, and its 25th anniversary series of adult lectures. Thirty-five years ago a small group of children gathered on the top floor of the National Museum to hear the first museum lecture given in Canada. Out of these Saturday morning lectures grew the Wednesday evening series for adults. The two series, which continue to grow in popularity and to attract capacity audiences, are 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 anniversary series was made up of twenty-eight programs on Saturday mornings for children and thirteen on Wednesday evenings for adults. In 1946-47 a special series designed to appeal to the junior audiences was arranged, with a resultant sustained increase in interest and attendance. The program of the 1946-47 series follows:

Wednesday evening series for adults:

Giants of the Past, by C. M. Sternberg, Geological Survey, Department of Mines and Resources, Ottawa.

Britain Today, by Sir Alexander Clutterbuck, K.C.M.G., M.C., High Commissioner, United Kingdom and Northern Ireland, Ottawa.

Java-Bali Report (motion picture). The program introduced by A. L. Rand, Ph.D., National Museum of Canada, Ottawa.

Food from Afar, by W. H. Cook, Ph.D., National Research Council, Ottawa.

Europe's First Civic Centre, by Professor Homer A. Thompson, Department of Art and Archæology, University of Toronto, Toronto, Ont.

Dark Rapture (motion picture).

Quebec, Yesterday and Today, by J. M. Humphrey, Travelogue Lecturer, Vancouver.

Away down South in Canada, by F. C. Nunnick, Director, Publicity and Extension Division, Department of Agriculture, Ottawa.

The Grand Canyon of the Colorado, by F. J. Alcock, Ph.D., Geological Survey, Department of Mines and Resources, Ottawa.

The Beginning of History, by James A. Gibson, Department of External Affairs, Ottawa.

Montreal Botanical Garden, by Jacques Rousseau, Ph.D., Director, Montreal Botanical Garden, Montreal.

Glimpses of India Today, by T. L. Tanton, Ph.D., Geological Survey, Department of Mines and Resources, Ottawa.

British West Africa, by Sir Andrew Jones, C.M.G., United Kingdom Food Mission, Ottawa.

The Saturday morning series for children:
Africa Speaks (motion picture).
Giants of the Past, by C. M. Sternberg, Geological Survey, Department of Mines and Resources, Ottawa.
Itchy Scratchy, etc. (motion pictures).
Adventures with Bird Clubs in Winter, by Dr. O. H. Hewitt, National Parks Bureau, Ottawa.
How to be Kind to your Pets, by Dr. R. C. S. Radmore, Ottawa.
Realm of the Wild, etc. (motion pictures).
A Visit to Eskimo Land, by Douglas Leechman, Ph.D., National Museum of Canada.
Around the World through the South Seas, by Alan Ewart, Ottawa.
The Grand Canyon of the Colorado, by F. J. Alcock, Ph.D., Geological Survey, Department of Mines and Resources, Ottawa.
Track! Track! (motion pictures).
Tracking Animals, by F. C. Zufeldt, Ottawa Public Schools, Ottawa.
A Visit to India, by T. L. Tanton, Ph.D., Geological Survey, Department of Mines and Resources, Ottawa.
Treasure Island, etc. (motion pictures).
The Bear and Its Relatives, by Dr. A. L. Rand, National Museum of Canada, Ottawa.

The total attendance at all the lectures and motion picture programs was 15,200 school children and 7,600 adults.

Members of the Canadian Boy Scouts Association (Ottawa Branch) acted as ushers 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 National Film Board and the National Film Society for assistance in obtaining suitable motion pictures, and of the local newspapers for reports of the various lectures, as well as of the Ottawa Public Library in selecting and providing lists of books related to lecture subjects on Museum programs. Copies of these lists were made available at the Museum to all who were interested in supplementary reading. Thanks are due also to the United States National Parks Service for the loan of lantern slides.

LECTURE HALL

The Lecture Hall was made available to scientific, educational, and government organizations, and 137 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 42,678 at the various meetings, and approximately 400,000 feet of film and 1,995 lantern slides were shown.

Organizations accommodated included:

Royal Astronomical Society
Canadian Geographical Society
Canadian Institute of Mining and Metallurgy
Engineering Institute of Canada.

BUREAU OF MINES

The year under review was a transitional period for the Bureau in which its activities were readjusted to assist the industries it serves in becoming successfully established on a peace-time basis. As is evident from the accounts of activities given under the headings of its four Divisions, much was accomplished in this direction. Problems on the treatment of metallic ores were worked out, making it possible for the companies concerned to proceed with the design of efficient flow-sheets for their milling plants. Valuable assistance was given toward the development of uses for certain recently disclosed industrial minerals raw materials. Extensive investigations were made on Canadian

fuels, directed mainly toward the wider and more efficient use of these fuels. Numerous economic surveys were made in reference to various phases of mineral development in Canada, partly for use of the Government, and partly as a means of assisting industry. Large and small mining and metallurgical enterprises made use of the facilities of the Bureau, but the service was perhaps of special benefit to the smaller enterprises, which in most cases are unable to maintain facilities of their own.

Based on the experience of the war years, and in line with what has long been the desire of the Bureau, increasing emphasis was given to research projects as distinct from the test and investigative work designed for immediate or near future application in industry. Owing to the urgency of work on the latter it was difficult in the past to maintain a proper balance between the two fields of endeavour. Considerable difficulty continued to be experienced in obtaining suitably qualified personnel for this research work owing to the competition from industry, but the metallurgists and engineers who joined the staff of the Bureau during the fiscal year are proving to be highly capable.

The increased attention to research work pertains to all Divisions of the Bureau, but more especially, during the fiscal year, to the work in physical metallurgy. This work has been a function of the Bureau since its establishment in 1907, but it was of only minor importance until the war, when it became a major activity and led to the erection of the new Physical Metallurgy Research Laboratories on Booth Street, Ottawa. To maintain the desired close co-operation between the Bureau and industry, many of the major investigations in physical metallurgy are conducted in conjunction with such organizations as the American Foundrymen's Association, the American Society for Testing Metals, the Canadian Welding Society, the Steel Castings Institute of Canada, and the Magnesium Association. Committees of these associations serve in an advisory capacity as to what projects should be undertaken, and the knowledge gained as work on the projects progresses is passed on to the industries concerned. Membership of the committees include senior metallurgists of the Bureau. As this work on the present scale is a comparatively new field of endeavour for the Bureau, attention is specially directed to the more detailed account of activities elsewhere.

Certain of the major projects in physical metallurgy are undertaken in conjunction with the National Research Council, the most important being studies on the development of better heat-resisting alloys for use in jet propulsion. Quite apart from these is the work of the Bureau in co-operation with the National Research Council under the Atomic Energy Control Board. In general, this comprises (a) a long-term research program in reference to the Chalk River Development, in which work research is undertaken on materials of construction at Chalk River and on the development of special purpose alloys, and advice is given on the fabrication of certain metal components; and (b) metallurgical work on radio-active ores. The excellent co-operation received from the President of the National Research Council and from the Directors of its Divisions in these joint projects deserves special mention.

Events during the year emphasized the importance of fuel research and the risk of too great reliance on imports of fuels. It became increasingly apparent that research on Canadian fuels must be continued in order to safeguard industry against any lengthy cessation of imports. The war interfered to a great extent with the program of fuel research, and members of the staff were seconded to other Government departments in connection with special war duties, and to Boards and Commissions such as the Royal Commission on Coal. A start was made during the year to fill the vacancies on the staff of the Fuel Research Laboratories to enable the continuance of programs started prior to the war. These programs comprise field and laboratory surveys on Canadian

fuels, including testing of coals, peat, petroleum oils, and natural gas samples collected by field parties; large laboratory-scale (plant engineering) testing for the industrial evaluation of Canada's fuel resources; tests in commercial plants of the coal mining, by-product coke and gas, and petroleum oil refining industries; fundamental research on coal, oil, and gas products; and under consideration, pilot-plant establishments for conducting semi-commercial scale tests in confirmation of results obtained on the large laboratory scale. Preliminary plans were made during the year for a large laboratory-scale high-pressure apparatus to make hydrogenation tests of pressures up to 20,000 pounds, chiefly on bitumen and heavy petroleum oils.

The increasing need for a comparatively accurate appraisal of Canada's mineral resources led to the setting up of a Mineral Inventory to compile an index of all known occurrences of metallic and industrial minerals as the first step in determining the extent of Canada's mineral resources. Close co-operation is maintained with provincial governments and with industry so as to make the index as nearly complete and accurate as possible.

Field and investigative work on industrial waters, which was greatly curtailed during the war, was actively resumed and a mobile laboratory was fitted out to permit the making of various determinations on water samples as collected. Investigations were undertaken to develop uses for recently discovered sources of industrial mineral raw materials, particularly magnesium oxychloride and magnesium oxysulphate cements for flooring materials and as bond in new products being developed.

As noted elsewhere, a revision in the Explosives Act was made necessary by administrative changes in the Department of Mines and Resources, and as a result of experience gained in the administration of the old Act. This revision will require more inspectional work, but will place all premises from which high explosives are sold under the direct supervision of the Bureau of Mines.

Several administrative and other staff changes were made. C. S. Parsons, who had been Chief of the Metallic Minerals Division since 1936, was appointed Chief of the Bureau of Mines. R. J. Traill was appointed as Chief of the Mineral Dressing and Metallurgy Division, a tentative reorganization of the Metallic Minerals Division. G. C. Monture, who had been Chief of the Economics Division, was appointed Chief of the enlarged Mineral Resources Division, of which the former Economics Division forms a part, as does the former Industrial Minerals Division. B. F. Haanel, who was Chief of the Division of Fuels and of its predecessor, the Division of Fuels and Fuel Testing, since April 1, 1909, retired on superannuation, February 2, 1947, and was succeeded to that position by R. E. Gilmore, formerly senior engineer of the Division.

MINERAL RESOURCES DIVISION

This Division comprises two main sections, the Industrial Minerals Section, and the Economics Section, consolidating the two former Industrial Minerals and the Economics Divisions. The Library of the Bureau is attached to the Division for administrative purposes.

The Division acts as a central clearing-house for all information pertaining to mineral resources and their economic development and use. Basic to this important function, as well as to the effective carrying-on of the economic and technical investigatory work of the Division, is the continuous work of assembling, correlating, tabulating, recording, and indexing current mineral and allied information from all available sources for addition to the already large pool of such data has been accumulated over many years. Of special interest in that connection was the progress made in obtaining the co-operation of provincial departments of mines and of mining associations in organizing the

collection and compilation of data for a comprehensive inventory of the mineral resources of Canada, correlating for each known mineral deposit all significant data pertaining to discovery, exploration, and past, present, and possible future development. This information is applied to practical service by means of special reports prepared for distribution to the industry, of articles prepared for publication, and of economic and other studies and investigations undertaken as required by the Government in dealing with problems of mineral interest, and by replies to inquiries by correspondence and personal call. The post-war revival in mining interest in Canada was reflected in a substantial increase, to about 2,000, in the number of requests so received by letter, and by personal call, during the year from prospectors, mining and allied operators, and others for information pertaining to Canada's mineral resources, mine development problems, mining laws and regulations, markets for minerals and mineral products, etc., and notably with reference to the industrial minerals.

Increased calls were made upon officers of the Division to serve upon various interdepartmental committees by reason of their technical and special knowledge pertaining to national and international mineral problems.

A senior officer of the Division continued on assignment to the Director's Office, on the administration of specially assisted mineral projects undertaken during the war. Two valued members of the staff were lost during the year, one by the death of Wilfrid J. Flood, senior map draughtsman, who had been on loan to the National Research Council and who was not only an outstanding draughtsman but an artist of recognized merit; and the other by the retirement prior to superannuation of Thomas C. Madgwick, senior investigator, with long experience in the field of petroleum resources.

Industrial Minerals Section

This Section is concerned primarily with the occurrence, processing, and utilization of industrial minerals and their products, with rare minerals, and with certain strategic minerals such as cobalt, molybdenite, manganese, and tungsten. With the rapid growth of industrialism in Canada, the resources of industrial minerals that are so widely utilized by modern industry are playing an increasingly important rôle in the national economy, and the scope of activities of the Section is steadily widening.

The staff of the Section was increased by three engineers. One of these, who had previous experience as a specialist in the treatment and utilization of industrial waters, was placed in charge of the survey of the industrial waters of Canada, and a full program of activities was mapped out for the coming season. A mobile laboratory was fitted out to permit of making various determinations on water samples as soon as collected. Arrangements were made with the Dominion Water and Power Bureau and with private companies for the regular collection, and despatch to the Division, of samples of water from various places on the Ottawa, Gatineau, and Lièvre Rivers. Visits were made to various industries using large quantities of water in their processes, and problems in connection with water treatment and supply were discussed.

At the request of the Surveys and Engineering Branch of this Department, an engineer of the Section investigated road materials along the Alaska Highway in the Fort Smith area, and a report on this investigation was prepared.

Field investigations were made into the occurrence and utilization of salt, sodium sulphate, granite, clay, gypsum, silica, and potash minerals in western Canada, with particular attention to the recent discoveries of potash and rock salt underlying the Great Plains. Thick beds of salt were encountered in seventeen deep wells drilled in a search for oil in Alberta and Saskatchewan from Elk Point in east central Alberta to Radville in southern Saskatchewan. Although the information so far available is not sufficient to determine whether the salt

beds are continuous over this entire area, it is evident that a vast quantity of salt is present. Plans were under way for the building of salt plants near Unity, Saskatchewan, and Lindbergh, Alberta, to utilize these resources.

Associated with the salt in some areas are important beds of potash minerals and this discovery was also being actively investigated to determine the possibility of Canada becoming self sufficient in this essential fertilizer material.

In eastern Canada, field work was done on deposits of limestone, marble, gypsum, anhydrite, silica, clay, marl, beryl, calcite, feldspar, fluorspar, graphite, mica, nepheline syenite, radio-active minerals, talc, soapstone, industrial waters, diatomite, cobalt, molybdenite, slate, garnet, rock-wool materials, diopside, serpentine, brucite, and asbestos. In this field work particular attention was devoted to the examination of possible sources of beryl and radio-active minerals required in the development of atomic energy; to deposits of anhydrite which, though hitherto of little economic importance, are being considered as promising sources of sulphuric acid and other sulphur compounds for industrial use; and to the examination of deposits of raw materials for the making of rock wool, which industry is rapidly expanding in eastern Canada.

Special studies were made of raw materials and plant operations of a number of industrial companies that had applied for assistance in overcoming problems in the processing and utilization of various non-metallic minerals. Co-operation was also given to provincial government organizations in making studies of the possibilities of utilizing various undeveloped mineral resources.

An engineer of the Section represented the Department of Mines and Resources at the Second Pan-American Congress of Mining Engineering and Geology held in Brazil in October, 1946.

In co-operation with provincial authorities and the National Research Council an investigation was made into the mechanics of destructive mud slides at Beattie Gold Mines (Quebec), Limited, Duparquet, Quebec.

Laboratory investigations were made on rock wool, magnesia, brucite, diopside, lime, amphibole asbestos, mineral fillers, slate, corundum, cobalt, diatomite, garnet, gypsum, barite, clay, granite, and marble. As an outcome of the investigation into rock-wool materials, certain silicate rocks such as diopside and syenite, not hitherto used, were found to yield a superior type of rock wool and preparations were being made by several plants to utilize these materials.

Investigations were made into the possibilities of using slags available in various parts of Canada for the manufacture of rock wool.

Laboratory work on magnesia consisted chiefly of a detailed investigation of the magnesium oxychloride and magnesium oxysulphate reactions, to determine the suitability of Canadian brucite magnesia for use in oxychloride and oxysulphate cements. Exhaustive tests proved that the magnesia as produced was suitable for oxysulphate cements, and with slight modifications was suitable for oxychloride cement. Formulas for various products were worked out using such Canadian raw materials as are available.

Work was continued with the object of improving the process of producing magnesia and lime from brucitic limestone, with emphasis on the production of a pure grade of magnesia from a siliceous brucitic limestone. A method of lowering the lime content of the magnesia produced was successful and was recommended to the producing company, who put it into use.

Revision was made of the report "Industrial Waters of Canada," previously issued as Bureau of Mines Report No. 807, and the enlarged and revised report was forwarded for printing.

A report was prepared on the suitability of mine waste and mill tailings of northeastern Ontario for road materials, and revision was made of a report on the gravels of southwestern Ontario, and on the road materials in the counties of Renfrew, Hastings, Haliburton, Nipissing, and Muskoka, in Ontario.

Brief special reports were made on uranium and thorium minerals.

Annual reviews of thirty-eight minerals and mineral products in Canada were prepared for inclusion in "The Canadian Mineral Industry in 1945".

Abstracts of all German-owned patents at the Canadian Patent Office were examined, and those concerning industrial minerals and their products were noted and listed for reference. A report was made indicating which Canadian companies might be interested in the various patents.

A report, "Clays and Shales of Prince Edward Island" was compiled from information on file in the Division, and was issued as Memorandum Series Report No. 91.

Five technical papers were presented before technical societies.

A great deal of the work of the Section consisted in answering inquiries from industries and individuals regarding mineral deposits and supplies of mineral products, and in examining and reporting upon numerous mineral samples submitted for expressions of opinion as to their economic value.

Close contact was maintained with other scientific and industrial research organizations in Canada, and with similar organizations in the British Commonwealth of Nations, the United States, and South America. Members of the Section serve on a number of interdepartmental committees and on commitees of numerous technical and scientific organizations.

Economics Section

This Section is basically concerned with all economic considerations pertaining to the development and conservation of Canada's mineral resources, and more particularly of the metallic 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 one or other of the economic aspects of Canadian mining development.

The year under review was a difficult period for the gold mining industry by reason of inability to rebuild war-depleted working forces to restore production and to reopen closed mines, of increasing costs of supplies and equipment, of the reduced price obtained for gold resulting from the restoration of the Canadian dollar to parity of United States exchange, and, finally, of the necessity in late 1946 to grant substantial wage increases. Accordingly, special attention was given to the making of studies and the preparation of data for the information of Government in considering policies designed to assist in the rehabilitation of the industry. In addition, a study was made on Canadian gold mining in the national economy.

Studies were made on the silver situation in Canada; the magnetite deposits of eastern Ontario; the zinc deposits of the Grenville formation of Ontario and Quebec; and of available information on the iron ore discoveries on the Quebec-Labrador boundary.

The preparation of the annual reviews of Canadian minerals for 1945 was completed with the assistance of the engineers of the Bureau, and these reviews were made available for distribution in mimeographed form. They were also prepared for publication as Report No. 820, "The Canadian Mineral Industry for 1945". These reviews deal with minerals; reviewing briefly in each case the noteworthy developments for the year. Substantial progress was made in the preparation of manuscript of the fifth edition of "The Mineral Industries of

Canada". This report is designed to present for each mineral produced in Canada a concise statement on Canadian resources and their development, that each successive annual review for the mineral will supplement and bring to date.

Increased attention was given to mining taxation matters, in the preparation of the submissions on behalf of the Department for implementation of its undertakings to co-operate with the Department of National Revenue in the administration of tax legislation granting special tax concessions on mining operations, including the legislation which authorizes three years' exemption from income and excess profits taxes to new mines satisfying certain conditions; also with the Department of Finance in matters pertaining to tax legislation which affects mine and oil operators. A senior officer of the Section served on the Business Classification Committee, Excess Profits Tax Act, which advises the Minister of National Revenue on applications for reference to the Board of Referees for revision of Standard Profits on the basis that a substantial change has taken place in the class of business carried on.

Submissions were prepared, with the assistance of the Chief Geologist, for the Minister's consideration in dealing with five applications received under Section 8 (10), Income War Tax Act, authorizing special tax deductions in respect of deep test oil wells recommended by the Minister and approved by the Governor in Council.

Prospector's Identification Cards were again issued by the Mines and Geology Branch in 1946, chiefly by the mining recorders across Canada with the co-operation of the provincial departments of mines. the number issued being 1,117, compared with 1,015 in 1945, 922 in 1944, and 790 in 1943. Arrangements for the issuance of these cards, which, through the co-operation of the Wartime Prices and Trade Board, enable their holders to obtain the extra quantities of rationed foods required for prospecting in non-settled areas, were made by the Section, which reviewed and recorded all applications. As rationing of certain foods was being continued into the 1947 prospecting season, arrangements were made for another issuance of these cards.

Publications

Revised lists, including: Coal Mines in Canada; Milling Plants in Canada, Part I, Metallic Minerals; Milling Plants in Canada, Part II, Industrial Minerals; and a new list, Manufacturers of Clay Products in Canada, were issued, as was a revised Catalogue of Publications of the Bureau of Mines. Manuscript copy was completed for other lists, including, Cement Plants in Canada; Lime Kilns in Canada; and Stone Operators in Canada.

Library

The Librarian reports the following additions:

Books and pamphlets ordered	258
Bureau of Mines reports added to the circulating division	14
Canadian Government documents—individual issues (by exchange and gift)	1,436
British and Foreign Government documents—individual issues (by exchange and gift)	1,669
Scientific societies' bulletins, proceedings and transactions—individual issues (by exchange and gift)	1,222
Periodicals (other than scientific societies, Canadian, British and Foreign Government documents)—individual issues	2,504
Books and pamphlets by gift	100
Periodicals and annuals subscribed for	227
Annuals and continuations and periodicals (by gift and exchange)	299
Cards added to the catalogue	706
Volumes bound	173
Recorded loans	10,830

MINERAL DRESSING AND METALLURGY DIVISION

Mineral Dressing and Extractive Metallurgy Section

This Section maintains modern laboratory facilities for tests and investigations on all types of Canadian ores.

Thirty-five complete reports of investigations were sent out to the mining companies and syndicates and to others concerned, and fifteen investigations were reported by letter. Much of the work was on ores from gold and base metal prospects throughout Canada. On some of these properties, milling plants with flow-sheets based on the work in the Section had been erected by the end of the fiscal year; and, on others, construction of such plants was under way.

Several companies interested in special new mineral development projects made use of the laboratory facilities to conduct their own investigations in co-operation with engineers of the Division.

The pilot-plant investigation for the purification of rock salt at Malagash, Nova Scotia, was continued. This problem was being jointly studied by the Dominion Department of Fisheries, Malagash Salt Company, and the Bureau of Mines, Ottawa, and the work has indicated that a salt suitable for fisheries purposes can be produced. Before the process can be considered successful, however, several operating difficulties have to be overcome.

Further refinements for plant operation and control were developed in connection with the process devised for the separation and recovery of bismuth from the molybdenite concentrate of a property in western Quebec. The plant has since been producing a high-grade molybdenite concentrate and a readily marketable bismuth concentrate.

Investigations were continued on the supply of raw materials for atomic energy purposes. Operations at Port Radium, Northwest Territories, were studied and plans were formulated in an endeavour to improve recoveries and to simplify the flow-sheet. Progress was made on chemical and radio-metric methods of analysis.

The volume of work in the spectrographic laboratory increased considerably. Development work, standardization of analytical procedures, and investigation of solution methods were continued. Preliminary results of an attempt to apply energy from a pulse transmitter or radar unit as a form of excitation were favourable. A total of 1,611 samples were analysed, 1,030 quantitatively, and 581 qualitatively. This, with the standardization and development work necessary, involved about 6,000 exposures and 34,277 determinations; 12,518 quantitative determinations were made. Further work was done for the Crime Detection Laboratory of the Royal Canadian Mounted Police, and in several instances this contributed materially to the apprehension and conviction of criminals. Expansion of the facilities of the spectrographic laboratory for quantitative analysis is contemplated.

The Mineragraphic Laboratory issued forty-two reports, seven of which were special studies for outside parties. This work involved the examination of 562 polished sections and 9 thin-sections; the taking of 45 photomicrographs; and the making of 439 prints. In addition, 84 polished sections were prepared for mining companies equipped to make their own microscopic studies, and 73 hand-specimens were examined and reported on.

In the Chemical Laboratories, 6,023 samples were received and reported in the calendar year 1946. On these, 25,485 determinations were made, involving approximately 43 different mineral constituents.

	Samples	Determinations	Per cent of samples	Per cent of determinations
Metallic Mill	3,199	9,332	53·11	36·62
Industrial Minerals Division	525	1,511	8·71	5·93
Physical Metallurgy Research Laboratories	1,269	7,636	21·07	29·96
Bureau of Geology and Topography	52	158	0·87	0·62
National Research Council	257	1,162	4·27	4·56
Inspection Board of Canada	1	18	0·15	0·30
Department of National Defence	2	16		
Department of Reconstruction	6	43		
Fuel Testing Laboratories	26	306	0·44	1·20
Water Analysis	209	3,790	3·47	14·87
Miscellaneous	313	1,024	5·19	4·02
Custom Assays	164	489	2·72	1·92
Totals	6,023	25,485	100·00	100·00

Total determinations	25,485		
Total gold assays	2,200	Per cent of determinations	8·63
Total silver assays	1,615	Per cent of determinations	6·34

List of Mineral Dressing Investigations Reported Upon

1984. Analysis, examination and cyanide tests on gold ore from the Upper Canada Mines, Limited, Dobie, Ontario. (January 8, 1946.)

1987. Concentration tests on samples of lead-zinc ore from Comara Mining and Milling Company, Limited, at Ferguson, British Columbia. (January 15, 1946.)

1989. Report on jigging tests performed on minus 1½-inch fluorspar fines from the Millwood Fluorspar Mines, Limited, Madoc, Ontario. (February 2, 1946.)

1992. Final report on the concentration of barytes tailings from Canadian Industrial Minerals, Limited, Walton, Nova Scotia. (January 22, 1946.)

2008. Amalgamation, flotation, concentration and cyanidation tests on a gold ore from Duvay Gold Mines, Limited, Duverny township, Quebec. (February 26, 1946.)

2018. Laboratory tests on the recovery of silver in a sample of tailings from former mill operations at Cobalt, submitted by La Rose-Rouyn Mines, Ltd., Toronto, Ontario. (March 20, 1946.)

2020. Pilot-plant investigation on a nepheline syenite rock deposit of the American Nepheline, Ltd., Lakefield, Ontario. (April 1, 1946.)

2021. Investigation of procedures for improving the recoveries of molybdenite and bismuth at the mill of the Molybdenite Corporation of Canada, Limited, La Corne, Quebec. (March 27, 1946.)

2022. Tests on a zinc silicate ore from the "Oxide Group", Ymir, British Columbia. (March 27, 1946.)

2026. Concentration of hematite-taconites from the "Attikamagen" deposit, New Quebec-Labrador district. (April 4, 1946.)

2028. Summary of samples of gold ore and mill tailings from the Sullivan Consolidated Mines, Limited, Sullivan P.O., Abitibi, Quebec. (April 20, 1946.)

2033. Summary of flotation and cyanidation tests on a sample of gold ore from the Louvicourt Goldfield Corporation, Perron, Quebec. (April 17, 1946.)

2038. Amalgamation, flotation and cyanidation tests on a gold ore from Golden Arrow Mines, Limited, Hislop and McCann townships, Ontario. (April 28, 1946.)

2041. Fusion tests on a sample of vacuum pan salt from the Dominion Tar and Chemical Company, Limited, Montreal, Quebec. (April 30, 1946.)

2044. Gravity concentration of uranium ore from Contact Lake, Northwest Territories. (May 3, 1946.)

2046. Laboratory tests on gold ore from the Squall Lake property of Wekusko Consolidated, Limited, in northern Manitoba. (May 2, 1946.)

*1990. Report on the use of Geigér-Muller counters for the determination of uranium in ores. (January 21, 1946.)

2055. Flotation and cyanidation tests on a sample of gold ore from Hasaga Gold Mines, Limited, at Red Lake, Ontario. (May 29, 1946.)

2057. Sink and float tests on a sample of split drill cores from an orebody containing both massive and disseminated pyrite at Noranda Mines, Quebec. (June 10, 1946.)
2068. Summary of flotation tests on samples of sulphide ore from East Sullivan Mines, Limited, Val d'Or, Quebec. (June 18, 1946.)
2075. Summary of amalgamation, flotation, and cyanidation tests on five samples of gold ore from Kenville Gold Mines, Limited, Nelson, British Columbia. (July 9, 1946.)
2077. Concentration tests on a lead-zinc ore from Montbeillard township, Rouyn area, Quebec. (July 16, 1946.)
2078. Summary of experimental test work on Ore Shipment "A" from the Giant Yellowknife Gold Mines Property, at Yellowknife, Northwest Territories. (July 17, 1946.)
2084. Cyanidation and concentration tests on a sample of silver-bearing material from the bed of Cobalt Lake, at Cobalt, Ontario. (July 31, 1946.)
2098. Sinter tests on siderite ore from Algoma Ore Properties, Limited, Helen mine, Ontario. (October 2, 1946.)
2100. Summary of results of flotation pilot-plant operations on Ore Shipment "C" from Giant Yellowknife Gold Mines at Yellowknife, Northwest Territories. (September 3, 1946.)
2101. Sintering Freeman pyrite burner calcines from MacDonald Mines Pyrite. (December 18, 1946.)
2106. Screen analysis of barite ore from Walton, Nova Scotia. (September 10, 1946.)
2107. Some laboratory experiments on the recovery of gold from a high-grade ore from the property of the Gogita Mining Syndicate at Boston Creek, Ontario, with the purpose of outlining profitable operation at a small tonnage. (September 24, 1946.)
2111. Cyanidation and flotation tests on old mill tailings (silver-bearing) from the Miller Lake O'Brien Property, Gowganda, Ontario. (September 28, 1946.)
2122. Summary of results of pilot-plant operations on a shipment of silver ore from the Miller Lake O'Brien Project of Siscoe Gold Mines, Ltd. (October 16, 1946.)
2127. Concentration and cyanidation tests on a shipment of gold ore from Beaulieu Yellowknife Mines, Limited, Yellowknife district, Northwest Territories. (November 14, 1946.)
2137. Laboratory tests on a gold ore submitted by Privateer Mine, Limited, from a group of claims on the west coast of Vancouver Island, B.C. (November 15, 1946.)
2138. Preliminary report on jigging and flotation tests on lead-zinc ore from the Candego Mines, Limited, Marsoui River, Gaspe Nord, Quebec. (November 13, 1946.)
2153. Laboratory experiments on gold recovery from a high-grade ore from the property of Thunderhead Gold Mines, Limited, Thunder Bay district, Ontario. (December 21, 1946.)

Ceramic Section

The Ceramic Section is devoted to the investigation of raw materials suitable for use in the ceramic industries, and to the improving and testing of Canadian ceramic products. Technical assistance is given to industry and to the public through laboratory investigations, plant visits, and through correspondence.

A research laboratory for high-temperature phase equilibrium studies of silicate systems of interest to the ceramic industries was being equipped. Fundamental investigations of this kind are necessary for the advancement of ceramic technology and can be expected to lead to developments of practical value.

The investigations undertaken by the Section are briefly referred to below. In some cases reports were issued, but most of the work was covered by memoranda or letters.

Structural Clay Products

An investigation was made for a brick company in Quebec, to determine the cause of "popping" in its brick. Corrective measures were recommended.

Two reports on structural clay products based on work done prior to the war were prepared for publication.

Clay Testing

The testing of clays submitted by the public or by industry, and the evaluation of their ceramic properties, is one of the major functions of the laboratory. During the year, 95 clay samples were tested: 28 from British Columbia, 2 from Alberta, 9 from Saskatchewan, 19 from Ontario, 10 from Quebec, 11 from New

Brunswick, 6 from Nova Scotia, 6 from Prince Edward Island, and 4 from the United States. Brief reports were issued giving the physical characteristics, firing properties, and the commercial value of the samples.

Special work, including washing and screening tests, was done on a sample of kaolin from Lac Remi, and on a sample of clay from Thirty-one-mile Lake, Quebec; and on china clay samples from Saskatchewan. A low-porosity slip casting body was developed in tests conducted on a clay from Aldershot, Ontario. Work was started on the properties and utilization of a refractory clay from Okanagan Lake, B.C.

Refractories

The investigation of refractories is carried on in co-operation with manufacturers and consumers of refractories.

The use of Nova Scotia quartzite for the manufacture of silica brick was investigated, and a report was issued indicating that satisfactory refractory brick could be made from Yarmouth quartzite. Work on the use of brucite magnesia in refractory brick was continued, to improve their properties and to ensure their further use in the metallurgical industries. Test work on samples of refractory brick and cement was also carried out to assist manufacturers of refractories in keeping the quality of their product up to standard. The installation of an A.S.T.M. panel spalling unit, including two gas-fired kilns and special cooling hoods, was started. When completed, this unit will provide additional equipment necessary for testing and research of refractory brick.

Whitewares, Porcelains, and Glazes

Investigations on the development of a low-firing whiteware body maturing at cone 04, and on a problem concerning a suitable glaze to fit this body, resulted in the establishment of a new pottery industry in Hamilton, Ontario.

A study of rare earth oxide refractory porcelains was commenced in co-operation with The National Research Council.

Miscellaneous Services

Service was rendered to other Government departments and groups. Laboratory tests were made on 59 samples of clay and other materials and technical advice was given on many problems. Petrographic examinations for the identification of rocks and minerals were carried out on many samples.

Investigations Reported

46-1 Investigation of Leitches Creek and Yarmouth quartzites for the manufacture of silica brick; investigation of the physical properties of silica brick made from Leitches Creek, Yarmouth, and Quebec quartzites by the Dominion Steel and Coal Corporation, Limited, Sydney, Nova Scotia. (June 3, 1946.)

Physical Metallurgy Research Laboratories

The use made of these Laboratories, and the volume of work handled by the staff of metallurgists, provide evidence of the increasing awareness of industry to the value of technical guidance in peace-time endeavour. In a broad sense, the aim has been mainly to render a service to Canadian manufacturers of metal products, and to foundrymen, comparable in value to that provided the mining industry by the Bureau's Mineral Dressing Laboratories. The activities and services of the Physical Metallurgy Research Laboratories comprise: fundamental and applied research in the field of physical metallurgy, including studies on physical, mechanical, and chemical properties of metals and alloys, their fabrication techniques, testing methods, and proper applications;

development of fabricating methods of metallic products for special application or for new alloys; testing of metals and alloys and their products submitted for examination of properties, fabricating characteristics, and serviceability, or to establish causes of failure in production or service; advisory and information service for other Government agencies, the Armed Services, and industry; and collecting scientific and technical data on metals and alloys from publications and from information gained from experimental work. Research projects carried out in the Laboratories are sponsored by the Government or by private industrial organizations. Research sponsored by the Government has first call on the staff and facilities. Projects sponsored by industry are undertaken within the limits of staff and facilities available.

By the end of the fiscal year, practically all the equipment had been installed in the Metal Forming Laboratory and its operation awaited the installation of electrical hook-ups. The equipment comprises an outstanding set of modern machinery for almost all phases of plastic deformation of metals, the main items in this assembly being: a rolling mill; a 750-ton horizontal, hydraulic, direct extrusion press; a 25-ton variable speed chain drawing bench; a 500-pound combination drawing bench and wireblock; a 1,500-pound double-frame forging hammer; a 500-pound double-acting universal hydraulic press; oil and electric furnace; and a pickling shop. A miniature model of any industrial metallurgical process can be operated in the Laboratory in order to carry out practical research through pilot-plant operation.

A precision high-temperature creep-testing laboratory consisting of 16 units, designed by the staff, was installed, and by the end of the year had been in successful operation for six months. The equipment will enable the measurement of increments of elongation as small as 0·00002 inch at temperatures as high as 2100° F., and the conditions of testing meet the rigid requirements of British and American standards. Shot-peening equipment of special design was installed and placed in operation. In this apparatus, chilled shot is driven by an air blast against the surface to be peened, work-hardening the surface and inducing residual compressive stresses. The process is known to improve the fatigue resistance of machine components. Other equipment installed included a rotating bending fatigue machine and an X-ray spectrometer. The spectrometer will greatly facilitate quantitative determinations and will make possible the rapid identification of materials. It is suitable for the measurement of thin films on metal surfaces, an important consideration in high-temperature alloy research.

Until the expanded facilities of the Laboratories became available, Canadian foundries had no satisfactory access to technical guidance, as few of the approximately 1,000 plants in Canada are large enough to employ skilled metallurgists. In outline, the aim of the work in the Laboratories is to improve the quality of the castings and reduce the amount of scrap being produced by investigating casting techniques, types of moulding and core sands, and the merits of various core oils. Practically all of the core and moulding sand used in Canadian foundries is imported and much attention was given in the Laboratories, during the year, to the testing of domestic sands. Endeavours were continued also toward finding substitute core oils to replace the expensive oils now in use. Metal penetration or "burn in" is a troublesome problem in the use of steel foundry sand, the results being that the cleaning cost of the casting may be as high as all other production costs combined. At the request of the Steel Castings Institute, an investigation of the problem was undertaken and, by the end of the year, encouraging headway had been made toward solving it.

In co-operation with the National Research Council, a long-term investigation was under way to study the nickel-aluminium-molybdenum, nickel-aluminium-vanadium, and nickel-aluminium-chromium alloy system, the object

being to develop an alloy that will be superior to existing alloys for such applications as blades for gas turbine engines, and jet propulsion. This alloy must be able to withstand deformation at extremely high temperatures. One of the alloys under development gave results comparable with those obtained on the heat-resisting high-temperature alloys, with the advantage of having a density 10 per cent less than alloys so far developed. Many of these alloys are non-machineable, and the principles of the "lost wax" precision casting method are used in the Laboratories for their production. This method has many other applications also.

The study was continued of the behaviour of various steels under dynamic loading to determine the mechanism of fatigue failure in service, the theory of which has yet to be established. Critical failures in air, sea, and land transport are often due to fatigue when either the material or the design is at fault. The object of this research is to contribute toward the better understanding of the nature of fatigue failure, and thus to eliminate many of the difficulties being encountered. Tests were made on a number of typical steels used in Canadian industry.

In co-operation with the National Research Council, the National Bureau of Standards in Washington, and the National Physical Laboratories in England, work was continued on the unification of screw-thread standards. The desirability of a uniform standard was emphasized during the recent war when bolts and nuts for use in American war equipment, for instance, could not be replaced by those of British manufacture because of the difference in pitch and in the number of threads per inch.

Research on the non-ferrous metal alloys was continued on a limited scale, awaiting installation of the aforementioned equipment in the Metal Forming Laboratory. Broadly, this field of endeavour comprises investigations and studies on fabricating, alloying, centrifugal casting, pressure die-casting, and other techniques, with the aim of further developing and improving existing techniques as a service to industry. Research investigations on magnesium alloys were started during the war to aid the war effort, and, after the war, the work was continued to aid industrial reconversion. A special Industrial Advisory Committee on Magnesium Research was set up in 1945 at the Bureau of Mines, comprising representatives of the Armed Forces, and of the Canadian magnesium industry, to discuss research projects and to suggest new investigations on problems encountered in fabrication or service of magnesium alloy products. The Armed Forces requested a broad research program on fabrication problems of magnesium alloys to enable conversion of all defence equipment for airborne operations and service at extremely low temperatures. The program accepted comprised investigation on melting, refining, alloying, sand casting, heat treatment, rolling, extruding, pressing, and finishing of the alloys. Some phases of the program, including work on melting, refining, sand casting and heat treatment were well advanced by the end of the fiscal year.

A study of the effect of various metal additions on the corrosion resistance of magnesium alloys showed that a small proportion of lead increases the resistance of a number of these alloys to marine conditions. A small proportion of silver increases the resistance under high humidity and elevated temperature conditions. The use of various combinations of magnesium, zinc, and aluminium for cathodically protecting domestic hot-water tanks from corrosion was investigated, and conditions under which best protection can be obtained were determined. The cathodic protection of steel from corrosion in sea water was investigated in hope of increasing the life of steel structures, such as ships' hulls

and piling. Methods of electroplating ordinary metals on the more active metals such as magnesium alloys were developed. The effectiveness of paints used for combating corrosion in the mining, metallurgical, and chemical industries was investigated.

The work on extractive metallurgy was limited by lack of equipment. However, with the installation of the equipment on order, it will be possible to investigate a variety of problems relating to the production of such metals as uranium, beryllium, lithium, zirconium, and titanium.

List of Physical Metallurgical Investigations Reported Upon

1991. Research on optimum thread form for proposed Anglo-American-Canadian screw thread. Part I.—Comparison of N.P.L. and P.M.R.L. endurance limit determinations on studs. (In collaboration with N.B.S., N.P.L., and N.R.C.) (January 21, 1946.)
1995. Cathodic corrosion protection of steel by various magnesium alloys in hot waters of different compositions. (Dominion Magnesium, Limited.) (January 28, 1946.)
2002. Research on optimum thread form for proposed Anglo-American-Canadian screw thread. Part II.—Static tension calibration of 20-ton Avery-Schenck Pulsator (Push-Pull) fatigue testing machine. (February 18, 1946.) (In collaboration with N.B.S., N.P.L., and N.R.C.)
2007. Comparison of two moulding sands; factors to consider in purchasing core sand. (Warden King Ltd.) (February 25, 1946.)
2060. Stress analysis with brittle lacquer, performed on a cast magnesium piano plate. Part I.—(Dominion Magnesium, Limited.) (June 5, 1946.)
2082. Metallurgical examination of various steels for dumbell and bushing connectors in dual jungle track. (Army.) (July 24, 1946.)
2103. Metcolizing of Hastalloy B. (National Research Council.) (September 20, 1946.)

List of Research Reports, Physical Metallurgy Research Laboratories

17. Development of slab and billet casting procedures and equipment at the P.M.R.L., Bureau of Mines, Ottawa. (July 25, 1946.)
18. Equipment for experimental work on the casting of aluminium and magnesium alloys in permanent moulds. (July 26, 1946.)
20. Experimental permanent mould casting of aluminium alloys. (August 1, 1946.)
21. Experimental permanent mould casting of magnesium alloys. (August 6, 1946.)
22. Preliminary investigation on the ageing of sand-cast magnesium alloy AZ80X. (August 5, 1946.)
23. Investigation on the effect of calcium additions to magnesium alloy AZ80X. (September 5, 1946.)
24. Cathode corrosion protection of steel afforded by pure aluminium, pure zinc, and 60% Mg-20% Al-20% Zn in hot waters of different compositions. (October 8, 1946.)
25. Electrical measurements in connection with the cathodic protection of steel in hot waters. (October 10, 1946.)
27. Investigation on the effect of calcium additions to magnesium alloy M-1. (October 22, 1946.)
28. Cathodic corrosion protection of steel in hot waters by magnesium, aluminium, zinc, and various combinations of these metals. (December 27, 1946.)
29. Interim report on investigation of experimental permanent mould casting of magnesium alloys. (December 2, 1946.)
30. Electrodeposited metallic coatings on magnesium and its alloys. (December 3, 1946.)

A representative list of the thirty informational memoranda that were prepared and that present abstracts of research information on various projects, follows:

Corrosion-resistant lining for steel tanks containing nickel, acetate, and coal-tar dyes.
Heat-resistant cast irons.
High-speed steel twist drill for drilling austenitic manganese steel.
Measurement of permeability in sand.
Powder weld system.
Use of hard nickel instead of chromium for coating shafts.

During the year, 169 test reports were issued by the Physical Metallurgy Research Laboratories. These cover all routine testing to check quality of materials; and include endurance tests on aircraft control cable, and tensile tests on hundreds of various corrosion-resisting compounds to specification. The following list indicates the variety of materials dealt with:

Broken 7-inch astern manoeuvring valve. (Naval Service.)
Cartridge case that failed on firing. (Inspection Board of Canada.)
Cast steel shoe for dual jungle track. (Army.)
Corrosion resistance of Army clasp knives. (Army.)
Endurance and tensile tests on samples of aircraft cable. (R.C.A.F.)
Examination of steamship tail shaft. (Department of Transport.)
Hardness tests on high-speed steel twist drill. (Inspection Board of Canada.)
Hardness tests on core and case of steel crown gear and pinion. (Inspection Board of Canada.)
Identification of markings on bird band. (National Parks Bureau.)
Investigation of cracking of copper alloy pipe liner. (Forest Products Laboratories—Department of Mines and Resources.)
Metallurgical examination of iron oilite. (Inspection Board of Canada.)
Nature of aluminium alloy sheet. (National Film Board.)
Properties of the corrosion-resisting compound tested to Specification DND 702. (Army.)
Relative machineability of alloys "Nimonic 80", "S-816", and "Inconel 'X' ". (Turbo Research.)

DIVISION OF FUELS

The Division conducts field investigations on Canada's fuel resources, their exploration, development, mining operations, etc., for which work it maintains fuel research laboratories and facilities for investigation and research as will contribute to the more efficient use of the solid, liquid, and gaseous fuels produced or available in Canada, and the extension of markets for the raw fuels and processed products.

The Chief of the Division and senior technical officers, by means of inspection trips, interviews, and correspondence, keep 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 took a prominent part in the activities of the Coal Division of the Canadian Institute of Mining and Metallurgy; of the Coal Committee of the newly formed Research Foundation of Nova Scotia; and of the Mines, Minerals and Metallurgical Research Committee of the Ontario Research Commission. The Division was also represented at Committee meetings of the National Research Council (Petroleum Committee, and Canadian Government Purchasing Standards Committee); Committee D-5 on Coal and Coke of the American Society for Testing Materials; of the Royal Commission on Coal, and of other government organizations on matters relating to testing and research work on Canadian fuels.

As amplified below, the experimental work was continued on a method for separating bitumen from bituminous sand, with and without the use of a small amount of light petroleum oil as diluent, and on laboratory assays of drill core samples from the exploratory drilling of the bituminous sand deposits of Alberta.

The investigation of peat moss was also continued and in July and August the deposits and operating plants at twenty different locations in Quebec and the Maritime Provinces were inspected and samples were collected for examination. A co-operative investigation with the Field Husbandry Division of the Department of Agriculture, Ottawa, for utilizing peat humus for soil improvement was initiated.

As listed below, twenty-one separate F.R.L. (Fuel Research Laboratories) reports on coal investigations were prepared and distributed to interested parties. These comprised fourteen physical and chemical survey reports on coal from different Canadian collieries; two on the quality and briquetting amenability

of coal from Pond Inlet, Baffin Island; two on combustion and coking characteristics, respectively, of coals from the Sydney area, Nova Scotia and Bulkley Valley area, British Columbia; and three reports of field investigations on coal preparation and beneficiation in the United States and Alberta.

"The Analyses Directory of Canadian Coals", containing the analyses of different sizes of coals as prepared for the market at Canadian collieries, was being revised for publication in mimeographed form for a much wider distribution than formerly. Samples of coal sent in regularly by the Departments of Justice (Penitentiaries Branch), Veterans' Affairs, and National Defence, were analysed in reference to their purchase according to specification.

Hydrogenation Investigations

Visits were made to the laboratories that are under the direction of the Office of Synthetic Liquid Fuels (United States). Following these visits, plans were made to continue the study of the technique of hydrogenation, especially as applied to bitumen and heavy crude oils. To permit the use of active catalysts in contact with asphaltic materials it was decided to remodel the hydrogenation laboratory so that higher pressures can be employed. Designs were made for the necessary new equipment. Other studies, related to hydrogenation of bitumen, were concerned with distillation of bitumen under vacuum; estimation of asphaltene content; and the nature of the mineral matter associated with bitumen.

Study of the data on fuel technology that were obtained by investigators who visited Germany in 1945 was continued. A translation and reproductions of drawings were made from a detailed description of the Fischer-Tropsch plant of the Ruhrchemie. Microfilm copies of captured German documents were purchased and a reader for viewing the microfilms was ordered. Copies of the reports of numerous investigating teams were received and some of these were studied in detail.

Assistance was rendered to the Royal Commission on Coal by preparing a submission on synthetic liquid fuels, and later by participating in the preparation of the Report of the Commission.

Pressurized Combustion and Fluidizing Technique

A project was initiated for the study of combustion of pulverized coal under pressure. This work is being done in collaboration with the Locomotive Development Committee of Bituminous Coal Research Incorporated. The immediate objective of this organization is to develop a locomotive powered by a coal-fuel gas turbine, but pressurized combustion, if successful, will probably have a wider application. The other laboratories in the United States that are associated in the project were visited during September and October. It was agreed that the part of the program to be undertaken by the Division of Fuels would be the study of fundamentals of pressurized combustion using a small furnace for experimental work. At the end of the fiscal year, the furnace had been designed and was being fabricated, and the auxiliary equipment had been installed.

An experimental investigation was also initiated of the technique of reacting pulverized solids with gases by passing the gases upwards through a bed of solid particles at such a rate that it is kept in motion, but is not carried out of the reaction vessel. As applied to coal, this technique can be used for carbonization, gasification, partial oxidation, combustion, etc. Preliminary studies were made of the mechanics of fluidizing, and later carbonization and partial oxidation tests were conducted on a series of Canadian coals.

Combustion Engineering Investigations

The services of engineers were again made available to other Government departments, public institutions, industrial firms, and to individuals seeking advice on fuel, heating, and allied problems. Several burning tests were made to evaluate beehive coke in comparison with by-product coke for certain industrial uses; several materials such as pyrex glass, charcoal, peat, and coke were ground and processed to exacting specifications for varied purposes; work on ground and processed peat formerly undertaken for the Department of National Defence was brought to a close; and varied information was supplied to the Technical Information Service of the Department of Reconstruction and Supply throughout the year. The liaison and consultive work on fuel and heating problems undertaken during the war for the Coal Controller, the Fuel Purchasing Section of the Department of Reconstruction and Supply, and the Army and Air Force, was greatly curtailed and largely completed by the end of the year.

Investigative work involving field and laboratory studies included work on smoke abatement; utilization of sawdust in small portable and stationary types of sawmills; and preliminary study of problems facing the small stoker industry. In the last connection, a "Stoker Operation Survey in Relation to Canadian and Imported Coals" was under way in co-operation with the member concerns of the Stoker Institute of Canada.

The routine weather study in regard to the degree-day heating loads 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 to January, 1947, and recently to the Dominion Fuel Board. Inasmuch as the Meteorological Division of the Department of Transport now publishes this data as part of the weather service, future statistical data will be obtained from that source.

Natural Gas, Petroleum Oils, and Bituminous Sand

A field study was made of natural gas resources in western Canada to estimate the possible use of the gas as a raw material for the production of synthetic gasoline and other petroleum products by the modified Fischer-Tropsch process. Much valuable information was obtained from provincial government authorities and officers of companies interested in the production of natural gas. Most of the thirty samples of natural gas collected from twelve fields in southwestern Ontario were analysed for hydrocarbons, sulphur, and other gases.

An investigation was undertaken to obtain comprehensive data on petroleum produced in Canada and elsewhere in order to facilitate the use of these oils in commercial refineries in Canada. As a preliminary, records of previous work were examined and correlated with existing data. Arrangements were made to obtain samples, and studies were made of improved apparatus for doing intensive laboratory work.

A survey of the quality of gasoline being sold in Canada was made, for which over sixty samples representing twenty-nine brands of gasoline were collected from the principal cities. The survey revealed that three definite grades of gasoline are being marketed, the knock ratings of which average 78, 74, and 60 octane numbers. The other characteristics, such as volatility, vapour pressure, and sulphur and gum content, are similar for all three grades, with a slight advantage in volatility in favour of the premium grades. A report has been prepared correlating these results with those obtained during the years 1939 to 1945. The information obtained in this work is of value for specification purposes and as a guide to petroleum refining and hydrogenation investigations.

An investigation of the possibility of separating bitumen from bituminous sand, using water at normal temperatures, showed that bitumen can be separated from the sand with water at a temperature between 50°F. and 90°F., and that better separation occurs at temperatures above 70°F. than below it. A light petroleum distillate was used as a diluent to assist in the separation in an amount equal to 10 per cent of the bitumen present. When all factors are carefully controlled, quite consistent and complete recoveries of bitumen can be made. The presence of clay up to 10 per cent of the charge of bituminous sand does not appear to hinder the separation. Samples of bitumen from different locations and of bitumen from sand containing different percentages of bitumen were found to have substantially the same composition from a refining point of view.

Representatives of the Division of Fuels continued to co-operate with and assist the National Research Council through the Associate Committee on Petroleum, and the subcommittees on specifications of the Canadian Government Purchasing Standards Committee. Considerable time was devoted to furthering the program of research on petroleum in Canadian universities, and in collaboration with the Department of National Defence, on cold-weather operations. An officer of the Division investigated the petroleum supply along the Alaska Highway and made recommendations at the request of the authorities.

Coal Preparation, Storage, Carbonization, and Briquetting

The survey of the coals from Canadian collieries with regard to their physical and chemical properties and beneficiation was continued. Fundamental studies on the characteristics of the coals as mined were completed on samples from various mines in Nova Scotia and Alberta. The coals included coking bituminous coals from the Stellarton area in Pictou county, Nova Scotia, and the Mountain Park, Cadomin, and Highwood areas of Alberta; and non-coking subbituminous coals from the Brooks, Taber, and Drumheller areas of Alberta. In addition, studies of the fundamental properties of a sample of coal from Pond Inlet, Baffin Island, was completed for the Administration of the Northwest Territories; and, as a co-operative investigation, a study of two coals from Ohio was made for the Canadian National Railways. Interim reports on these investigtions were prepared for limited distribution. Mine-run coal samples were collected at several collieries in Saskatchewan, Alberta, and British Columbia, and the study of these was begun during the latter part of the year.

In view of the projected installation of a modern cleaning plant at Stellarton, Nova Scotia, a comprehensive study was completed on the physical and chemical, and washing characteristics of a large sample of coal composited from several seams in the ratio in which they are to be processed.

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

Physical and Chemical Survey Report No. 115 (F.R.L. Report No. 37—R.I.C.S. No. 227): Douglas Seam, Highwood Area, Highwood Coal Mines, Ltd., near Highwood River, Alta.

Physical and Chemical Survey Report No. 116 (F.R.L. Report No. 39—R.I.C.S. No. 228): Connors Seam (No. 4), Highwood Area, Highwood Coal Mines, Ltd., near Highwood River, Alta.

Physical and Chemical Survey Report No. 117 (F.R.L. Report No. 42—R.I.C.S. No. 230): Birnwell Mine, No. 2 Seam, Brooks Area, Birnwell Coal, Ltd., Eyremore, Alta.

Physical and Chemical Survey Report No. 118 (F.R.L. Report No. 43—R.I.C.S. No. 231): Continental Mine, No. 2 Seam, Taber Area, Continental Coal Corp., Ltd., Grassy Lake, Alta.

Physical and Chemical Survey Report No. 119 (F.R.L. Report No. 44—R.I.C.S. No. 232): Murray Mine, No. 2 Seam, Drumheller Area, Murray Collieries, Ltd., East Coulee, Alta.

Physical and Chemical Survey Report No. 120 (F.R.L. Report No. 46—R.I.C.S. No. 234): Brilliant Mine, No. 1 Seam, Drumheller Area, Brilliant Coal Company, Drumheller, Alta.

Physical and Chemical Survey Report No. 121 (F.R.L. Report No. 50—R.I.C.S. No. 236): Newcastle Mine, No. 1 Seam, Drumheller Area, Newcastle Collieries, Ltd., Drumheller, Alta.

Physical and Chemical Survey Report No. 122 (F.R.L. Report No. 51—R.I.C.S. No. 237): Hy-Grade Mine, No. 1 Seam, Drumheller Area, Hy-Grade Coal Mining Co., Ltd., Drumheller, Alta.

Physical and Chemical Survey Report No. 123 (F.R.L. Report No. 53—R.I.C.S. No. 239): Acadia No. 1 Seam, Stellarton Area, Acadia Coal Co., Ltd., Stellarton, N.S.

Physical and Chemical Survey Report No. 124 (F.R.L. Report No. 63—R.I.C.S. No. 246): Luscar No. 2, No. 3, and Burke Mines, Mountain Park Area, Luscar Coal Ltd., Luscar, Alta.

Physical and Chemical Report No. 125 (F.R.L. Report No. 62—R.I.C.S. No. 245): Cadomin Strip Mine, No. 1 Seam, Mountain Park Area, Cadomin Coal Co., Ltd., Cadomin, Alta.

F.R.L. No. 58—R.I.C.S. No. 241: Report on a Study of the Physical and Chemical Characteristics of Coal Occurring at Pond Inlet, Baffin Island, Northwest Territories.

F.R.L. No. 61—R.I.C.S. No. 244: Report on Comparative Study of the Physical and Chemical Characteristics of Washed and Hand Prepared Coal from the Misco Mine, Perry County, Ohio, submitted by the Fuel Department of the Canadian National Railways.

F.R.L. No. 41—R.I.C.S. No. 229: Report on the Washing Characteristics of Coal Mined at the Allan and Albion Collieries by the Acadia Coal Co., Ltd., Stellarton, N.S.

The briquetting study, with a view to the beneficiation of the slack sizes arising during the preparation of subbituminous coals and lignites in Alberta and Saskatchewan, was continued throughout the year. The interim results on this extensive investigation, which included studies on the briquetting of raw coal with various binders, followed in some cases by carbonization, were presented to a meeting of Drumheller Coal Operators. This was reported in F.R.L. No. 55 (C.S.M. No. 36): "Report on an Informal Discussion on Coal Research Problems with Drumheller Operators."

The extensive study made of the briquetting characterstics of the fusain-rich coal at Pond Inlet, Baffin Island, for the Administration of the Northwest Territories, was to determine whether a suitable product that would handle and store well can be produced from this low-rank, readily weathered coal as a substitute for United States anthracite being distributed in the Northwest Territories at a very high price. The reports of these investigations were:

F.R.L. No. 38—C.S.M. No. 33: "Report on the Quality and Briquetting Amenability of Coal from Pond Inlet, Salmon River, Baffin Island, Conducted for the Administration of the Northwest Territories."

F.R.L. No. 64—R.I.C.S. No. 247: "Concluding Report on the Briquetting Amenability of Coal from Pond Inlet, Salmon River, Baffin Island."

The results indicated that satisfactory weatherproof briquettes can be prepared from this coal. The successful application of this method of beneficiation will depend upon the available coal supply, and upon the location and extent of the markets.

The application of new processes for the beneficiation of Canadian coals was studied, and extensive field investigations were conducted in the United States and Canada. Special attention was paid to newly developed or developing methods for the cleaning, carbonization, and briquetting of coal fines. In this regard, the cyclone washer, developed by the Dutch State Mines, appears to offer valuable possibilities, and in order to study its application to Canadian coals, an experimental unit was designed and constructed. The Coal Logs process whereby fines sizes of coal are carbonized on a vibrating metal deck at great speed also appears, if proven commercially successful, to be applicable to the preparation of chars from non-coking Canadian coals. Processes for the preparation of ultra-clean coal were investigated as well as methods for the separation of resins from coal which may be used as substitute in the paint and varnish industry. All the data collected as a result of these field investigations appear in F.R.L. No. 56—R.I.C.S. No. 240 "Report on Field Investigations on Coal Preparation and Processing in Western United States and Canada."

Because of the increasing scarcity of suitable coking coal for the production of gas and coke in West coast centres, a study was made of the coke- and gas-making properties of certain seams in the Telkwa coalfield, the results of which are presented in F.R.L. No. 45—R.I.C.S. No. 233: "Report on the Coke and Gas Making Properties of Coal from the Betty Seam, mined by the Telkoal Co., Ltd., Bulkley Valley Area, British Columbia". They indicate that only the upper section of this seam would be suitable.

A thorough study of the coking, clinkering, and burning properties of the coals from several seams mined in the Sydney area, Nova Scotia, was conducted to determine the relationship of these factors to the suitability of the coals for use in domestic underfeed stokers. This was a continuation of an investigation started several years ago and was conducted in co-operation with Dominion Coal Company, Limited. The results appear in report F.R.L. No. 59—R.I.C.S. No. 242: "Laboratory Study on the Clinkering, Coking and Burning Characteristics of Certain Nova Scotia Coals".

The preparation of processed buckwheat anthracite for use in blower-operated furnaces was continued by dealers in the central Canadian coal market, and certain phases of it were investigated and are reported in F.R.L. No. 40—C.S.M. No. 34: "Field Report on the Use of the Blower Coal Clinkering Process in Ontario and Quebec."

Routine Chemical Laboratory Work

As shown below, 1,505 samples of solid, liquid, and gaseous fuels were analysed, the examination of which involved, roughly, 10,500 separate chemical and physical determinations, mostly in duplicate, of the different items of analysis. The total includes 189 samples of mine air from British Columbia and Alberta, and 250 samples of coal, liquid fuel, and lubricants from the Department of National Defence. During the year, 1,324 samples of drill core from the bituminous sand deposits in Alberta, and 116 samples of bituminous sand relating to separation tests made on the material were also analysed, but are not included in the tabulated data that follow.

Source of Samples		Number of samples	Per cent of total
1. Samples pertaining to investigations of Fuels Division—			
Solid Fuels		723	48·1
Coals	687		
Cokes, peat, briquettes, etc.	36		
Liquid Fuels		80	5·3
Crude oils, gasolines, lubricating oils and hydrogenation products	80		
Gases		13	0·9
Natural gas, manufactured gas and gas from hydrogenation tests	13		
2. Samples from other Divisions of Department of Mines and Resources:—			
Solid, liquid, and gases 11+4+1		16	1·1
3. Samples from other Government departments—			
Department of National Defence—Army, Air, and Navy		250	16·6
Coals, cokes, briquettes, etc.	81		
Gasolines, fuel oils, lubrication oils	169		
Department of Veterans' Affairs		32	2·1
Coals, etc.	32		
Department of Justice (Penitentiaries Branch)		119	7·9
Coals, etc.	119		
Department of Reconstruction and Supply	2	2	0·1
Other Departments, including National Research Council	0+45	45	3·0
4. Provincial governments—mostly mine airs from British Columbia and Alberta	1+196	197	13·1
5. Commercial firms, private individuals and others*		28	1·8
Totals		1,505	100·0

*Includes municipalities and public boards and commissions.

EXPLOSIVES DIVISION

A Bill to revise the Explosives Act, Chapter 62, R.S.C., 1927, was passed by the Senate on April 4, and by the House of Commons on May 20, and received Royal Assent on May 28, 1946. The revision was made necessary by administrative changes in the Department and as a result of experience gained in the administration of the old Act. The significant changes of the new Act affect: sale of explosives; forfeiture of unauthorized explosives; seizure of explosives; destruction of abandoned, or deteriorated explosives; and possession and storage of explosives by government employees.

Regulations made under the new Act were prepared and these were approved by the Governor in Council, P.C. 5115, December 12, 1946. They were published in a supplement to the *Canada Gazette*, December 21, 1946.

The last of the war regulations affecting explosives (P.C. 2903, July 4, 1940, which was passed under the War Measures Act to regulate the possession, use, and sale of explosives) continued in force until December 31, 1946, though its desirable provisions were incorporated in the new regulations. Through the press the public were advised of the lifting of war restrictions on explosives and of the purpose of the new regulations.

The Explosives Act, 1946, requires every vendor of high explosives to be the owner or operator of a licensed factory, licensed magazine, or registered premises. This provision will require more inspection, but will place all premises from which high explosives are sold under the direct supervision of the Division.

With the closing of all but two of the war factories, the Division resumed much of its peace-time work and there was a marked increase in the number of magazine inspections made in 1946. The number of magazine licences in force was the greatest in the history of the Division, as were the explosives importation permits issued. Since the passing of the new regulations many inquiries about, and requests for, certificates and licences were received, as many former vendors propose to resume the sale of explosives.

Officers of the Division continued to serve on the Decontamination Committee of the War Assets Corporation and gave advice and assistance in disposing of surplus military explosives.

In the conversion of "continuing" war plants to a peace-time basis, officers of the Division were called upon to examine plans and to advise the management on matters affecting the application of the Act and Regulations, the safety of the employees, and the security of property.

Laboratory

The Explosives Testing and Research Laboratories, Montreal Road, are maintained jointly by the Division and the National Research Council under an agreement of June 30, 1942.

These laboratories continued to test and examine commercial explosives submitted for authorization. There were large importations of fireworks from United States with a corresponding increase in laboratory testing. Research on the properties of commercial and military explosives was continued by chemists of the Division in collaboration with the staff of the National Research Council, and also independently.

There was a decrease in the number of military explosives received and an increase in commercial explosives and fireworks. During the year, 88 samples were received. These are classified as follows:

Commercial blasting explosives	20
Military explosives	12
Initiators, safety fuse, etc.	3
Commercial pyrotechnics	23
Railway fuses, torpedoes, etc.	17
General	13

Samples comprised both investigational and routine test work and were submitted by or on behalf of the Royal Canadian Mounted Police; Department of National Defence; Post Office Department; National Research Council; and the Inspection Service of the Explosives Division.

Many long-term projects and investigations started during the war were still in progress and will be completed to obtain all necessary data.

Members of the staff attended conferences and meetings dealing with explosives. At a meeting of the Propellants and Explosives Sub-Committee held in Quebec, the Chief Explosives Chemist summarized his recent visit to England and Scotland where he visited munitions and explosives factories. He also gave a series of lectures on "The Legal and Illegal Use of Explosives" to the Canadian Police College at the Royal Canadian Mounted Police Barracks, Rockcliffe.

Magazines

The new Act provides for a type of storage known as "Registered Premises" to accommodate vendors whose sale of explosives is small.

At the end of the fiscal year, 382 permanent licences were in force, an increase of 23 over the previous year; and an increase in temporary licences from 359 to 512 was shown.

From July 4, 1940, when P.C. 2903 came into effect, to the end of 1946, when it was revoked, 135,000 explosives purchase permits were issued. Members of the Royal Canadian Mounted Police, police officers of the provinces and municipalities, and inspectors of provincial departments of mines co-operated in issuing these permits and in enforcing the regulations. Members of the Royal Canadian Mounted Police are also deputy inspectors of explosives and in this capacity gave valuable assistance in the administration of the Explosives Act and Regulations.

Inspections

—	Factories	Magazines	Unlicensed premises
Explosives Division Inspectors	32	376	847
Royal Canadian Mounted Police	.....	346	4,948
Ontario Provincial Police	.....	20	.....

Importation Permits

Imports of fireworks increased considerably. Propellants, nitroglycerine, and detonating fuse were imported, and large quantities of nitrocotton for use in the manufacture of lacquers. During the year, 440 permits and 23 special permits were issued.

Accidents

There was one serious accident in a commercial factory. At the James Island Plant of Canadian Industries, Limited, on September 26, the gelatin cartridging house blew up, killing three men. An investigation failed to determine the cause of the explosion, but probable causes were: impact, the result of dropping a box of powder; foreign material getting into the gelatin; or the wooden spade used for filling the hopper becoming caught in the worm gear. Recommendations were made to correct these possibilities.

A fire in the Hall cartridging machine house of Canadian Industries, Limited, at Belœil, Quebec, destroyed the building and equipment, with a loss estimated at $30,000. No one was injured, and although a large quantity of explosives burned there was no explosion. The accidental introduction of foreign material into the hopper appeared to be the most likely cause.

A number of unusual incidents and minor explosions were reported by other explosives factories and where the cause was determined corrective measures were taken.

During the year 137 accidents in the use and handling of explosives were reported. These resulted in 24 deaths and injuries to 138, and covered such industries as mining, construction, and farming. Playing with detonators, fireworks, and other explosives accounted for nearly a third of the total, children being the chief victims in this type of accident.

The Division is indebted to the provincial departments of mines, Workmen's Compensation Board, Department of Labour, Ottawa, and to several individuals for reports and newspaper clippings on explosives accidents.

——	Accidents	Killed	Injured
Mines and quarries	56	9	52
Elsewhere in industry	31	10	26
Playing with detonators	10	0	10
Playing with other explosives	27	0	36
Miscellaneous	13	5	14
Total	137	24	138

Prosecutions

Proceedings were entered under the Explosives Act with convictions as follows: A construction firm was fined $25 for improper storage of explosives. Two individuals were each fined $10 for improper storage. One man was fined $10 for violation of the Act by his son. One firm was fined $10 for illegal manufacture of toy caps, and the finished stock was confiscated; proceedings were also entered against another firm for a similar offence.

Eleven persons were charged and convicted for infractions of P.C. 2903 (July 4, 1940), which covers illegal possession or sale of explosives. Fines up to $50 were imposed.

Eleven persons charged under P.C. 3561 (April 30, 1942) were fined $50 each, for unlawful possession of matches in explosive plants.

Prosecution of cases involving explosives was also instituted under the Criminal Code, the Railway Act, and the Ontario Mining Act.

Destruction

A considerable quantity of deteriorated explosives was destroyed by inspectors, deputy inspectors, and the manufacturers. Some of this had been left by United States engineers in the Northwest Territories, and the rest was abandoned by mining and construction companies, or was condemned in licensed magazines. The total destroyed amounted to 159,488 pounds of dynamite, 13,936 detonators, 4,904 feet of safety fuse, 3,000 feet of primacord, and 9,346 pounds of T.N.T. Pyrotechnic stores were also destroyed by an officer of the Division for War Assets Corporation.

PUBLICATIONS

Following is a list of publications issued during the fiscal year.

Mines and Geology Branch

English Publication

Separate of Annual Report for the Fiscal year Ended March 31, 1946.

French Translation

Separate of Annual Report for the Fiscal year Ended March 31, 1945.

Geological Survey

English Publications

Report No.

G.S. Bulletin No. 3. *Problems of Sudbury Geology, Ontario,* by H. C. Cooke.

G.S. Bulletin No. 4. *Echinodermata of the Ottawa formation of the Ottawa-St. Lawrence Lowland,* by Alice E. Wilson.

G.S. Bulletin No. 5. *Geology and Mineral Deposits of Northern British Columbia West of the Rocky Mountains*, by J. E. Armstrong.

G.S. Bulletin No. 6. *Gravimetric Surveys of 1944 in New Brunswick*, by A. H. Miller.

G.S. Bulletin No. 7. *Glacial Lake Agassiz with Special Reference to the Mode of Deformation of the Beaches*, by W. A. Johnston.

G.S. Bulletin No. 8. *Brachiopoda of the Ottawa Formation of the Ottawa-St. Lawrence Lowland*, by Alice E. Wilson.

2474 Memoir 241. *Geology of the Ottawa-St. Lawrence Lowland, Ontario and Quebec*, by A. E. Wilson.

2475 Memoir 242. *Cypress Lake Map-area, Saskatchewan*, by G. M. Furnival.

Economic Geology Series 15: *Canadian Lode Gold Areas* (Summary account), by H. C. Cooke.

*46-1 *A Middle Triassic (Anisian) Fauna in Halfway, Sikanni Chief, and Tetsa Valleys, Northeastern B.C.*, by F. H. McLearn.

*46-2 *St. Stephen, N.B.*, by F. J. Alcock. (Map only.)

*46-3 *Honeydale, N.B.*, by F. J. Alcock. (Map only.)

*46-4 *Gregg Lake, Alberta*, by E. J. W. Irish.

*46-5 *Brûlé Map-area, Alberta*, by A. H. Lang.

*46-6 *McConnell Creek, B.C.*, by C. S. Lord.

*46-7 *Salmon Arm, B.C.*, by H. M. A. Rice. (Map only.)

*46-8 *Ashcroft, B.C.*, by S. Duffell and K. C. McTaggart. (Map only.)

*46-9 *Snow Lake and Nor-Acme Mine Area, Manitoba*, by J. M. Harrison. (Map only.)

*46-10 *Callum Creek, Alberta*, by R. J. W. Douglas. (Map only.)

*46-11 *Aiken Lake (South Half), B.C.*, by J. E. Armstrong. (Map only.)

*46-12 *Strait of Canso Map-area, N.S.*, by S. A. Ferguson.

*46-13 *Lacorne Map-area, Abitibi County, Quebec*, by L. P. Tremblay.

*46-14 *Flin Flon-Mandy Area, Manitoba and Saskatchewan*, by C. H. Stockwell. (Two maps and descriptive notes.)

*46-15 *Northwest Bourlamaque, Abitibi County, Quebec*, by G. W. H. Norman. (Map only.)

*46-16 *Northeast Bourlamaque, Abitibi County, Quebec*, by G. W. H. Norman. (Map only.)

*46-17 *Southwest Bourlamaque, Abitibi County, Quebec*, by G. W. H. Norman. (Map only.)

*46-18 *Southeast Bourlamaque, Abitibi County, Quebec*, by G. W. H. Norman. (Map only.)

*46-19 *Tramping Lake (northern part), Manitoba*, by M. S. Stanton. (Map only.)

*46-20 *Pleistocene Deposits and Beaches of Orillia Map-area, Simcoe and Ontario Counties, Ontario*, by R. E. Deane.

*46-21 *Northeast Dubuisson, Abitibi County, Quebec*, by G. W. H. Norman. (Map only.)

*46-22 *Cripple Creek, Alberta*, by O. A. Erdman. (Map and descriptive notes.)

*46-23 *Yellowknife-Beaulieu Region, N.W.T.*, by Y. O. Fortier. (Map only.)

*46-24 *Rottenstone Lake Area, Saskatchewan*, by J. B. Mawdsley.

*46-25 *Upper Triassic Faunas in Halfway, Sikanni Chief, Prophet River Basins, Northeast British Columbia*, by F. H. McLearn.

*46-26 *Morton Lake, Manitoba*, by J. M. Harrison. (Map only.)

*43-7 *Rouyn-Beauchastel, Témiscamingue County, Quebec*, by M. E. Wilson. (Maps only, second edition.)

National Museum of Canada

English Publications

Bulletin 102. *Catalogue of Canadian Recent Mammals*, by R. M. Anderson.

Bulletin 103. *Canadian Dinosaurs*, by C. M. Sternberg.

Bulletin 105. *List of Yukon Birds and Those of the Canol Road*, by A. L. Rand.

Bulletin 106. *The 1945 Status of the Pronghorn Antelope, Antilocapra Americana (Ord.) in Canada*, by A. L. Rand.

Special Contribution 46-1. *Some Canadian Fur Bearers*, by A. L. Rand.

Bureau of Mines

English Publications

811 *Limestones of Canada, Part V—Western Canada*, by M. F. Goudge.

814 *Petroleum Fuels in Canada, Deliveries for Consumption 1940 to 1944*, by J. M. Casey.

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* Indicates a mimeographed report.

~~815~~ *The Canadian Mineral Industry in 1945.*
817 *Peat Moss Deposits in Canada,* by H. A. Leverin.
818 *Catalogue and Index of Bureau of Mines Reports.* (Revised edition.)
822 *Physical Properties of Canadian Structural Tile,* by J. G. Phillips and G. A. Kirkendale.
Folder: *Prospectors' Identification Cards and Application Forms 1947.*
Folder: *Petroleum Fuels in Canada, Deliveries for Consumption, Calendar Year 1945.*
List No. 4–1. *Coal Mines in Canada, 1946.*
List No. 6–3. *Manufacturers of Clay Products in Canada, 1946.*
Memorandum Series No. 90. *The Peat Moss Industry in Canada,* by A. A. Swinnerton.
Memorandum Series No. 91. *Clays and Shales of Prince Edward Island,* by A. R. MacPherson.

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LANDS, PARKS AND FORESTS BRANCH

R. A. GIBSON, DIRECTOR

During the past year, Government expenditures in the Northwest Territories provided substantial evidence of faith in the potentialities of the mining areas of the Mackenzie District, particularly in the field which centres on Yellowknife. Some of the more important projects on which outlays were made included the Grimshaw-Great Slave Lake road; the hydro-electric power development on Snare River and the transmission line to Yellowknife; the improvement of the Yellowknife airport which now provides facilities for the larger type of transport and passenger aircraft; the improvement of roads, the installation of water and sewer services and assistance in the construction of a modern public school and Red Cross hospital in Yellowknife, and the construction of adequate administration buildings at Yellowknife, Fort Smith, and elsewhere.

Although the number of new claims staked in the Yellowknife mining area decreased, more intensive prospecting and actual development were undertaken. Moreover, a great deal of interesting new territory was brought into the mining picture. The Eldorado mine continued to produce .pitchblende concentrates on a satisfactory scale. With the announcement of the Government policy for the mining of radio-active substances, more development in this field may be anticipated. Imperial Oil Limited continued the production of crude petroleum and oil products at Norman Wells, but the output is designed to meet the requirements of the local market.

For those who are dependent on hunting and trapping for a livelihood, the most significant improvement was the organization of a forest protection and game conservation service. Wood is utilized for a great variety of purposes in the Northwest Territories, and as forests mature more slowly in northern latitudes they must be conserved. The native population and a great many of the half-breeds are totally dependent upon wildlife for sustenance. Their only revenue is derived from the pelts that they trade for necessities. Statistics indicate that the annual fur catch has been declining, and the need for a long range wildlife management policy is apparent.

Steps are under way to improve and extend the system of education in the Northwest Territories. Plans include the use of the most modern methods of teaching, and the extension of the program to include adults. Concurrently, with the improvement of education, increased attention is being devoted to the welfare of the local population. In this connection, the benefits derived from family allowances are becoming apparent.

The interdepartmental Committee on Agriculture in northwestern Canada has continued its studies, and the reports issued by the Experimental Farms Service of the Department of Agriculture are very encouraging. It has been possible to assign more scientists to the study of all resources, and steady progress is being made in the mapping of the Northwest Territories.

The past year marked the retirement from the post of Deputy Minister of Mines and Resources and Commissioner of the Northwest Territories of Dr. Charles Camsell, whose name has been synonomous with northern development for so many years. He has been succeeded by Dr. Hugh L. Keenleyside, who is well-known for his interest in northern Canada. Two other veterans of the Northwest Territories Administration, Austin L. Cumming and Kenneth R. Daly, retired from the Northwest Territories Council and were replaced by

A/C Harold F. Godwin, of the Royal Canadian Air Force, and Louis de la C. Audette, Legal Adviser, Department of External Affairs. John G. McNiven, manager of Negus Mines Limited, Yellowknife, also was appointed to the Northwest Territories Council. His appointment was the first made from outside the public service to the Council as at present constituted, and provides a member who is resident in the Territories.

Administration in the Yukon was marked by the retirement of Controller G. A. Jeckell, who served the Territory long and well. John E. Gibben, Stipendiary Magistrate, has been acting in his stead. The re-opening of the former Treadwell Yukon property in the Mayo District by the Keno Hill Mining Company Limited, and increased exploration and development of mineral properties at many other places in the Territory, have stimulated interest in the natural resources.

A desire on the part of a great many people, particularly from the United States, to travel to the Yukon and Alaska by way of the Alaska Highway has been apparent, but, as there was insufficient overnight accommodation available, it was necessary to continue a permit system. Permits to travel over the highway were granted to those having business in the region, provided their vehicles were roadworthy and were properly equipped and supplied for the journey. It is the feeling of the administration that, for the present, tourists should be encouraged to travel to places where better facilities are available.

Attendance in the National Parks has shown a sharp increase and the totals should soon exceed pre-war figures. For many years it was possible to do little more than actual maintenance of these outstanding national properties, but during the past year additional funds have been provided for the replacement of worn-out and obsolete equipment, so that the standard of maintenance has been improved. Unfortunately it was impossible to obtain delivery of all equipment required. Satisfactory labour was increasingly difficult to secure. Competing employers were able to offer rewards which exceeded the prevailing rates upon which Government wages are based. The aims of the administration have been the improvement and extension of facilities for comfortable travel and accommodation at fair rates. Concessionaires were unable to obtain building materials, as these were required to alleviate the current housing situation. In the circumstances, the public camp-grounds in the parks were used by travellers to a greater extent. Camp-grounds are being made more convenient and attractive and all are equipped with camp-stoves, tables and fuel. In some of the largest, electricity, running water, and community refrigerators with individual lockers have been provided. Concessionaires operate on the larger camp-grounds and cater to the needs of travellers.

Looking to the future, a broad program of National Park extension and development is envisaged. One of the chief needs of the National Parks system is additional accommodation for travellers of limited means. If private capital is unable to make the required investments, it may be necessary for the Government to erect accommodation and lease it to concessionaires, preferably returned service personnel who are qualified to provide the services required. A considerable extension of the wildlife conservation policy, including maintenance of a proper balance of wildlife and the replenishment of game fish, is desirable. The improvement and extension of communication systems in the parks should be continued. Consideration should be given to the recruitment and training of personnel for the park warden service. The principal highways leading to the parks, and the main avenues of travel in the parks, require improvement by widening, hard-surfacing, and the provision of new bridges where necessary.

Municipal services might be extended and improved where there is a permanent resident population. Adequately trained personnel, especially those required for technical positions, should be appointed. To make the National

Parks system more truly representative, additional National Park areas of suitable size and character, located near the chief centres of population, should be established.

World War II had a very serious effect on the forest resources of the nation, and the work of the Dominion Forest Service is being reorganized to an appreciable extent to meet the changing need for leadership in the post-war development field.

Key personnel who were engaged in war activities have returned to duty. The staff has been strengthened by the addition of valuable, trained personnel. It has been possible to acquire some much needed equipment. Larger appropriations have been made available. Silvicultural research has been continued and expanded on the five forest experiment stations. Additional demonstration work and field surveys have been undertaken. Important programs of research are being carried on in the three forest products laboratories. In planning the schedule of scientific work to be carried on at the laboratories and field station of the Service, the needs of provincial forest services, forest industries, and other departments and organizations interested in research are recognized. The results of investigations are made available to all interested agencies.

During the past year substantial progress has been made in gathering information on the rate at which Canada's forests are reproducing, in the development of methods of preparation of a national forest inventory, in manufacturing techniques for wood products, and in the curtailment of forest waste.

From the representations that are being received, it is evident that the Dominion is expected to provide vigorous leadership in the development of a national forest policy, with the idea of ensuring maximum yields of most desirable wood products in perpetuity, and that, concurrently, watersheds may be protected, wildlife conserved, and healthy recreation afforded to all.

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 land and freshwater area of the Northwest Territories is 1,304,903 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. An estimate of the population made in 1947 placed the total at 15,514, including 5,527 whites, 4,334 Indians, 5,651 Eskimos, and 2 others (Asiatics).

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

Commissioner	Hugh L. Keenleyside.
Deputy Commissioner	Roy A. Gibson.
Members of Council	Stuart T. Wood, Robert A. Hoey, John G. McNiven, Louis de la C. Audette, Harold B. Godwin.
Secretary	James G. Wright.

Work of Council

Four regular and nine special sessions of Council were held during the year. Assent was given to the following ordinances and amendments: Sanitary Control Ordinance; School Assessment Ordinance; School Ordinance; Local Administrative District Ordinance.

In addition, matters of policy were discussed in connection with the eastern Arctic Patrol; Eskimo affairs; medical services in Eastern Arctic; health and welfare; hospital and medical services; Northwest Game Act and Regulations; game and fur situation; radio service; briquetting of coal at Pond Inlet; assistance to mining companies in the construction of trunk roads and airports; meteorological requirements; public buildings, and appointment of Territorial officers and commissioners.

Dr. Charles Camsell, a member of Council since 1921 and Commissioner since 1936, retired on superannuation on November 15, 1946. He was replaced as Commissioner of the Northwest Territories by Dr. H. L. Keenleyside, effective March 15, 1947. J. G. McNiven was appointed member of the Northwest Territories Council as of February 20, 1947, vice K. R. Daly, who resigned on account of ill health. A/C H. B. Godwin was appointed member of the Northwest Territories Council as of March 31, 1947, to replace A. L. Cumming, who also resigned on account of ill health. L. de la C. Audette was appointed member of the Northwest Territories Council on March 31, 1947.

Aministration

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 Agent of Dominion Lands, Crown Timber Agent, Mining Recorder, Stipendiary Magistrate, and Marriage Commissioner. The Superintendent of Wood Buffalo National Park is also stationed at Fort Smith, as is the Sheriff of the Northwest Territories. 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 situated 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

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.

Although the medical staff of the Department of Mines and Resources was absorbed by the Department of National Health and Welfare, the Government medical officers in the Territories continued to represent the Department of Mines and Resources in the administration of 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 patrol outlying areas and all make use of the Northwest Territories radio system in prescribing for those who are unable to obtain treatment at the medical centre.

Hospitals

During the year, 11 hospitals were operated in the Territories, 9 by missions of the Roman Catholic Church and the Church of England in Canada and 2 by mining companies at Yellowknife and Port Radium. Hospital facilities were also provided by private enterprise at Norman Wells for those engaged on the Canol Project and related activities.

The mission hospitals were 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 and half-breeds who were admitted on the recommendation of the resident medical officers. 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 were also admitted on the recommendation of the Government medical officer, and the missions received $200 per person per annum for their care and maintenance until January 1, 1947, when payment was increased to $400 per person per annum. During the year, the sum of $16,291.74 was expended for the care of destitute patients in the hospitals, representing approximately 6,875 days of treatment. Thirty-eight patients were accommodated in the industrial homes at a total cost of $6,875.47, and nine insane patients, together with a number of indigents, were treated in provincial institutions at a cost of $5,358.36. The above figures do not include the amounts paid by the Indian Affairs Branch for services to Indians only. A considerable drop in expenditure was effected by the action of the Department of National Health and Welfare in taking over the hospitalization of Eskimos.

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 operated only during periods of the year when the natives are in the vicinity. During the year, 135 children attended the residential schools and 411 pupils attended the day schools. Public schools were operated at Fort Smith and Yellowknife and were attended by a total of 181 pupils.

Grants totalling $26,351.51 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, Quebec, and Moose Factory, Ontario. School supplies were also furnished to a number of mission 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 of Indian children.

During the year, the school inspector made an inspection of the educational facilities in the Mackenzie District, and steps are being taken to implement the recommendations made following this tour of inspection. Plans were also drawn up for the construction of a modern public school at Yellowknife, with provision for instruction in several lines of vocational training.

Law and Order

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

Eastern Arctic Patrol

The Eastern Arctic Patrol for 1946 sailed from Montreal on July 6 on the Hudson's Bay Company vessel R.M.S. *Nascopie*. After calling at posts on Hudson Strait and on the west coast of Hudson Bay, the vessel reached Churchill, Manitoba, on August 14. Passengers were exchanged and coal, freight, and supplies were loaded for the northern part of the voyage. Stops were made at nineteen ports of call and the distance covered before returning to Montreal on October 3 was 10,600 miles. J. G. Wright, Superintendent of the Eastern Arctic, Bureau of Northwest Territories and Yukon Affairs, was Officer in Charge of the Patrol.

Medical arrangements connected with the patrol were in charge of Dr. H. W. Lewis, of the Department of National Health and Welfare, which is responsible for the medical care and hospitalization of Indians and Eskimos. Dr. George Hooper, of Ottawa, joined the Patrol at Churchill and acted as surgeon on the northern portion of the voyage, which included calls at the only two hospitals in the region—the Roman Catholic mission hospital at Chesterfield and the Anglican mission hospital at Pangnirtung. By arrangement with the Canadian National Institute for the Blind, an eye-specialist group again accompanied the Patrol. Dr. J. F. A. Johnston, a Toronto ophthalmologist, headed the eye group sailing from Montreal and was relieved at Churchill by Dr. W. L. Crewson, of Hamilton, who was in charge of this work in 1945. This group improved the vision of many Eskimos. The ship's dentist treated a number of patients at all ports of call. The Department of National Health and Welfare supplied X-ray equipment and Dr. Lewis and his associates were able to take over 1,500 chest X-ray plates as part of a general survey of tuberculosis conditions among the Eskimos.

The health of the Eskimos was found to be generally good although in some areas there appeared to be a high infant mortality. It is hoped that this condition can be alleviated in future by the supplying of proper foods for small children.

The *Nascopie* and auxiliary schooners carried mail and medical and other supplies to all ports in the Eastern Arctic, and relief personnel for Royal Canadian Mounted Police detachments and weather and radio stations. Several buildings at the air base at Southampton Island were dismantled and moved to Chesterfield for transhipment to Baker Lake and re-erection as a group of ten buildings to comprise an Arctic research station. Unfortunately, owing to transportation difficulties in the Arctic, they did not reach Baker Lake in time to be erected before winter set in.

A radio transmitter was installed at the Royal Canadian Mounted Police post at Dundas Harbour, which had been without radio communication with the outside world for the past year.

Through the co-operation of the Royal Canadian Air Force, the Officer in Charge of the Patrol, accompanied by the medical and eye group, was flown from Churchill to Eskimo Point and Baker Lake, points not visited by the *Nascopie*.

Liquor Permits

Operation of the Territorial liquor stores at Yellowknife and Fort Smith was continued by the Saskatchewan Liquor Board as agent for the Northwest Territories Administration. Additional quantities of liquor became available during the year, permitting an increase in quantities rationed to individual permittees. There was a substantial gain in the business at the Yellowknife store. The beer sales at the store and at licensed hotel premises in the settlement increased more than 300 per cent. The volume of business at the Fort Smith store also increased, but not to the same extent as at Yellowknife.

Net profits from the operation of the liquor stores during the fiscal year amounted to $206,227.77 as compared to $125,485.01 in 1945-46. Profits from the Yellowknife store were $158,620.29 and from the Fort Smith store, $47,607.48. Profits from liquor sales and permit fees in the Mackenzie District, together with $3,330 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, 1947, was $587,957.74. The sum of $94 was obtained from the sale of liquor permits issued at Ottawa.

During the fiscal year, 5,345 Class "A" annual permits were issued in the Northwest Territories. Liquor permits issued at Ottawa were 4 Class "B" permits covering sacramental wine and 48 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 9,220 gallons of spirits, 1,352 gallons of wine, 9 gallons of ale and stout, and 101,050 gallons of beer. Importation permits covered 98 gallons of spirits, 192 gallons of wine, and 105 gallons of beer.

Lands and Timber

Land Sales.—Twenty-five settlement lots were sold and patented as follows: Aklavik (Pokiak Subdivision) 4; Arctic Red River 2; Fort Norman 2; Fort Smith 2; Hay River 12; Taltson River 3. In addition, one group lot comprising 97·6 acres was sold in Group 862.

Leases and Permits to Occupy (Surface Rights).—There are now in force 632 leases and permits to occupy. Of these, 542 are for land in the Yellowknife Administrative District and the remainder for land at various points throughout the Northwest Territories. The types of leases and permits are as follows: residential and business purposes 607; agricultural leases 13; grazing leases 3; fur-farm leases 9. Leases are authorized by Order in Council and generally are issued for a term of five years, with a renewal option for a further five years. Permits to occupy unsurveyed Dominion Lands are issued subject to cancellation upon the serving of a stipulated notice.

Assignments.—During the year, 50 assignments affecting lands were registered in the Department.

Hay Permits.—Five hay permits were issued under which 83 tons of hay were cut.

Timber.—Ninety-six timber permits, exclusive of those granted in connection with timber berths, were issued authorizing the cutting of 4,880 linear feet of timber, 20,000 feet board measure of lumber, 205 fence posts, and 5,397 cords of wood. Of these permits, 41 were issued free of dues to educational, religious, and charitable institutions; to settlers for domestic use, and to Government Departments. Twenty-four timber berth permits were granted during the year and 2,373,744 feet board measure of lumber were manufactured, together with 105,557 linear feet of timber and 3,223 cords of wood.

Revenue.—Total revenue derived from lands, timber, grazing and hay was $42,671.78.

Forest and Wildlife Conservation

The relatively dry summer of 1946 and low water levels throughout the Mackenzie District in general created fire-hazard conditions requiring close supervision by the Forest and Wildlife Service. Fifty-eight forest fires were reported during the year, of which 48 occurred along waterways and other routes of travel. Many of them were attributable to the failure of travellers to extinguish camp-fires. The three most serious fires destroyed valuable forest cover in the Point Separation area, Mackenzie Delta; in the Providence District; and south and west of Fort Resolution. A large number of fires occurred in the mining and prospecting areas of the Yellowknife district.

The protection service established in the Mackenzie District during 1945 under the immediate direction of E. G. Oldham, Superintendent of Forest and Wildlife Management, was strengthened by the addition of a forest engineer, J. S. Prescott, and a number of new park wardens. The Mackenzie River area has been divided into five districts for the purpose of convenient supervision and fire suppression, as follows: Aklavik, Fort Norman, Fort Simpson, Fort Resolution, and Yellowknife.

Under the direction of the Department of Public Works, park wardens' cabins were erected at Fort Resolution, Fort Simpson, and Fort Norman. Supplies were also delivered to Aklavik for erection of a cabin at that point. The new park wardens were given a period of training at Fort Smith under the direction of the Superintendent and were assigned to the above districts in September, 1946. The wardens were equipped with small patrol boats and modern fire-fighting equipment. Arrangements were made to establish a park warden in the Yellowknife area in 1947. The latter officer will be provided with a heavy-type boat suitable for use on Great Slave Lake in transporting crews and equipment in connection with fire-suppression work in the Fort Rae and Yellowknife areas.

One patrol boat only, the M.B. *Caribou,* of about ten tons, was available for use on the Mackenzie River for fire-suppression purposes during 1946. Three specially-designed tunnel type launches ordered for use on the Mackenzie, Slave, and Liard Rivers were not delivered due to difficulty in obtaining the necessary construction materials.

The total area burned during the year was estimated at 1,452,487 acres, of which 285,883 acres contained timber having an estimated merchantable value of $223,497. Much of the area burned contained immature, potentially merchantable timber which provided cover for the wildlife. Forest fires are to a large degree responsible for the reduction in the beaver and muskrat population in many valuable fur districts. The natural food of many big game animals has also been destroyed. These conditions have an important bearing upon the livelihood of the natives, who of necessity have had to depend more and more on the barren ground caribou for food and clothing.

A Fox-Moth aeroplane was chartered and made available to the Superintendent of Forest and Wildlife Management for reconnaissance purposes throughout the summer. The aircraft was used to transport crews and fire-suppression equipment. The organization succeeded in extinguishing a number of fires before they assumed serious proportions.

Fur Production

There was a noticeable increase in the number of muskrat pelts taken as compared with the previous year. The yield of muskrat pelts in 1946 was valued at $448,912, as against $288,248 in 1945. There was a slight increase in the number of beaver taken. A very noticeable decrease in the number of fox, lynx, and mink was apparently due to cyclic causes.

A. W. F. Banfield, of the National Parks Bureau, carried out a preliminary investigation of the muskrat habitat of the Mackenzie Delta in preparation for a more extensive biological survey to be undertaken next year. Evidence of a local disease affecting the muskrat was obtained, and the subject has been noted for investigation during the course of the biological survey.

The close season for the taking of marten remained in effect throughout the year. Some evidence was produced indicating an increase in the marten population in some of the remote districts, but the general situation throughout the extensive hunting grounds does not seem to warrant any relaxation of the close season provision.

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 north and west of the Liard River and west of the Yellowknife Game Preserve. The reports indicate some improvement in the beaver situation in this territory. Elsewhere conditions have not improved to such an extent that modification of the close season provisions of the regulations could be justified.

Wood Buffalo Park

Conclusive evidence of the serious damage to forests in the northern area of the park due to fires that occurred during the years 1943 and 1945 was found during extensive investigations. It is estimated a minimum of fifty per cent of the timbered area was burned from 1941 to 1945 inclusive. The extensive damage to the forest cover resulted in total destruction of the beaver and muskrat habitat in certain areas and immeasurable loss to the native population through diminishing fur returns. The lack of transportation facilities, the absence of suitable roads and trails, and inability to obtain labour during the war years had made fire prevention work impossible.

The road between Fort Fitzgerald and the Government Station at the Hay Camp on the Slave River, a distance of 32 miles, was reconstructed under the direction of J. H. Atkinson. Two dump trucks and two general utility trucks were purchased for use on this road program. In addition, a D-7 Caterpillar tractor and angledozer was rented and used for a period of two months. It is the intention to extend the roads and trails as needed to facilitate the patrolling and supervising of the park area.

The work program also included the construction of new cabins for accommodation of park wardens at Chipewyan; on the south side of the Peace River near Fifth Meridian; at the Government Station at Hay Camp; and at the intersection of Salt River Road with the Little Buffalo River.

Observations made at various times during the year showed that the greater part of the buffalo population was occupying grazing areas in the southern part of the park to the north and west of Baril Lake and Lake Claire. A few small buffalo herds remain in the northeasterly part of the park and a herd of about two hundred animals is located between the Slave and Taltson Rivers within the boundaries of the Slave River Game Preserve.

Following investigations made at various times during the year, the Superintendent estimated the buffalo population at 7,500 head. These animals are healthy and the number of calves was estimated at between twenty and thirty per cent. Notwithstanding the severe drought conditions that have existed in recent years the Superintendent advised that there was no evidence of over-grazing. Fifty-five aged and outcast animals were killed during the winter to provide meat for needy natives and for distribution to missions and hospitals maintained and operated in the interests of the native population.

Except for a slight increase in the number of muskrat pelts, there was a reduction in all classes of fur taken by Treaty Indians and half-breeds who were privileged to hunt and trap in the Park.

Northwest Game Regulations

By Order in Council (P.C. 5114) dated December 12, 1946, amendments to the Northwest Game Regulations were made as follows:—

(*a*) The open season for the taking of muskrats north of the Arctic Circle will terminate on the 8th day of June instead of the former date, the 15th day of June.

(*b*) The killing of moose, mountain sheep, or mountain goat of the female sex was prohibited.

(*c*) The killing of male moose, mountain sheep, or mountain goat under one year of age was prohibited.

(*d*) The sale of moose meat was prohibited.

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, 1945 and 1946, follow:—

	Year ended June 30	
	1946[2]	1945[1]
Big Game—		
Caribou	28,212	28,704
Deer	1	44
Moose	595	790
Sheep	13	44
Goat	2	5
Game Birds—		
Ducks	10,077	11,850
Geese	423	656
Grouse	446	198
Partridge	548	489
Prairie chicken	1,620	696
Ptarmigan	6,173	5,945

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

	Licences Year ended June 30	
	1947[2]	1946[1]
Hunting and Trapping—		
Resident	420	476
Game Bird	49	33
Trading and Trafficking—		
Resident	104	124
Non-resident	4	3
Non-resident—(non-British)	1	1

—	Permits Year ended June 30	
	1947[2]	1946[1]
To establish trading posts in Northwest Territories	11	8
To take animals for propagation purposes	1	2
To take migratory birds	10	5
To take scientific specimens	4	3
To take (10) beaver	263	476
To Indians to hunt and trap in Wood Buffalo Park	214	296

[1] These figures may differ slightly from those recorded in the Annual Report for 1945-46 because of additional returns received after that report was printed.
[2] Subject to revision as additional returns are received.

Revenue.—Revenue under Northwest Game Act for fiscal years ended March 31, 1946 and 1947, is shown hereunder:—

—	Fiscal Year	
	1946-47	1945-46
Hunting licences	$ 900 00	$ 994 00
Trading licences	1,580 00	1,386 90
Bird licences	102 00	78 00
Fur farm licences	13 00	15 00
Trading post permits	7 00	6 00
Sale of furs	6,893 80	3,341 50
Fur export tax	90,894 44	56,834 64
Permit to export live fur bearers	.....	100 30
Fines and forfeitures	3 00	90 00
Sub-total	100,393 24	62,846 34
Revenue under the Businesses, Callings, Trades and Occupations Licence Ordinance, fiscal year ended March 31, 1947	8,915 57	5,875 50
Sale of buffalo hides	795 00	741 00
Total	110,103 81	69,462 84

Infractions of Game Laws.—There were 5 prosecutions for infractions of the game laws. Convictions were secured in 4 cases.

Reindeer

The herding of reindeer as a native industry in northern Canada is being fostered by the Dominion Government through the Northwest Territories Administration. The enterprise commenced with the delivery in 1935 of a herd of 2,370 reindeer from Alaska to a reserve on the east side of the Mackenzie Delta. There are now a main herd on the reserve and a subsidiary herd about 200 miles eastward near the mouth of the Anderson River. The field organization consists of about 20 men for supervision, labouring, and herding, with buildings, corrals, boats and other needed equipment. Wireless communication is used to a large extent. The herders are mainly Eskimos, assisted by two Laplanders.

At the roundup of the herds in July, 1946, there were 4,114 deer in the main herd and 2,402 head in the Anderson River herd. In the autumn of 1946, the usual donation of 100 carcasses was made to the mission hospitals and residential schools at Aklavik. Other reductions for meat purposes amounted to more

than 300 head, and in addition, ordinary losses from sickness, injury, and predators occurred. The revenue from the sale of reindeer products (meat and skins) during the fiscal year amounted to $7,480.56. Skins shipped to the Eastern Arctic numbered 220.

Investigations with a view to determining the best methods of developing the reindeer industry in the interests of the natives were continued during the year. Efforts are being made to secure improved field management, to recruit more young natives for reindeer training, to improve the technique of handling large herds, and to develop a suitable procedure for marketing, storing, and shipping surplus reindeer products. A recheck of the range is to be undertaken.

Mining

Mining and prospecting in the Northwest Territories during the year were confined mainly to the Yellowknife area, although a revival of prospecting interest in the area immediately to the west of Hudson Bay was evident. This area had been dormant for many years but during 1945 representatives of one of the large mining companies, the Hudson Bay Mining and Smelting Company Limited, staked and recorded 80 mineral claims scattered over a fairly large area. Additional prospecting and development work was carried on during 1946. There was also a revival of interest in the sub-Arctic region between Bathurst Inlet and the Arctic Circle. Considerable exploration was done and upwards of 100 claims were recorded in this area.

Progress was made on two projects which are expected to influence the development of mineral resources in the Northwest Territories, namely the Grimshaw-Hay River road which is expected to be completed by the end of 1947, and the Snare River hydro-electric power development, which is scheduled for completion by the end of 1948.

The number of mineral claims staked and recorded in the Territories during the year was considerably less than in the preceding year. Interest was transferred to the development of claims staked in previous years. This situation was illustrated by the number of Certificates of Work issued, which increased more than fifty per cent during the 12 months ended March 31, 1947. The total revenue derived from fees collected under the various mining regulations for the year ended March 31, 1947, amounted to $222,908.45, as compared to $184,019 for the previous year. The 1946-47 revenue was divided as follows:—

Quartz Mining—		
General fees	$ 99,867 46	
Leases	2,460 20	
Royalties	3,976 10	
Miner licences and renewals	61,937 25	
		$168,241 01
Petroleum Natural Gas—		
Leases	2,132 56	
Royalties and Government share in production of the "Proven Field"	52,362 88	
		54,495 44
Coal—		
Permits		26 00
Gravel—		
Permits		146 00
		$222,908 45

In August, 1946, the Con and Rycon mines were again brought into production after a shutdown of over three years and, together with the Negus mine, which was in production for the whole year, contributed to a very marked increase in the total gold and silver production of the Territories. The Thomp-

son-Lundmark and Philmore Yellowknife (successors to International Tungsten) mines, which also were shut down during the war period, were reported as being in preparation to resume production. Development work on the Giant Yellowknife property was further advanced. Two shafts, situated one mile apart and 520 feet and 409 feet deep, respectively, were completed, in addition to 4,000 feet of lateral development. It was reported that a plant capable of milling 500 tons a day would be in operation some time during 1947. A careful geological investigation led to a deep drilling program on the "Con" and Negus properties jointly financed by the two companies and it was reported that at a depth of more than 2,000 feet a large ore body, presumed to be the extension of the Giant ore body, was discovered. The owners of several other promising prospects were engaged in shaft sinking and underground development.

Work on the Crestaurum development, situated at the northern end of an extension to the Giant Road, was suspended after a shaft had been sunk to a depth of 421 feet, and 300 feet of lateral work had been done. No reasons were advanced for this step, but it was assumed that a shortage of labour and supplies was responsible. It was expected that this property would be reopened when labour became more plentiful and hydro-electric power became available.

The Yellowknife field in general showed steady expansion, and major development work was being carried on in the Indin Lake and Beaulieu River areas. Reports of a new rich find led to considerable staking in the vicinity of MacKay and Courageous Lakes, a new area about 150 miles northeast of Yellowknife. Operations were continued at the pitchblende-silver property of Eldorado Mining and Refining (1944) Limited throughout the year. About 200 people were employed and the concentrates produced were shipped to Port Hope, Ontario, for refining. Production figures were not available for publication.

Value of Mineral Production

The value of mineral production in the Northwest Territories for the past four years, together with the total value of production since 1938 to date, is indicated by the following figures which have been supplied by the Dominion Bureau of Statistics:—

—	1943	1944	1945	1946	Total Production to end of 1946
	$	$	$	$	$
Gold	2,272,732	799,838	333,218	860,685	15,204,304
Silver	5,996	5,881	956	5,113	842,636
Lead	.....	.....	.....	.....	490
Copper	.....	1,428	.....	.....	24,102
Tungsten	729	.....	.....	.....	37,674
Pitchblende products	†	†	†	†	5,805,423†
Crude petroleum	400,201	632,587	136,303	173,392	1,818,496
Natural gas	335	335	335	335	3,595
	2,679,993	1,440,069	470,812	1,039,525	23,736,720

† The value of pitchblende products, including radium and uranium, for the years 1942 to 1946, inclusive, is not available for publication.

During the fiscal year, 1,028 miner's licences and 1,169 renewals of miner's licences were sold; 5,715 quartz grants were issued, and 5,806 assignments and transfers of mineral claims were recorded. In addition to the above, 15 leases comprising 810·80 acres were issued under the Quartz Mining Regulations.

Coal.—There were no coal mining leases in force during the year, but three domestic coal mining permits were in force in the unorganized districts of the Territories.

Petroleum and Natural Gas.—All permits issued under the regulations approved by Order in Council P.C. 2904, dated April 27, 1944, and comprising 2,241,638 acres on the Mackenzie River in the vicinity of Norman Wells, were abandoned after an extensive but unproductive exploratory drilling program had been carried out. After these abandonments, only one permit issued under the regulations remained. This permit comprised 640 acres situated on the Hay River. Six leases, comprising 3,279·23 acres and the proven field, 7,939 acres, were still in good standing. Operations in the proven field produced 214,832 barrels of oil during the year, making a total production since April, 1942, of 1,939,463 barrels. Royalties, together with the Government's share of the proceeds of the sale of the oil, amounted to $39,119, making a total revenue of $52,362.88 from this source since the proven field agreement came into force.

Dredging.—Two five-mile stretches on Grizzly and Bennett Creeks, tributaries of the South Nahanni River, were the only dredging leases in good standing in the Northwest Territories. The combined annual rental of these two leases is $100.

Yellowknife Administrative District

During the year, the Local Trustee Board of Yellowknife Administrative District held 33 meetings and passed several by-laws including those covering such matters as assessment of property and rate of taxation within the District, prevention of fires, the installation of electric wiring, and burial of the dead. Many other matters of interest to the community were also discussed and passed by the Board.

Townsite Development.—Several areas were surveyed as additions to the townsite as laid out in 1945, and the unoccupied and suitable areas lying between the original settlement and the 1945 subdivisions were surveyed for utilization as residential and industrial sites. The total number of lots in all subdivisions of the townsite is 1,172. There is a fairly constant demand for lots and, during the year, 336 applications for lots were received.

Preliminary work was completed on a proposed water and sewer system to serve the new townsite, and this is to be built in 1947. During the summer of 1946, water was supplied to the old townsite through 4,000 feet of surface lines and a similar system was constructed to serve the new townsite in 1947.

Although building activity was hampered by a shortage of materials, approximately one hundred new homes and many substantial business premises were erected. In addition, various Government departments erected buildings for office and staff purposes. Arrangements were made for the construction in 1947 of a forty-bed hospital and a consolidated school.

Public Improvements

Work on the Grimshaw-Hay River Highway, the cost of which is being shared by the Dominion Government and the Government of Alberta, was commenced in 1946 and by the end of the year approximately 194 miles of clearing and 86 miles of grading had been completed. The work schedule calls for completion of the highway by the end of 1947.

Good progress was made on the hydro-electric power development on the Snare River, approximately 90 miles north of Yellowknife Settlement. At the end of the fiscal year, the main power tunnel, 136 feet in length, and a small exciter tunnel had been driven to completion. The coffer dam across the north-

west channel was constructed and borrow pits for the rock fill were opened up. A large amount of material was landed by barge near Fort Rae in the summer and transported by tractor train to the power site during the winter. Construction of the dam and foundations of the power-house was anticipated following breakup in the spring of 1947. Construction of the transmission line from the site of the power-house to the main camp of Giant Yellowknife Gold Mines, Limited, was also under way. Additional details of this development will be found in the report of the Surveys and Engineering Branch.

Airport access roads at principal settlements were maintained by the Department of Transport from funds provided by the Northwest Territories Administration. At Yellowknife the Department of Transport completed roads between the airport at Long Lake and Yellowknife Settlement, a distance of four and a half miles, and between the airport and radio range.

The two portage motor roads connecting Fort Fitzgerald, Alberta, and Fort Smith were kept in serviceable condition with equipment owned by the Northern Transportation Company Limited and the Department of Transport.

In the Yellowknife district, the road connecting property of Giant Yellowknife Gold Mines Limited and the new townsite addition, and an extension of this road to the property of Crestaurum Mines Limited, were completed. The road program within the settlement of Yellowknife was brought to completion under the direction of the Department of Public Works, and existing roads were improved by grading, surfacing, and drainage. The town and district are now serviced by excellent all-weather roads, towards which financial contributions were made by the Northwest Territories Administration.

Landing fields for aircraft along the Mackenzie River Route in the Mackenzie District were maintained at Fort Smith, Fort Resolution, Hay River, and Yellowknife by the Department of Transport, which also provided meteorological services and facilities for refuelling. Fields at Fort Simpson and Norman Wells were serviced by Canadian Pacific Air Lines Limited. Construction work was continued on the Yellowknife airport by the Department of Transport and included the completion of the 4,000-foot NW-SE landing strip, and the clearing and grading of the N-S landing strip to a length of 3,000 feet. A radio range was completed at Yellowknife and came into operation on March 1, 1947.

The Meteorological Division of the Department of Transport continued the operation of weather stations established in the Territories, including upper air observing stations at Aklavik, Norman Wells, Fort Smith, Southampton Island, and Arctic Bay. Further progress was made in arranging for the establishment of an upper air observing station to be located at Coppermine. Much of the material necessary for the construction of this station was on the site at the end of the year, and it was expected that operations would be commenced during the summer of 1947.

Two new meteorological stations were opened during the year—one at Baker Lake in Keewatin District (operated in co-operation with the Department of National Defence) and one at Eureka Sound, Ellesmere Island, in Franklin District (operated as a joint project with the United States Government). Surface observations only are taken at Baker Lake, while at Eureka Sound upper air observations are also taken.

As a result of increasing demands for meteorological information from the Canadian Arctic, negotiations were undertaken with the United States Government with a view to establishing additional weather stations. Plans assure the establishment of a base station at Winter Harbour during the summer of 1947. Meteorological observations will include both surface and upper air. It is proposed to establish subsidiary stations during 1948.

The Department of Transport continued the maintenance of aids to navigation along portions of the Mackenzie River waterway including points on the Slave River, Great Slave Lake, the Mackenzie River, and Great Bear Lake. The service was improved by the establishment of a new flashing electric light on Hardisty Island at the western entrance of the North Arm and by the provision of an electric lighted buoy for the marking of the Mackenzie Rock—both in Great Slave Lake. A new 65-foot twin-screw, tunnel-stern steel lighthouse and buoy tender for service on Great Slave Lake and the upper Mackenzie River was under construction in 1946. It is expected that the new craft will be in operation in July of 1947.

A franchise for a telephone system has been granted by the Yellowknife Administrative District, and it is planned to have the system in operation by the end of 1947.

The Royal Canadian Corps of Signals maintained the system of wireless communication in the Territories, made up of radio stations extending from Alberta to the Arctic Ocean. This system provides an outlet for 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 Geological Survey had six parties in the field. One of these commenced 4-mile reconnaissance mapping in the Camsell River area so as to assist in the exploration and delimitation of the uranium-bearing province bordering the southeast shore of Great Bear Lake. Another party commenced similar mapping some 200 miles northeast of Yellowknife, in the Lac de Gras area, which embraces an interesting gold belt. Geological mapping was started at a scale of 1 inch to 1 mile, in the active Indin Lake gold area; and on a more detailed scale, on the Negus-Giant gold belt at Yellowknife Bay. The remaining two parties continued detailed investigations in the vicinity of Eldorado mine. This work, done in close co-operation with the Crown company, Eldorado Mining and Refining (1944) Limited, was designed to aid in the discovery of uranium-bearing minerals. In addition, three Topographical Survey parties were engaged near Indin Lake, east of Yellowknife, and at Yellowknife, and provided the control necessary to compile detailed base maps of these areas.

Inspection of oil operations in the Norman Wells field was continued during the year by the Department of Mines and Resources. Geological parties of Imperial Oil Limited and Socony-Vacuum Oil Company continued geological exploration for petroleum. Imperial Oil Limited had three parties working in the lower Mackenzie River and Delta regions between the Arctic Red and Anderson Rivers. The company also undertook wildcat drilling at Whirlpool on the Mountain River, and on the Redstone River—both tributaries of the Mackenzie River—without success. Socony-Vacuum Oil Company had four geological parties working in the vicinity of the Peel River and the Richardson Mountains.

Surveys made by the Hydrographic Service included the Providence Rapids section of the Mackenzie River from Fort Providence to Beaver Lake. The harbour approach to Hay River settlement was sounded and reconnaissance surveys were made of two possible harbours on the west shore of Great Slave Lake. Harbour surveys were also carried out by the Department of Public Works at Buffalo River, Hay River, and several points on the north shore of Great Slave Lake with a view to improving existing facilities.

During the year a preliminary edition of the *Mackenzie River Pilot* was issued, and a revised edition of the chart entitled *Plans of Harbour, Great Slave Lake* was prepared. Hydrometric investigations were also extended systematically in the Great Slave Lake area by the Dominion Water and Power Bureau.

Legal surveys were made of the landing fields at Fort Smith and Fort Providence, and at the settlements at Fort Smith, Hay River, Yellowknife, Aklavik, and Rat River. The work at Hay River settlement included the survey of four townsite blocks consisting of 40 lots.

Aerial Mapping

Approximately 37,000 square miles were covered by vertical aerial photography undertaken by the Royal Canadian Air Force during the year.

In the immediate vicinity of Yellowknife, an area of 40 square miles was photographed on a scale capable of enlargement to 200 feet to the inch to provide sufficient detail for road and subdivision planning.

In connection with the development of the reindeer industry, and to permit a study of the terrain, an area of approximately 20,000 square miles was photographed north and east of Great Bear Lake.

For mapping and administrative purposes, and in connection with the economic development of the mineral resources, further photographs were taken covering the Whitehorse and Watson Lake areas, and east of Great Slave Lake, totalling 17,000 square miles.

Agriculture

Following the exploratory soil surveys of the lands adjacent to the Mackenzie and Liard Rivers in 1944 and 1945, the Joint Committee on Northern Agriculture recommended the establishment by the Experimental Farms Service of a main experimental sub-station at Fort Simpson and a smaller sub-station at Yellowknife. Activities in 1946 were limited to the securing of land at these points, inspection of the proposed sites, and the purchase of necessary equipment and supplies for development of the stations in 1947. J. A. Gilbey, a former member of the Experimental Farms Service, and latterly in charge of agricultural work undertaken by the Canadian Army at Goose Bay, Labrador, was appointed officer in charge of the new sub-station at Fort Simpson.

A detailed report of the exploratory soil survey of the Mackenzie and Slave Rivers conducted in 1945 has been delayed pending receipt of chemical analyses, and its preparation will be undertaken in 1947.

Twenty-two co-operators were selected to carry out vegetable trials in the Northwest Territories in 1946, including representatives at Fort Smith, Fort Resolution, Hay River, Yellowknife, Fort Providence, Trout River, Fort Simpson, Fort Norman, Norman Wells, Fort Good Hope, Fort McPherson, and Aklavik. Vegetable samples distributed consisted of three varieties of beets, four varieties of cabbage, and four varieties of carrots. Insecticides, pamphlets, and report forms were also included. At the end of the fiscal year reports from co-operators were not complete.

Commercial Fisheries

Commercial fishing for whitefish, lake trout, and inconnu was continued at Great Slave Lake by McInnes Products Corporation Limited during the summer season of 1946, and a total catch of 2,387,000 pounds (round weight) was reported. Fishing was extended over a larger area than in 1945, nets being set south from Yellowknife Bay to Output Island, and west from Blanchet Island to Gypsum Point on the west shore of the lake. All fish caught were landed at a processing plant located at Gros Cap and operated by the company.

The plant consisted of one large work barge and two freezer barges for quick-freezing operations. The frozen product was transported in refrigerator barges across Great Slave Lake and up the Slave and Athabaska Rivers to Waterways, Alberta, for shipment by rail to southern markets.

During the summer of 1946, biological investigations of the waters of Kakisa and Tathlina Lakes, southwest of Great Slave Lake, were undertaken by officers of the Department of Fisheries and the Fisheries Research Board of Canada, for the purpose of determining whether or not these lakes were capable of supporting a commercial fishery. The investigation of Tathlina Lake indicated a fish population of whitefish, dore (pickerel), northern pike, suckers, and burbot. In view of the lack of fish of commercial size, the opening of the waters to commercial fishing was not recommended until a further survey, possibly three years hence, could be undertaken to determine the development of the fish population.

The survey of Kakisa Lake showed dore, suckers, whitefish, northern pike, and ciscoe present, the volume of abundance being in the order named. A recommendation was made that consideration be given to the opening of Kakisa Lake to commercial fishing for dore. Subsequently, a permit was issued by the Department of Fisheries authorizing a winter catch in the lake not to exceed 200,000 pounds of dore, dressed weight. An ichthyological survey of Great Slave Lake was continued by the Fisheries Research Board of Canada. An interesting feature was a sounding of 2,400 feet taken within one-half mile of the shore in the western end of the lake.

Winter commercial fishing at Great Slave Lake was permitted for the first time during the winter of 1946-47, with a set limit of 1,000,000 pounds (dressed weight) of whitefish and trout. A further 593,942 pounds was carried over from the summer limit, making a total limit of nearly 1,600,000 pounds of whitefish and trout available to fishermen at the beginning of operation in December.

Twenty-seven licensed fishermen operated in the Yellowknife Bay area from the West Mirage Islands to Wrigley Point on the south shore of North Arm. Nets were set in from 36 to 140 feet of water. Deep water sets produced the heaviest catches of whitefish and trout, with only occasional inconnu being taken. Shallow water sets caught too many pike and suckers to be economically profitable. In view of the fact that the winter of 1946-47 was one of the most severe on record, fishing was carried on under the most difficult conditions. Transportation arrangements could not be completed and, in consequence, the entire catch of approximately 100,000 pounds in this area was lost.

A more successful operation was conducted in the Hay River area by an Alberta firm employing twenty licensed fishermen. The catch was hauled by truck over the Grimshaw-Hay River road and, toward the end of the season in March, fresh fish were hauled to the railhead at Peace River, a distance of 410 miles, in eighteen hours.

The winter commercial production from Great Slave Lake has been estimated as follows:—

Species	Fresh (pounds)	Frozen (pounds)	Total (pounds)
Whitefish	25,200	138,784	163,984
Trout	3,360	53,211	56,571
Inconnu	6,780	24,100	30,880
Pike		380	380
Pickerel	....	150	150
Totals	35,340	216,625	251,965

Deep snow and severe weather conditions discouraged commercial fishing for dore (pickerel) at Kakisa Lake.

Geographic and Economic Research

Studies dealing with the geography, natural resources, and peoples of the Northwest Territories were continued by the Bureau's geographer, aided by an assistant. Considerable time was devoted to research relating to the history and exploration of Mackenzie District, following which an article *Exploration and Settlement of Mackenzie District, N.W.T.* was prepared for publication in the Canadian Geographical Journal. Descriptions of the principal settlements in the Canadian Eastern Arctic were also compiled and mimeographed for general distribution.

The compiling and editing of information relating to the natural resources of Newfoundland, supplied by other Government services, were undertaken for the use of the Department of External Affairs.

The Bureau's geographer terminated his employment in August, 1947, to accept a position on the staff of the University of British Columbia.

Publicity and Information

Numerous requests for information about the Yukon and Northwest Territories, and particularly the Yellowknife area, were met by distribution of pamphlets, folders, and maps, and by correspondence. A new illustrated folder describing the mining community of Yellowknife was printed during the year, as well as additional issues of the multilithed publications *The Yukon Territory* and *The Northwest Territories*. Reprints of articles written in the Bureau and published in the Canadian Geographical Journal were purchased for distribution. These articles described in considerable detail the geography, peoples, settlements, natural resources, and industries of the Territories. To meet the demand for information concerning public use of the Alaska Highway, multilithed circulars were compiled and printed for distribution. A bulletin describing the Government reindeer herds was also prepared and mimeographed.

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

The Northwest Territories—Administration, Resources, Development.
The Yukon Territory—Administration, Resources, Development.
Weather and Climate of the Northwest Territories.
Exploration and Settlement of Mackenzie District, N.W.T.
Yellowknife—General Information.
The New North.
Canada's Reindeer Herds (mimeo.).
General Information concerning the Alaska Highway—Canadian Section (multilithed bulletin).

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 estimated in February, 1947, was 7,581.

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, and 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 by acclamation for a three-year term in January, 1947, is composed as follows: Dawson District, John R. Fraser, Dawson; Mayo District, Ernest J. Corp, Keno Hill; Whitehorse District, R. Gordon Lee, Whitehorse. The Acting Controller of Yukon Territory is J. E. Gibben, K.C., Dawson.

Work of Council

The Yukon Council met on April 15, and was prorogued on May 9, 1946. The annual supply bill was passed, and new ordinances were approved as follows: Governing the Safe Operation of Mines; Respecting Fair Wages and Hours of Labour for Shop Employees; To provide for a Plesbiscite on the Question of bringing into Force an Ordinance to Incorporate the City of Whitehorse; to Exempt the Mayo Light Plant from Payment of Licence Fee. In addition, the following ordinances were amended: Motor Vehicle, Poll Tax, Forest Fires, Dental, Assessment, and Gasoline and Fuel Oil Tax Ordinances.

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.

Revenue and Expenditures

The revenue collected under Territorial Government ordinances during the year amounted to $102,705.19. The amount transferred from the liquor account was $362,700. The sum of $150,000 was transferred from the Yukon Post-War Work Fund. Expenditures from the Yukon Consolidated Revenue Fund amounted to $618,594.88. The Territorial Government received no grant from the Dominion Government during the year.

Mining

Prospecting under both the Placer and Quartz Mining Acts continued in the Territory, and increased activity occurred upon lands administered under the Quartz Mining Act. Great interest was shown in the Nansen-Victoria Creek area which lies west of Carmacks where Brown-McDade, Conwest, and other mining companies carried out a considerable amount of development work. To facilitate operations, a small landing strip for aircraft was prepared by the Brown-McDade Company. In the Mayo District, satisfactory progress was made by Keno Hill Mining Company Limited, successors to Treadwell Yukon Corporation, Limited. Approximately 59 tons of high grade silver-lead ore were produced during the winter months. Two other companies were

engaged in underground development and it was anticipated that one or both would be producing during 1947. Other silver-lead deposits were investigated by the Hudson Bay Exploration and Development Company Limited on the Upper Swift River.

Gold production for the year was 57,065·48 ounces, an increase of 17,015·51 over the preceding year. The total gold production, valued at $35 an ounce, amounted to $1,997,291.80, an increase of $595,543 over the preceding year. Practically all gold produced was derived from claims administered under the Placer Mining Act in the Dawson Mining District. A total of 2,676 grants and renewal grants was issued and 446 miles of prospecting leases were granted under the Placer Mining Act. Under the Quartz Mining Act, 826 grants were issued, an increase of 528 over the preceding year, and 774 grants were renewed, an increase of 142 over the preceding year. The total revenue collected from mining in the Territory was $78,677.64, made up as follows: quartz mining fees $14,022.44; quartz mining leases $800; placer mining fees $39,745.06; royalty on placer gold $21,362.12; hydraulic mining leases $2,390; dredging leases $244.30; and coal leases $113.72.

Order in Council P.C. 4574, dated June 4, 1943, which provided for the suspension during the war of representation work required by the Acts and Regulations which control mining in the Yukon Territory, was revoked as of December 31, 1946. As a result of this revocation, representation work upon all mineral grants was obligatory from January 1, 1947. The period in which such work, which came due in the first half of the year 1947, had to be done was extended to July 15, by an order of the Minister of Mines and Resources.

Gold Royalty.—The total amount collected for royalty on gold obtained from placer deposits up to March 31, 1947, was $5,373,483.76, of which $21,362.12 was collected during the fiscal year.

Dredging Leases.—Six leases permitting the lessee to dredge for minerals in the beds of the river in the Territory were in force, and comprised a total length of 34½ miles. The rentals received from this source up to March 31, 1947, amounted to $213,866.27, of which $224.30 was collected during the fiscal year. No new dredging leases were issued.

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 $223,028 have been collected to date on account of such locations. Of this total, $2,390 was received during the year.

Coal Mining Leases.—There are four coal mining leases in good standing in the Territory, two of which were issued during the year. The revenue from these leases amounted to $113.72.

Quartz Mining Leases.—Twenty quartz mining leases were renewed and two new leases were issued.

PLACER MINING

Of the 2,676 placer grants in good standing, 2,463 were situated in the Dawson Mining District, 81 in the Whitehorse District, and 132 in the Mayo District. The majority of the claims in the Dawson District were held by the Yukon Consolidated Gold Corporation, whose dredges were in operation for a period of 1,036 days, as compared with 536 days during the previous year. The labour requirements of this company are reported to be approximately

700 men for full-scale operations. During the year the company's maximum labour force was 406, and this figure dropped to 310 by the end of August. A total of 5,614,700 cubic yards was dredged by this company during the year.

Yukon Explorations Limited, which was incorporated to take over the assets of the Sunshine Mining Company (Yukon Division), held under lease 113 placer creek claims in the Sixtymile River drainage area, and in addition, 62 miles of placer prospecting leases under option. During the year 400,000 cubic yards of overburden were moved in preparation for dredging. It was reported that approximately 40 men would be employed by the company during 1947.

Yukon Gold Placers Limited continued operations at two camps, at Thistle Creek and Henderson Creek. More than 50 men were employed in preparing for the installation and operation of new steel dredges which were expected to go into production in 1947.

Clear Creek Placers Limited operated from April to November, and employed 24 men. The company's dredge was in operation for 142·6 days and handled 303,040 cubic yards of material, which produced 2,706·56 ounces of gold. A landing strip for aircraft was completed during the year. In the Mayo District, Fred Taylor, operating on Dublin Gulch, produced 608 ounces of gold, using a caterpillar tractor, bulldozer, and gasoline-operated derrick.

In the Whitehorse District gold production from placer operations showed an increase of more than 100 per cent over 1945-46. Most of the gold was produced at Shorty and Burwash Creeks in the Kluane Lake area, the more important producers being Barker and Ray on Shorty Creek, Burwash Mining Company Limited on Burwash Creek, Kluane Dredging Company Limited on Burwash Creek, and Frank MacDougall on Bullion Creek.

LODE MINING

Keno Hill Mining Company Limited made satisfactory progress in working the properties formerly held by Treadwell Yukon Corporation, and at the close of the year employed approximately 90 men. A mill with a daily capacity of 100 tons was operating at 50 per cent capacity and producing five tons of concentrates per day.

Mayo Mines Limited completed about 80 feet of tunnelling in prospecting the "Rio" group of claims. Yukon Northwest Explorations Limited carried on a limited amount of development on their holdings on Keno Hill and Galena Hill.

Operators in the Victoria Creek-Nansen Creek areas in the Whitehorse District included Brown-McDade Mines Limited, Conwest Exploration Limited, Nansen Yukon Mines Limited, Huestis Prospecting Syndicate, and Coleray-Yukon Mines Limited, as well as several individuals. Transportation of equipment and supplies was effected over a winter road connecting the approach road from the Alaska Highway to Aishihik aerodrome.

Active prospecting was continued in many sections of the Whitehorse District, including drilling operations undertaken by Hudson Bay Exploration and Development Company Limited on Logjam Creek and Upper Swift River. It is reported that this company is undertaking the construction of an access road from the Alaska Highway to properties on Sea Gull Creek and Crescent Lake. Prospecting was commenced on a group of 41 claims held by T. E. Noon in the vicinity of Aishihik Lake.

In the Dawson District, 427 new entries were granted as against 185 in the preceding year; in the Whitehorse District, 204 entries as compared with 36 in the previous year; and in the Mayo District, 195 new entries were granted as against 77 in the previous year. Renewals of quartz grants in the same districts were 279, 86 and 409 respectively, a total increase of 217 over the previous year.

ASSAY OFFICE

At the Assay Office maintained by the Territorial Government at Keno, 851 samples of rock were received from all parts of the Territory, and 1,179 assays or quantitative analyses were made. In addition, qualitative analyses and chemical tests were made in connection with identification and classification of various rocks and minerals of which no record was kept. The assays made were: gold and silver, 851; lead, 303; copper, 14; zinc, 10; manganese, 1.

LANDS AND TIMBER

Lands.—During the year 3 lots were sold and patented. There are now in force 10 agricultural leases; 4 grazing leases; 19 permits to occupy Dominion Lands; 24 waterfront leases; 2 miscellaneous leases, and 24 homestead entries.

The revenue from lands and Land Titles Office Fees was $8,475.25.

Timber.—The number of timber permits issued was 181, authorizing the cutting of 2,539,500 feet board measure of saw-timber and 14,379 cords of wood. Fourteen licence timber berths were in force. The total revenue amounted to $10,308.73.

In connection with the maintenance of the Alaska Highway in Yukon Territory, 24 leases of privately-owned lands were negotiated and 11 such leases were terminated during the year.

FOREST PROTECTION

The development of the Forest Protective Service in the Territory was continued. Additional equipment was received early in the season and distributed to strategic points along the Alaska Highway and the Yukon River and to Dawson and Mayo. Instruction in the use and care of the equipment was given to the Royal Canadian Mounted Police, seasonal wardens, and others. During the year, numerous inspections and patrols were made along the Alaska Highway, Haines Cut-off, Canol and access roads in Yukon Territory, a total of 19,500 miles being travelled. Suppressive action was taken on some 16 fires which burned approximately 21,000 acres during the season. Several small buildings within abandoned construction camps along the Alaska Highway were obtained for use as fire patrol cabins. Arrangements were made with the Royal Canadian Air Force, the Canadian Army, and land and air transportation companies operating in Yukon Territory whereby they would report immediately any fires observed. Permanent 60-foot radio antennae were erected at headquarters in Whitehorse and at Kluane Lake, and experiments were conducted in the use of portable two-way radio-telephones over distances extending from 25 to 150 miles.

The Officer in Charge continued to assist the Crown Timber and Lands Agent at Whitehorse in the administration of timber and public lands in southern Yukon. Activities in this connection included the locating of potential tourist camp-ground sites along the Alaska Highway, and arrangements for preliminary work on an addition to Whitehorse townsite. He also served as liaison officer for the Department in matters arising from the assumption by the Northwest Highway System of maintenance responsibilities for the Alaska Highway. The requirements and interests of the Department were presented and protected, particularly with reference to obtaining certain United States Army surplus buildings, equipment, and materials required by the various branches of the Department. Field work relating to the restoration of private property leased during construction of the Alaska Highway was continued, and a number of leases were terminated.

The Alaska Highway

Responsibility for maintenance of the Alaska Highway, together with access to airports along the Northwest Staging Route and flight strips bordering the highway, passed from United States authority to the Department of National Defence (Army) on April 1, 1946. The Alaska Highway and connecting roads in British Columbia and Yukon Territory are now known as the Northwest Highway System.

Airports along the Northwest Staging Route were maintained by the Royal Canadian Air Force, and flight strips bordering the highway were serviced by the Royal Canadian Engineers. The Royal Canadian Air Force also maintained the telephone and telegraph system paralleling the highway prior to turning it over to the Department of Transport for operation by Canadian National Telegraphs on April 1, 1947.

The Joint Traffic Control Board, with headquarters at Edmonton, continued to supervise travel on the highway until March, 1947, when its functions were assumed by the Department of Mines and Resources, assisted by the Royal Canadian Mounted Police, in whom responsibility for issuing travel permits was vested. An Advisory Committee consisting of representatives of the Department of Mines and Resources, the Northwest Highway System (Canadian Army), and Royal Canadian Mounted Police was formed to assist in formulating policy concerning the use of the highway. Restrictions in effect at the close of the fiscal year limited travel to persons having official business along the highway or in Alaska, bona fide prospectors, and organized hunting parties, accompanied by qualified guides. In addition, only operators of motor vehicles examined and passed as "roadworthy" were granted permits. Law and order along the highway were maintained by the Royal Canadian Mounted Police.

Bus services were operated regularly from Dawson Creek to Whitehorse and return by the British Yukon Navigation Company, and similar services were provided from Whitehorse to Fairbanks and return by O'Harra Bus Company, of Fairbanks, Alaska. Facilities for overnight accommodation of travellers were augmented by the opening of several additional stopping places, some of which provided meals and gasoline and oil service. Facilities for the maintenance and repair of motor vehicles, however, were still inadequate at the close of the year. A weekly trucking service was maintained over the highway by the British Yukon Navigation Company and, in addition, private trucking companies or individuals having legitimate business along the highway were granted permits.

The Haines Cut-Off Road connecting Haines, Alaska, with the Alaska Highway at a point approximately 100 miles west of Whitehorse, was opened for traffic during the summer of 1946. Considerable highway maintenance and bridge repair were necessary before the road was opened. The road was closed to traffic for the winter.

Engineers of the Engineering and Construction Service of the Department of Mines and Resources, who were located at Whitehorse, Y.T., and Fort Nelson, B.C., continued to make regular inspections of the highway, and furnished detailed reports describing its condition.

The Canol Project

The petroleum-distributing pipelines from Skagway to Whitehorse and from Whitehorse to Fairbanks, which were constructed as part of the Canol Project, were placed on an inoperative and stand-by condition during the year by the United States Government. Crude oil facilities, including the pipeline from Norman Wells to Whitehorse and the refinery at Whitehorse, were offered for sale by tender during the latter part of the fiscal year by the United States

Foreign Liquidation Commission. The date set for the closing of tenders was April 21, 1947. The service road paralleling the Canol pipeline from Johnson's Crossing to Norman Wells remained closed owing to washouts and lack of maintenance.

Roads, Bridges and Public Works

Expenditures on Territorial roads, bridges, and public works, including the purchase of equipment, amounted to $286,376.67. Landing fields for aircraft at Dawson and Mayo were maintained in good condition throughout the year despite the unusual severity of the winter.

During the year, officers of the Department of Transport made a survey of the air route from Whitehorse to Mayo and Dawson, the funds for which were provided by the Department of Mines and Resources. The purpose of the survey was to determine the feasibility of improving landing fields in use, select sites for alternate fields, and estimate the cost of improvement or new construction. Among the landing fields examined were those at Dawson, Mayo, Fort Selkirk, McQuesten, Minto, Yukon Crossing, Braeburn, and Carmacks. The construction of new emergency landing strips at Braeburn and Minto was recommended as a result of the survey.

Agriculture

Further progress was made by the Experimental Farms Service of the Department of Agriculture in establishing an agricultural substation at Pine Creek on the Alaska Highway, about 100 miles west of Whitehorse. Field tests were conducted in the summer of 1946 on land prepared in 1945. Approximately seven acres were devoted to cereal and forage trials and five acres to oats and barley. Samples from most cereal plots were later submitted to the Cereal Division, Central Experimental Farm, Ottawa, for appraisal, and the results obtained were generally satisfactory. During early summer, a virgin area of approximately 10 acres was brushed, plowed, and worked down for additional cropping in 1947, bringing to 30 acres the area available for this purpose. A new greenhouse was completed during the year.

In addition, garden trials of a fairly full range of common vegetables were undertaken, transplantation of tomatoes, cabbages, cauliflower, peppers, and cucumbers being made from flats developed in a greenhouse. The garden trials proved extremely encouraging, the common vegetables responding well. The tomatoes and cucumbers, however, were cut down by a light mid-summer frost.

It is planned to establish both cattle and poultry at the station in 1947, provided adequate buildings can be erected.

During the month of August, the Superintendent of the substation, J. W. Abbott, made a combined contact and inspection trip down the Yukon River system. Local pioneer agriculturists were visited and interviewed at various locations, and plots containing cereal and forage seed furnished by the substation were examined. Encouraging results were revealed. Mr. Abbott acted as judge of a vegetable and small fruit display at Dawson on August 17, the anniversary of "Discovery Day" (1896).

In the northern part of the Territory the season was drier than usual, but notwithstanding this condition, garden crops, with the exception of potatoes, were exceptionally good in the Dawson area.

Fur and Game

Collections made under the Fur Export Tax Ordinance amounted to $8,921.29, a decrease of $1,697.20 from the previous year. An increase in the number of cross fox, lynx, muskrat, and coyote pelts taken was reported. The

number of coyote pelts presented for tax was 40 as compared with 37 the previous year, and the number of wolf pelts 49, as compared with 63 the previous year. Revenue from Game Ordinance licences was $11,613, an increase of $6,203 from the previous year. Bounty payments for wolves and coyotes totalled $11,130.

Public Welfare

The health of the white population in the Territory was remarkably good during the year, Medical Health Officers in the various districts reporting a very low incidence of communicable diseases. However, an increase in tuberculosis among Indians was reported. The Venereal Disease Ordinance appeared to be functioning efficiently, and the incidence of venereal disease diminished greatly.

Registrations under the Vital Statistics Ordinance during the year were 225 births, 65 marriages, and 94 deaths. The Government hospital at Whitehorse and St. Mary's Hospital at Dawson were operated throughout the year. Grants toward their maintenance were provided by Council as follows: Whitehorse, $25,000; Dawson, $72,000. Hospital days for patients during the year were: Whitehorse, 9,221 for 700 patients; Dawson, 18,645 for 610 patients. Hospital days for indigent patients were: Whitehorse, a few days for 8 patients; Dawson, 11,329 days for 76 patients. A public nurse was employed in Mayo District for the full year. Increased activity in the Mayo Mining District necessitated the re-conditioning of the Mayo General Hospital, and during the year the building was repaired and orders were placed for a considerable amount of new equipment. Much difficulty was experienced in obtaining supplies, but at the end of the year it was expected that the hospital would be functioning within a few weeks.

The sum of $40,943.15 was expended for relief. A total of $4,721.49 was paid to St. Paul's Hostel, Dawson, for the care of all indigent half-breed and white children who attended the Dawson Public School.

Education

Seven schools were maintained in the Territory during the year, including two at Dawson and one each at Whitehorse, Mayo, Carcross, Brook's Brook, and Destruction Bay, the two last-named being located on the Alaska Highway. The total number of pupils enrolled during the school year ended June 30, 1946, was 385, and the total number of pupils enrolled as of March 31, 1947, was 432. The number of teachers employed was 14. The total amount expended on schools and education was $71,860.61.

Law and Order

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

Scientific Surveys

Scientific surveys in various fields were undertaken or continued by officers of the Department. A location survey for a road between Jake's Corner, on the Alaska Highway, and Atlin, B.C., was made by the Surveys and Engineering Branch, and plans, profiles, and cost estimates were prepared. A reconnaissance survey and a preliminary estimate of cost were also made of the Whitehorse-Mayo section of the proposed road from Whitehorse to Dawson. Triangulation work, commenced at Whitehorse in 1945, was continued by the Geodetic Service along the Alaska Highway, and by the end of the season had been completed as far as the British Columbia-Yukon boundary south of Teslin village. Level-

ling between Edmonton and Whitehorse was continued, and the year's work brought to completion a line of precise levels 1,400 miles in length between these places. The legal survey along the Alaska Highway was extended from Whitehorse to a point about 25 miles northwest of Burwash Landing, a distance of 200 miles. Gauging stations were maintained by the Dominion Water and Power Bureau on the important streams along the Alaska Highway, and provided a continuous record from which available water power resources were calculated. An engineer of the Engineering and Construction Service, stationed at Whitehorse, acted as a Departmental observer on the Alaska Highway, and made periodic reports on all phases of maintenance and reconstruction. The Canadian and United States Commissioners of the International Boundary Commission made a joint inspection of various points on the Yukon-Alaska boundary, particularly in the area where this boundary is crossed by the Alaska Highway. A survey party also cleared sections of the boundary near the Alaska Highway.

Geological investigation was continued in the Territory during the year by three parties of the Geological Survey of Canada. One party commenced a revision and more thorough study of the Whitehorse area, formerly a source of copper ore. Geological work was also continued in the McQuesten area between Mayo and Dawson, and commenced in the Dezadeash area west of Whitehorse. A party from the National Museum of Canada continued archaeological investigations in northwestern Yukon, with a view to tracing the migration routes from Siberia of the aboriginal inhabitants of North America.

LAND REGISTRY

The Land Registry deals chiefly with lands remaining under the control of the Dominion. A Central Office of Record is maintained in which lands controlled by other departments are listed and certain Ordnance and Admiralty Lands are administered, as well as Dominion Public Lands, Soldier Settlement charged lands, and lands which were reserved to the Dominion when the natural resources were transferred to the Western Provinces. Accounts of advances for seed grain, fodder, and relief made to settlers in the Western Provinces are kept in the Land Registry, which, in conjunction with the Provinces, deals with applications for the adjustment or apportionment of these accounts. The Land Registry issues Letters Patent, administers matters connected with the purchase of lands acquired for the Alaska Highway, and also administers the mineral rights reserved by virtue of Section 57 of the Soldier Settlement Act.

The Land Registry lost two of its senior members during the year in review. J. Lorne Turner, Registrar of Lands, died in July, 1946, and A. R. Chevrier, who had charge of seed grain work, passed away in March, 1947. These men gave many years of outstanding service to the Department.

During the year a number of veterans of the recent war were taken on the staff.

Central Office of Record

The Central Office of Record maintained by the Land Registry receives many requests from other Government departments and the general public for information regarding the ownership of particular parcels of land. At present the Central Office has 6,636 parcels listed, and this number is being increased by the addition of land acquired during the war years.

Ordnance and Admiralty Lands

The Ordnance and Admiralty Lands are areas in the Maritime Provinces, Quebec, and Ontario which were, because of their strategic situation, reserved or acquired by the Crown. They were transferred to this Department to be

administered, and have been made revenue producing whenever possible by being placed under lease. During the year a portion of the Levis Military Reserve was transferred to Land Registry control; thirty-eight sales of Ordnance Lands were completed to private individuals, corporations, and provincial governments; two areas in the Clayoquot district were transferred to the Province of British Columbia; fifteen investigations of lands in New Brunswick, Quebec, Ontario, and British Columbia were carried out; surveys were made of lands in New Brunswick, Quebec, Alberta, and British Columbia, and eighty-six leases and two permits were issued. The net revenue from Ordnance and Admiralty Lands in rentals, sales, and assignment fees was $23,408.90.

Public Lands

Lands, controlled by other departments and no longer required for the purpose for which they are obtained, are transferred to the Land Registry for administration and disposal. One parcel of these lands was sold during the year to the Government of the Province of Prince Edward Island, and seven areas were sold to corporations and private individuals. Nine inspections of Public Lands in Quebec, Ontario, Alberta, and British Columbia were made. The net revenue, consisting principally of rentals, fees, and land sales, amounted to $43,571.06.

Soldier Settlement Charged Lands

Lands in the four Western Provinces against which charges under the Soldier Settlement Act are registered remain vested in the Dominion. There are eighty-six quarter-sections remaining, comprising approximately 13,500 acres, divided as follows: Manitoba, 1,120 acres; Saskatchewan, 6,460 acres; Alberta, 5,440 acres; British Columbia, 480 acres. Crown Grants are issued to settlers who complete their duties in accordance with the terms of the Dominion Lands Act, if their indebtedness to the Soldier Settlement has been liquidated. If the indebtedness is still unpaid when the duties are completed, or if the entrant on the land desires this action to be taken, patent may be issued in the name of the Director of Soldier Settlement. During the year nine patents were issued, one in the name of the Director of Soldier Settlement of Canada and eight in the name of the various entrants.

Timber and Grazing Within the Provinces

Timber.—Within the boundaries of the National Parks there are eleven licence timber berths covering a total area of 61·212 square miles. Two are in Manitoba and nine in British Columbia. Licences, in duplicate, were issued for each berth. The year's revenue amounted to $2,923.11.

One timber permit berth is in force on the Dominion Government Coal Block near Hosmer, B.C. The revenue collected during the year was $288.81.

Throughout the year timber cutting operations were carried on at Ordnance Reserve No. 1 and Naval Reserve A on St. Joseph Island in Lake Huron. The revenue amounted to $283.35.

Grazing.—In southern Saskatchewan annual grazing permits were issued on Dominion Lands covering a total area of 9,916 acres and sworn returns by the permittees indicated that for the grazing season 1946 there were 560 cattle and 106 horses on the lands. The revenue collected, consisting of ground rental, amounted to $172.64.

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 1,560 cases by the Alberta, Saskatchewan, and Manitoba Adjustment Boards.

These recommendations were ratified by Orders in Council and 2,012 discharges and releases of liens were issued. As a result of indebtedness amounting to $202,433.40 was written off. A total of 2,721 inquiries was received from the provinces for statements of outstanding indebtedness relative to the issue of land grants, and 210 certificates of indebtedness were issued. In addition, 5,460 inquiries were received from Debt Adjustment Boards in the Western Provinces. Gross collections for the fiscal year amounted to $85,125.67. The sum of $3,069.04 was refunded, leaving a net revenue of $82,056.63.

As the staff engaged in 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, 1947:

	Principal	Interest	Total
Debits—			
Balance outstanding March 31, 1946	$2,406,911 55	$3,577,336 66	$5,984,248 21
Accrued interest April 1, 1946, to March 31, 1947		137,726 21	137,726 21
Total debits	$2,406,911 55	$3,715,062 87	$6,121,974 42
Credits—			
Net revenue, April 1, 1946, to March 31, 1947	56,418 88	25,637 75	82,056 63
Amount written off as loss by Orders in Council—(Sec. 1 Chap. 51, 17 George V.)	54,648 82	147,784 58	202,433 40
Total credits	$ 111,067 70	$ 173,422 33	$ 284,490 03
Amount outstanding March 31, 1947	$2,295,843 85	$3,541,640 54	$5,837,484 39

SUMMARY

Province of Manitoba

	Principal	Interest	Total
Debits—			
Amount outstanding March 31, 1946	$ 10,559 53	$ 17,044 30	$ 27,603 83
Accrued interest April 1, 1946, to March 31, 1947		555 21	555 21
Total debits	$ 10,559 53	$ 17,599 51	$ 28,159 04
Credits—			
Net revenue April 1946, to March 31, 1947	$ 377 62	$ 129 81	$ 507 43
Amount written off as loss by Orders in Council	144 80	931 79	1,076 59
Total credits	$ 522 42	$ 1,061 60	$ 1,584 02
Amount outstanding March 31, 1947	$ 10,037 11	$ 16,537 91	$ 26,575 02

SUMMARY

Province of Saskatchewan

	Principal	Interest	Total
Debits—			
Amount outstanding March 31, 1946	$1,562,705 26	$2,273,824 89	$3,836,530 15
Accrued interest April 1, 1946, to March 31, 1947		89,092 24	89,092 24
Total debits	$1,562,705 26	$2,362,917 13	$3,925,622 39
Credits—			
Net revenue April 1, 1946, to March 31, 1947	$ 46,543 27	$ 22,437 15	$ 68,980 42
Amount written off as loss by Orders in Council	14,756 19	66,731 89	81,488 08
Total credits	$ 61,299 46	$ 89,169 04	$ 150,468 50
Amount outstanding March 31, 1947	$1,501,405 80	$2,273,748 09	$3,775,153 89

SUMMARY

PROVINCE OF ALBERTA

	Principal	Interest	Total
Debits—			
Amount outstanding March 31, 1946	$ 833,621 76	$1,286,427 47	$2,120,049 23
Accrued interest April 1 1946, to March 31, 1947		48,078 76	48,078 76
Total debits	$ 833,621 76	$1,334,506 23	$2,168,127 99
Credits—			
Net revenue April 1, 1946, to March 31, 1947	$ 9,497 99	$ 3,070 79	$ 12,568 78
Amount written off as loss by Orders in Council	$ 39,747 83	$ 80,120 90	$ 119,868 73
Total credits	$ 49,245 82	$ 83,191 69	$ 132,437 51
Amount outstanding March 31, 1947	$ 784,375 94	$1,251,314 54	$2,035,690 48

SUMMARY

PROVINCE OF BRITISH COLUMBIA

Amount outstanding March 31, 1947	$ 25 00	$ 40 00	$ 65 00

LETTERS PATENT

During the fiscal year there were 46 Letters Patent issued covering a total of 2,959 acres, divided according to provinces as follows:

	Patents	Acres
Manitoba	4	647
Saskatchewan	10	1,490
Alberta	6	693
Northwest Territories	23	121
Yukon Territory	3	8
	46	2,959

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

	*Homesteads		*Soldier Grants		†Special Grants		Sales	
	Patents	Acres	Patents	Acres	Patents	Acres	Patents	Acres
Manitoba	3	487	1	160	.....	.....	.....	.....
Saskatchewan	5	719	4	612	1	159	.....	.....
Alberta	2	320	3	369	.....	.....	1	4
Northwest Territories	.....	.....	.....	.....	.....	.....	23	121
Yukon Territory	.....	.....	.....	.....	.....	.....	3	8
Totals	10	1,526	8	1,141	1	159	27	133

* 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 is included land entered for by a returned soldier affected by a loan from the Director of Soldier Settlement of Canada, which land was patented to the said Director at the request of the entrant under the Soldier Settlement Act.

There were 227 certified copies of Letters Patent issued during the fiscal year, for which the Department received $700.

ALASKA HIGHWAY LAND ACQUISITION

In connection with the acquisition of land for the right-of-way of the Alaska Highway, title for seven parcels has been secured. The remaining seven are in the hands of the Department of Justice. Negotiations in connection with

camp-sites and flight strips have been completed in six cases, and the remaining one, in which expropriation proceedings were necessary, is in the hands of the Department of Justice. Easements have been secured covering three parcels on the water line to Dawson Creek. Crown Grant has not been completed in three cases, while the fourth has been expropriated through the Department of Justice. Of a total of nine easements required on the water line to Fort St. John, seven have been secured; the remaining two are now in the hands of the Department of Justice pending the settlement of the estates of the original owners of the property. All telephone and telegraph easements have been completed both in Alberta and British Columbia, with the exception of two which have been delayed due to the absence of the property owners. These are now in hand.

NATIONAL PARKS BUREAU

There are eighteen National Parks and nine National Historic Parks established across the Dominion, with each of the provinces having one or more of them within its boundaries. These parks are administered under the National Parks Act, the authority and provisions of which also cover the many National Historic Sites and Monuments set aside in all parts of Canada to perpetuate leading men and events in national history. Besides the controlling staff at Ottawa, a resident superintendent is located in each of the principal parks and is assisted by a capable staff in the handling of his administrative duties. A scientific service is maintained in the National Parks Bureau to advise on wild-life problems and to administer the Migratory Birds Convention Act.

It is proposed to abolish Buffalo Park and Nemiskam Park in Alberta and to withdraw certain parcels of land from Waterton Lakes Park in Alberta, Prince Albert Park in Saskatchewan, and Riding Mountain Park in Manitoba. At the same time it is proposed to add to Fort Beausejour Historic Park, New Brunswick, three small tracts of land containing important historical features, to attach a section of land to Riding Mountain Park in exchange for another section to be withdrawn, and to add 23·6 square miles of pasture land to Elk Island Park in order to provide sufficient range to guarantee the preservation in a healthy condition of the herd of buffalo located there.

TRAVEL TO THE PARKS

During the fiscal year 1946-47 the National Parks resumed their normal rôle as outstanding tourist attractions and made a major contribution to the well-being and morale of the many Canadians who visited these areas, dedicated to them for their benefit, education, and enjoyment.

The considerable increase in the number of visitors to the parks which became so evident with the termination of hostilities in World War II during the preceding year was continued during the period under review. The attendance figure reached pre-war levels, and was only slightly less than the record established in 1940. Of the 992,745 visitors recorded, nearly 210,000, or approximately twenty-one per cent, came from outside Canada, mostly from the United States.

The number of visitors to each park and a comparison with the tabulation of the previous year are given in the following table:

National Parks

—	1946-47	1945-46	Increase
Banff	246,397	148,113	98,284
Cape Breton Highlands	23,896	18,863	5,033
Elk Island	39,976	24,939	15,037
Georgian Bay Islands	6,591	3,842	2,749
Glacier	461	330	131
Jasper	29,191	16,127	13,064
Kootenay	64,530	28,326	36,204
Mount Revelstoke	8,542	6,474	2,068
Point Pelee	87,150	59,948	27,202
Prince Albert	31,474	18,858	12,616
Prince Edward Island	50,281	48,068	2,213
Riding Mountain	161,237	108,060	53,177
St. Lawrence Islands	15,824	10,809	5,015
Waterton Lakes	126,337	46,744	79,593
Yoho	23,015	10,868	12,147

National Historic Parks

Fort Anne	8,754	5,544	3,210
Fort Beausejour	12,023	5,343	6,680
Fort Chambly	22,546	16,203	6,343
Fort Lennox	1,223	655	568
Fortress of Louisbourg	4,238	3,126	1,112
Fort Malden	17,335	15,279	2,056
Fort Wellington	5,699	2,594	3,105
Port Royal Habitation	6,025	3,296	2,729
Totals	992,745	602,409	390,336

Among the many distinguished visitors to the National Parks during the year were Their Excellencies, the Governor General of Canada and Viscountess Alexander of Tunis, who visited Banff and Jasper Parks, and Field Marshal Montgomery, who visited Jasper Park.

DIRECT REVENUE

The net revenues from the National Parks Services and from the administration of the Migratory Birds Convention Act for the fiscal year 1946-47 amounted to $422,219.91 and $1,229.50, respectively, totalling $423,449.41, an increase of approximately 37·6 per cent over the total of $307,831.06 for the preceding year.

CONSERVATION SERVICES

Forest Protection

Every possible effort was made to maintain and increase the efficiency of the fire-fighting organization in all phases, including personnel, fire-detection and suppression, transportation, and communication. Improvement work was affected adversely by the prevailing shortages in labour, materials, and new equipment, so that no new fire lookouts were completed during the year. A considerable amount of preliminary work was done toward the establishment of the Geraldine lookout in Jasper Park and the Aylmer lookout in Banff Park, however, and it was expected that both would be completed in 1947. Panoramic infra-red photographs were completed for most of the lookouts in both Banff and Jasper Parks to assist the lookout men in describing more accurately the location of fires which come under their observation.

New fire-fighting equipment, including twelve portable gasoline pumps, one booster pump, and 21,500 feet of hose, was purchased to replace articles worn out during the war years.

FIRE WEATHER STATIONS

Stations which take readings several times a day of factors affecting the rate of spread of forest fires, such as wind velocity, temperature, precipitation, relative humidity, and rate of evaporation, were in continuous operation from early in May until the end of September in Banff, Jasper, Yoho, Waterton Lakes, Prince Albert, and Riding Mountain Parks. These stations maintain charts showing the fire hazard conditions at stated times throughout the day and make short range forecasts of weather conditions likely to occur, in order to guide the responsible officers in disposing their staffs, crews, and equipment. They also co-operate with the Meteorological Service of the Department of Transport, wiring certain weather data every day and receiving in return daily forecasts to supplement their information and charts.

FIRE LOSSES IN NATIONAL PARKS

During the year 1945 a record was established for the small number of forest fires started and the small extent of the areas burned. This reflected not only the very efficient services of the fire-fighting and prevention organizations, but a very favourable fire-hazard condition. During the latter part of May and early in June, and again during July and August, 1946, extremely hazardous forest fire conditions prevailed. This situation resulted in forty-nine fires being reported, compared with nineteen during the preceding year. However, due to the promptness with which they were reported and the efficient action taken in extinguishing them, they were mostly confined to spot fires, or those of small dimensions.

The number of forest fires in each park, the areas burned, the costs of suppression, and a comparison with the figures of the preceding year are given in the following table:

Park	Number of Fires		Area Burned Acres		Cost of Suppression	
	1946	1945	1946	1945	1946	1945
					$ cts.	$ cts.
Banff	19	4	2	2¼	396 05	69 52
Jasper	7	1	248	9½	2,137 46	4 25
Glacier	1	2	2½	131	206 30	351 92
Kootenay	3	3	161	4½	440 58	132 67
Yoho	9	0	1½	0	304 18	0 00
Mount Revelstoke	0	3	0	1¾	0 00	483 28
Waterton Lakes	4	2	Spot	Spot	4 30	2 50
Elk Island	1	1	1,120	Spot	408 11	5 00
Prince Albert	2	2	177	½	55 13	70 00
Riding Mountain	1	0	65	0	5 34	0 00
St. Lawrence Islands	0	0	0	0	0 00	0 00
Point Pelee	1	0	Spot	0	0 00	0 00
Georgian Bay	0	0	0	0	0 00	0 00
Cape Breton	0	1	0	4	0 00	142 77
Prince Edward Island	1	0	Spot	0	0 90	0 00
Total	49	19	1,777	153¾	3,958 35	1,261 91

An analysis of the causes of these fires shows that lightning was responsible for 32·6 per cent of the total; smokers 24·4 per cent; campers 14·2 per cent, and miscellaneous known causes 12·1 per cent, and that the remaining 16·7 per cent were attributable to settlers, the railways, or to causes unknown.

INSECT CONTROL

An infestation of bark beetle (dendroctonus monticolae) similar to earlier outbreaks which had constituted a serious threat to other large tracts of pure lodgepole stands in the western parks, was discovered in a stand of lodgepole pine (pinus contorta) near Leanchoil in Yoho Park. These attacks had been successfully controlled in Banff and Kootenay Parks by the standard method of cutting and burning the infested trees during the winter months, and it was decided to use the same method to control the infestation in the Leanchoil area.

Due to the scarcity of labour, this work during the winter of 1945-46 was limited to January, February, and March. The operation was resumed in October, 1946, but the labour situation proved even more difficult, particularly as to the type of labour then available. As a result, the costs of the operation became excessive and with the exhaustion of the appropriation the camp was closed in December, 1946. The infestation continues to be active and further control work is planned for 1947.

DISPOSAL OF TIMBER UNDER ANNUAL CUTTING BUDGET

Disposal of saw-timber, fuel-wood, and other forest products to local settlers under the annual cutting budget was continued in Riding Mountain Park. In comparison with that of 1945-46 this year's cut showed a considerable increase in saw-timber, principally in hardwood, the cut of coniferous species remaining well within the limit allowed under the working plan. During the current year 2,103 permits were issued for 3,788,250 feet board measure saw-timber, 19,605 cords of fuel-wood, 69,832 posts, and 12,017 trees.

WILDLIFE MANAGEMENT

Studies of animal populations, disease, and range conditions for big game in the National Parks were continued. Capt. A. W. F. Banfield, Parks Mammalogist, conducted investigations in the mountain parks during the summer of 1946, and began studies of predation and range conditions in Prince Albert Park and Cape Breton Highlands Park during the winter of 1946-47. Dr. Ian McTaggart Cowan, of the University of British Columbia, continued winter range studies in the mountain parks. Wildlife, including big game species, was found to be in fairly good condition. Because of continued serious overgrazing in Banff and Jasper Parks, large numbers of surplus elk were removed. The dressed meat and hides were given to the Indian Affairs Branch for distribution to Indian reservations. Investigations in 1947 will show whether the reduction of elk has been adequate to prevent further destruction of range.

Owing to threatened depletion of food supply and damage to certain scenic locations, it was necessary to trap a number of beaver alive in Jasper, Banff, and Waterton Lakes Parks. Fifty-seven animals were donated to the Indian Affairs Branch for liberation on Indian trapping areas elsewhere in Alberta. No marten were live-trapped during the year.

Some control of predators was effected in certain National Parks, especially on park borders in the vicinity of cultivated and stock-raising areas.

WILD ANIMAL PARKS

In order to avoid damage to the range in Elk Island Park by over-use, it was necessary to slaughter 200 elk and 66 buffalo. The meat and hides of the elk were donated to the Indian Affairs Branch for distribution to the Indians. Sixty-two buffalo hides and the meat of 53 buffalo were sold by tender. The meat of 13 buffalo was set aside for Banff Indian Days in 1947 and for other special purposes. Thirty-two buffalo were slaughtered at Riding Mountain Park as part of a program to ensure maintenance of a moderate-sized, healthy

herd. The meat and hides of these buffalo were sold by tender. Two buffalo were slaughtered at Prince Albert Park to protect the allotted range from over-use. The meat was given to the Indian Affairs Branch and the hides were sold by tender.

Three hundred and seventy-five surplus elk were slaughtered in Jasper Park because of the serious condition of over-population of elk and in order to preserve and restore the natural ranges, which were becoming seriously overgrazed. The dressed meat and hides were donated to the Indian Affairs Branch.

For similar reasons, 321 surplus elk were slaughtered in Banff Park. The hides and dressed meat were donated to the Indian Affairs Branch.

A census of wild animals in fenced enclosures in National Parks as of March 31, 1947, is as follows:

Species	Banff Park Paddock	Elk Island Park	Prince Albert Park Paddock	Riding Mountain Park Paddock	Total
Buffalo	9	1,019	6	22	1,056
Elk	.....	552	.....	168	720
Moose	.....	390	.....	.....	390
Mule deer	.....	96	.....	1	97
White-tailed deer	.....	.....	.....	15	15
Rocky Mountain goat	1	.....	.....	.....	1
Rocky Mountain sheep	1	.....	.....	.....	1
Total	11	2,057	6	206	2,280

FISHING AND FISH CULTURE

Fishing in the National Parks of Canada was reported good by the majority of experienced anglers, and fine catches of all game species were reported in the creel census.

In addition to the six parks in which creel census data have been collected for several years, Prince Edward Island Park, Riding Mountain Park, and Cape Breton Highlands Park have commenced similar operations. Increased co-operation in the return of the census cards was received from the anglers during the past year. Cards completed for use in fisheries research totalled 2,068.

During the summer of 1946 Dr. V. E. F. Solman, Parks Limnologist, carried out studies in nine western parks. These investigations produced data for guidance in the development of park policies of fish management, for improvement of the angling, and for more efficient utilization of hatchery products.

General conditions in Banff Park seemed to have improved in all waters, except for lake trout fishing in Lake Minnewanka. The Third Vermilion Lake was overfished. The Engineering and Construction Service carried out experiments with the use of Bow River water at the Banff hatchery. The Bow River water was found to be warmer and therefore more suitable than the present supply, with the exception that heavy silting takes place during warm weather.

In Cape Breton Highlands Park, extremely dry weather and low water in all streams throughout the fishing season were believed responsible for unusually small catches. Good catches of trout were reported from the Clyburn, North Aspy, and MacKenzie Rivers, and some sixty salmon were reported taken in the Cheticamp River. Plans have been made to carry out a limnological investigation of the waters in this park.

Fishing in the streams of Glacier Park was generally poor throughout the season.

Fishing in Jasper Park was "spotty", although it was the opinion of anglers that plenty of fish were present. Weather conditions probably affected the angling, and it is known that many inexperienced anglers were fishing during the season.

From the Jasper hatchery 121,000 rainbow trout eggs and 54,600 Eastern brook trout eggs were transferred to Banff Park, and 100,000 rainbow eggs to Waterton Lakes. Sixty thousand rainbow fingerlings were also forwarded to Banff Park.

Angling was poor throughout the season in Kootenay Park, due to unusually high water in the early summer, and consequent muddiness.

Fishing was good in Mount Revelstoke Park, and favourable reports were received of the fishing in Millar Lake, Eva Lake, and Lake of Jade.

The quality of the angling in Prince Albert Park was generally better than last year. Good catches of pickerel, pike, and bass were reported from Waskesiu, Crean, and Heart Lakes. A noticeable increase of fishermen visited Kingsmere Lake, and good catches of lake trout were taken in the early part of the season. Netting of whitefish in Waskesiu Lake was again permitted to a limited extent during the summer, for local use only.

During 1946 fishing conditions in Prince Edward Island Park were generally poor, although some very good trout were taken from the Lake of Shining Waters, and Long Pond. A limnological investigation of the waters is planned for 1947.

Fishing in the lakes in Riding Mountain Park showed some improvement over past years, no doubt due to the higher lake levels. Another shipment of approximately 328 mature lake trout was made from Clearwater Lake, north of The Pas, to Clear Lake.

Angling in Waterton Lakes Park was fairly good. There were good catches of lake trout from Waterton Lake and very good catches of eastern brook trout from Cameron Lake early in the season; excellent catches of trout were made from Lineham Lake.

In Yoho Park the fishing in the lakes and streams was generally poor throughout the season except in Lake O'Hara, where several 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	278,000	120,000	72,000	.....	470,000
Jasper	127,350	.....	33,190	.....	160,540
Kootenay	30,000	40,000	.....	.....	70,000
Waterton Lakes	69,875	73,900	.....	.....	143,775
Yoho	15,000	.....	.....	.....	15,000
Riding Mountain	.....	.....	.....	328	328
Total	520,225	233,900	105,190	328	859,643

Provincial-Dominion Wildlife Conference

The Eleventh Provincial-Dominion Wildlife Conference was held in Ottawa February 27 and 28, 1947. This conference of Provincial and Dominion officials who co-operate in the conservation of Canadian wildlife resources is of great value in the promotion of scientific research and the solution of administrative problems. The United States Fish and Wildlife Service was well represented.

Resolutions were adopted relating to the following subjects: increased protection for North American waterfowl; stimulation of wildlife research in Canada; uniformity in restrictions on firearms; establishment of courses in wildlife management in Canadian universities; uniform fur royalty schedule; the importation of scientific publications into Canada; safeguarding of biological resources in international, interprovincial, and provincial waters where alterations in waterways and water areas are proposed; investigation of the status of barren ground caribou; establishment of a "Wildlife Conservation Week"; adequate control of the use of aircraft for transporting hunters and tourists into remote areas; and investigation of crop damage by sandhill cranes in parts of Canada.

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.

Under the Migratory Birds Convention Act there are reserved in Canada, under federal control, bird sanctuaries covering a total area estimated at 1,356 square miles.

The Ontario Provincial Hannah Bay Waterfowl Sanctuary was established a bird sanctuary under the Migratory Birds Convention Act, and was included in the Federal Hannah Bay Bird Sanctuary (N.W.T.), during the period under review.

During the year, 1,095 permits and licences were issued. Distributed printed material comprised 5,251 copies of the Migratory Birds Convention Act and Regulations, 14,551 Abstracts of the Regulations, 41,558 posters, and 6,629 educational pamphlets.

Field administration of the Act was continued under the supervision of four district officers. The title of these positions has been changed from Chief Federal Migratory Bird Officer to Dominion Wildlife Officer. Throughout the year, the Dominion wildlife officers conducted investigations of the waterfowl situation. They supervised, in their respective districts, a special inventory of wintering waterfowl. This was the first year in which Canada participated in this census, which is continental in scope.

The Dominion Wildlife Officer for British Columbia conducted special investigations on wildlife in the Cariboo and Vanderhoof regions, and at Sixteen Mile Lake, Frances Lake, and Lakelee Lake. He also investigated various waterfowl habitat improvement projects, and studied the problem of oil pollution in coastal waters.

The Dominion Wildlife Officer for the Prairie Provinces investigated waterfowl conditions at various P.F.R.A. projects, carried out joint inspections of certain bird sanctuaries with provincial authorities, made special investigations of wildlife in Prince Albert and Riding Mountain National Parks, and engaged in varied field research.

The Dominion Wildlife Officer for Ontario and Quebec patrolled and inspected the ten bird sanctuaries on the north shore of the Gulf of St. Lawrence, and added to the coloured motion picture of this region which was begun in the previous year. Special studies were made in Point Pelee National Park, and in other areas, in co-operation with the provinces. An investigation of the blue goose situation in James Bay was begun, and will be continued.

The Dominion Wildlife Officer for the Maritime Provinces made studies of woodcock populations, the waterfowl situation, and condition of the eelgrass.

Officers of the Bureau delivered many illustrated lectures during the year, and in other ways disseminated information relating to migratory birds and their conservation.

In 1946, the general waterfowl population throughout Canada showed a considerable decrease, due, it is believed, to a poor nesting season and increased hunting pressure. This situation led to shortened seasons and other increased restrictions on waterfowl hunting.

As of December 31, 1946, the official Canadian bird-banding records contained 497,482 records of birds that had been banded, and a total of 33,406 detailed records of recovery of birds that carried bands.

Persons who recover birds wearing official bands are urged to further the success of bird-banding by reporting the details. No postage is required on reports related to banded birds if they are directed to the Controller, National Parks Bureau, Ottawa, Canada.

The Bureau was represented at the Sixty-fourth Meeting of the American Ornithologists' Union in Urbana-Champaign, Illinois, September 2-6, 1946; the Twelfth North American Wildlife Conference in San Antonio, Texas, February 3-5, 1947; and the annual meeting of The International Association of Game, Fish, and Conservation Commissioners in St. Paul, Minnesota, September 9-11, 1946. Two papers were presented at the latter two meetings—one on wildlife conditions in Canada and one on the Canadian waterfowl situation.

MAINTENANCE AND IMPROVEMENTS

Due to the prior national need of homes and the shortages in labour, materials, and equipment, no new work or improvement of major importance was undertaken in the National Parks during the year. However, all facilities such as highways, roads, bridges, trails, telephone lines, buildings, and municipal services were maintained in a state of efficient operation.

Roads and Bridges

The work done under this heading consisted of repairs to road grades, surfaces, bridges, and culverts in order to keep them in good condition for traffic. In Banff Park work was done on the Eldon revision, preparing the subgrade for asphalt paving; a new road into the rock quarry was commenced, and 700 feet of new road was built from Calgary Highway to Bungalow Camp "A". Four miles of fire road was built to extend the Cascade fire road toward Flint's Park, and 8 miles of the Healey Creek fire road was improved. In Yoho Park a new steel bridge over the Kicking Horse River at Leanchoil was completed, and in Prince Edward Island Park a half mile of secondary road was built. In Cape Breton Highlands, a new road was made from near Mile 8 on the main highway into Warren Lake, as well as a short road from the athletic field to the Keltic Lodge road.

Trails

In Banff Park, 3½ miles of trail was rebuilt and 2 miles of new horse trail was constructed, while in Jasper Park 2 miles of fire trail was constructed at Mile 9 of the Medicine Lake River road.

Communication Systems

No new construction work was carried out on telephone systems in the National Parks except in Jasper, where one mile of forest line was constructed along the East Highway, Mile 17 to 18. All telephone lines in the various parks

were maintained in good working order, and in Banff and Cape Breton Highlands considerable equipment was installed for radio communication. This has been working satisfactorily and has proved of considerable value where wire lines have not been built.

The following table indicates the existing mileage of roads, trails, and telephone lines within the National Parks, as of March 31, 1947:

National Parks	Roads				Trails	Telephone Lines
	Motor	Secondary	Fire	Total		
	Miles	Miles	Miles	Miles	Miles	Miles
Banff	182·4	10·5	98·5	291·4	745·55	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	592·1	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	3·0	.....	10·1	.....	.....
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	152·3	363·2	1,214·8	2,352·25	1,188·1

Buildings

Building activity undertaken by the Parks Administration during the year was confined mostly to maintenance, repairs, and alterations, although a few small buildings which were urgently required were constructed.

In Banff Park, preliminary steps were taken by the administration for the removal to Banff of 33 buildings from Seebe Internment Camp, as well as 4 additional buildings which were being dismantled prior to removal. Wardens' cabins were completed at Stoney and Goat Creeks, the Healy Creek cabin was remodelled, a storage shed was built at Lake Louise Warden Station, and a floating boathouse constructed at Lake Minnewanka. In Tunnel Mountain camp-ground, 23 emergency shelter cabins for war veterans and one service building were built. In Kootenay Park, several small buildings were erected; a root house and a storage and office building were constructed at Radium Hot Springs, and a patrol cabin was built on Whitetail Creek northwest of Kootenay Crossing. Two single residences were started in Waterton Lakes Park to house members of the park staff who would otherwise have been unable to obtain year-round living accommodation in the townsite, while in Yoho Park 2 frame buildings were constructed for the storage of mechanical equipment and calcium chloride. In Cape Breton Highlands Park, 2 log cabins were completed along the highway between Pleasant Bay and Cheticamp, while in Elk Island Park a building to provide living accommodation for the staff was completed at the park headquarters.

Townsites

The National Parks Bureau is responsible for providing normal municipal facilities in the townsites, such as streets; sidewalks; and public health services, including sewers, water supply, and garbage collection and disposal; and the control of building design, taking into account the utilitarian, aesthetic, and fire-prevention factors. These municipal services are operated on a repayment basis.

The general shortage in the supply of labour, materials, and new equipment increased the problems of those responsible for the operation of the municipal services, and although they were maintained efficiently, projects for improving or extending them were in some cases curtailed or delayed.

In Banff the Deer Street area was levelled and water and sewer lines were started to serve the newly constructed veterans' houses. A chlorinating plant was installed to treat the town water supply upon the firm recommendation of engineers of the Department of National Health and Welfare. At Radium Hot Springs in Kootenay Park a new dam was constructed at the water supply intake, while in Riding Mountain Park a transmission line was built from Erickson to Wasagaming to supply the latter with electric power from the Manitoba Hydro System.

Tourist Accommodations and Camp-grounds

The year was marked by the restoration of normal tourist facilities which, in some cases, were expanded. These facilities are of two general kinds. First there are the public camping and picnic grounds which are maintained and operated by the Parks Administration. And secondly, there are those maintained and operated by private enterprise.

The National Parks Bureau has laid out public camp-grounds in nearly all the parks for the benefit of those tourists who wish to take an economic holiday and to camp out in tent or trailer. These grounds have suitable lots for the erection of tents or for parking trailers, and are provided with water supplies, sanitary facilities, kitchen shelters with cooking stoves, fuel supply, and tables, and often with electrical plugs for the trailers. No extensions were made to any of the camp-grounds during the year, but they were all well maintained and operated, and were patronized by many thousands of tourists.

The tourist accommodations provided by private enterprise in the parks run from de luxe hotels, moderately-priced hotels, and rooming houses in the townsites to inexpensive cabins in auto bungalow camps outside the townsites. All are subject to supervision by the Administration.

The building program undertaken by private enterprise in the parks during the year may be listed as follows: In Banff Park, forty-seven new cabins were erected in the various auto bungalow camps, and four single detached houses, one duplex house, and one rooming house were constructed in the townsite. In Jasper Park, thirty-two cabins were built in the various bungalow camps and concessions lying outside the townsite, while seven cottages were completed and one duplex was started in the townsite. In Prince Albert Park, six new buildings were brought to an advanced stage of completion in the Lakeview subdivision; thirty-four cabins and five toilet buildings were practically completed in the Waskesiu Bungalow Camp, and ten cabins and one pump and power-house were almost completed at the Narrows Bungalow Camp. In Riding Mountain Park, one summer hotel, ten summer cottages, and five auto bungalow cabins were erected. In Waterton Lakes Park, four summer cottages were built in the townsite and three double cabins were completed in the auto bungalow camp. In Prince Edward Island Park, two summer cottages were erected at Wyand Bungalow Camp, while in Cape Breton Highlands Park, the Provincial Government of Nova Scotia completed two eight-room cottages, four two-room cottages, one caretakers cabin, two staff dormitories, and one warehouse at Keltic Lodge.

NATIONAL HISTORIC PARKS AND SITES

The restoration, preservation, and administration of National Historic Parks and Sites, and the commemoration of the public service of outstanding characters in Canadian history are carried out by the National Parks Bureau.

In this phase of its work the Bureau is advised by the Historic Sites and Monuments Board of Canada, an honorary body composed of recognized historians representing the various parts of the Dominion.

The personnel of the Board is as follows: Chairman, Dr. J. Clarence Webster, Shediac, New Brunswick; Prof. Fred Landon, London, Ontario; Prof. 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; Prof. M. H. Long, Edmonton, Alberta; Prof. 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 15-17, 1946, when many matters relating to the historic background of the Dominion were reviewed and sites to be marked were selected. Of the many sites considered by the Board to date 337 have been marked or acquired and 216 recommended for attention at a later date.

National Historic Parks

Fort Anne National Historic Park, Annapolis Royal, Nova Scotia:—The east side and north end of the museum building and all wood-work downstairs in the north and south halls were painted, together with the library, cannon, and cannon balls around the building, the chain fence, well-sweep, and sign posts; the roads were repaired, magazines were cleaned, the moat drained, a new floor was laid in the bandstand, and repairs were made to the bases of the columns at the entrance to the museum; the hedges around the memorials were trimmed and the hay was cut and removed from the fort grounds facing the highway.

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.

Port Royal National Historic Park, Lower Granville, Nova Scotia:—Preserving fluid was applied to all shingled roofs and to the cannon platform, palisade, and new built-in bunks; additional furnishings, including four baby harbour seal skins, were obtained for the various rooms; all iron work was cleaned and oiled, bridges were repaired, the cannon was painted, and the lawns were rolled and fertilized.

Fortress of Louisbourg National Historic Park, Louisburg, Cape Breton Island, Nova Scotia:—A section of the breast-work near the main entrance was dismantled and rebuilt; the cairn near the west gate, marking the Dauphin's Bastion, was taken down and the tablet was affixed to the remains of the Bastion which has been partly restored; repairs were made to the north-west walls of the casemates, the doorway in the citadel was rebuilt, and concrete bases were made for the cannon; the main entrance gate, the fence enclosing the Society of Colonial Wars memorial, and all windows in the museum building and caretaker's quarters were painted, as were the cannon and anchors in front of the museum; the bridge across the moat at the citadel was repaired, part of the entrance road was re-surfaced and the lawns and paths were kept in good condition.

Fort Beausejour National Historic Park, Sackville, New Brunswick:—The stonework of the museum building was caulked and made waterproof; the caretaker's residence, rest lodge, and cannon were painted; the pavilion provided for the convenience of visitors was moved to a more suitable location; repairs were made to one of the stone pillars at the main entrance gate; all road signs were relettered, and the grounds were maintained in good condition.

Fort Chambly National Historic Park, Chambly, Quebec:—Flagstone walks were laid in the picnic grounds; the iron fence around the cemetery and in front of the fort, the picnic tables, and the storm doors were painted; the trees and shrubs were trimmed, and the grounds were kept in good condition.

Fort Lennox National Historic Park, Ile-aux-Noix, Quebec:—Permission was granted to the Jeunesse Etudiante Catholique Organization to use a portion of the park property during the summer months as a youth training centre; the metal roof on the Powder Magazine was painted, the roof of the Officer's Quarters was repaired and the entrance to the latter building was repaired and painted; a new floor was laid in the Men's Barracks, a temporary landing dock was constructed on the east side of the island, and a cement platform was built around the well; repairs were made to the entrance bridge and to the windows in the various buildings; the parade ground was levelled, casemates and picnic grounds were cleaned, brush and dead trees along the embankment were cut and removed, and the grounds were kept in good condition.

Fort Wellington National Historic Park, Prescott, Ontario:—The old fence around the fort property was taken down; the new palisades were erected to replace those in poor condition; all fort buildings and cannon were painted; repairs were made to the entrance gates; new signs were made and placed in position; trees and shrubs were planted, and the grounds were kept in good condition.

Fort Malden National Historic Park, Amherstburg, Ontario:—The top floor of "The Fort" residence was converted into living quarters for the park custodian and arrangements were made with the Provincial Government for a police constable to occupy the dwelling known at "The Cottage" to give additional protection to the property. A small bronze plate was attached to the "Tecumseh Stone" donated to the park; the existing tile drain was extended into the sunken garden; repairs were made to the plumbing of the "Fort" and several sections of the rain conductor pipe on this building were replaced; additional fire extinguishers were obtained, lawns and hedges were trimmed, and many articles of interest, including a large anchor, were presented to the park.

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

National Historic Sites

Franklin Delano Roosevelt, Welshpool, Campobello Island, N.B.:—A cut-stone monument bearing an engraved tablet was erected near the library building to the memory of Franklin Delano Roosevelt, 1882-1945, statesman and humanitarian, who, during many years of his eventful life, found in that tranquil island, rest, refreshment, and freedom from care. To him it was always the "beloved island". The monument was unveiled on August 1, 1946, in the presence of a distinguished gathering including Mrs. Eleanor Roosevelt.

Father Jacques Marquette, Boucherville, Quebec:—A cut-stone monument, with tablet affixed, was erected in the small park lying between Highway No. 3 and the St. Lawrence River to commemorate the public services of Father Jacques Marquette, who was born in France on June 10, 1637. With Louis Jolliet he discovered the Mississippi River on June 17, 1673. He visited the seigniory in which the monument stands in May, 1668, and died in Michigan on May 18, 1675.

William Wilfred Campbell, Kitchener, Ontario:—A bronze tablet was erected in the Kitchener and Waterloo Collegiate building in memory of William Wilfred Campbell, Canadian poet, who was born in Berlin (Kitchener) on June 1, 1858, and died near Ottawa on January 1, 1918. His verses revealed the

beauty of the Great Lakes, "the magic region of blue waters". The tablet was unveiled on November 25, 1946.

Sir James Douglas, K.C.B., Victoria, B.C.:—A bronze tablet was erected at the entrance to the Legislative Chamber in the Parliament Buildings to commemorate the public services of Sir James Douglas, 1803-1877, "The Father of British Columbia". In his early life he was associated first with the North West Company and later with the Hudson's Bay Company. He founded Fort Victoria in 1843. By his firm and wise rule as Governor of Vancouver Island, 1851-1864, and Governor of British Columbia, 1858-1864, he laid the foundation of that province. The tablet was unveiled on November 19, 1946.

Frederic William Howay, New Westminster, B.C.:—A bronze tablet was affixed to the Court House in memory of Frederic William Howay, Historian of British Columbia and Judge of the County Court of Westminster, 1907-37, Member of the Historic Sites and Monuments Board of Canada, 1923-41, Chairman, 1941-43, and President of the Royal Society of Canada, 1941. Born near London, Ontario, on November 25, 1867, he died in New Westminster on October 4, 1943. The tablet was unveiled on November 25, 1946.

During the year all the sites which have been 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.

RECREATIONAL FEATURES

The National Parks serve as centres of outdoor life and recreation for both summer and winter sports. Hundreds of miles of smooth roads and thousands of miles of well kept trails provide access to all parts of the parks where the vacationist may enjoy the natural beauty of the scenery and the abundant wild-life resulting from the sanctuary conditions.

Favourite summer sports include hiking, riding, mountain climbing, boating, canoeing, swimming, fishing, tennis, and golf. Many of the Parks possess golf courses, some of which are equal to the finest on the continent, as well as tennis courts. Active consideration is being given to the provision of bowling greens in several of the larger parks. Work was started on greens in Riding Mountain Park, and plans are being made to commence similar work during 1947 in Banff, Jasper, Cape Breton Highlands, and Prince Edward Island Parks.

Winter sports, including skiing, skating, and curling, are popular in several of the parks. Banff Park in particular has developed into an outstanding resort for winter sports and is the centre of a vast territory where skiing lasts from December until April.

Special Events

Some events which had lapsed during the war years were resumed, and others were marked by greatly increased and, in some cases, record attendance.

The leading events in the National Parks during the year may be listed as follows: Golf tournaments were held in Banff, Riding Mountain, Prince Albert, and Waterton Lakes Parks, and two tennis tournaments were held in Prince Albert Park. The Trail Riders of the Canadian Rockies had two camps in Banff Park, and the Trail Hikers of the Canadian Rockies and the Skyline Trail Hikers had their annual encampments in Yoho Park. The Seattle Mountaineers and the Ohio Mountaineers Club camped in Glacier Park, and the "Mazamas", a Mountaineer Club from Portland, Oregon, had their annual

camp in Yoho Park. Successful ski meets were held in Yoho, Mount Revelstoke, Banff, and Jasper Parks, and bonspiels and winter carnivals were held in Banff and Jasper Parks.

Other popular events included the Indian Days Celebration between July 18-21, and a regatta on May 24th, which were resumed at Banff after having been discontinued for some years. Sing-songs and get-together meetings in the community buildings in the public camp-grounds are becoming increasingly popular in many of the parks.

The Banff School of Fine Arts, an extension of the University of Alberta, which since 1933 has been giving summer courses in drama, ballet, art, music, handicrafts, oral French, and short story and play writing, has gained an international reputation and is drawing students from widely scattered places on this continent who come to combine creative work in the fine arts with delightful recreation in the Canadian Rockies.

Conventions

The National Parks are becoming increasingly popular as convention centres. The Pacific Loggers' Congress, the Canadian Medical Association, and the Kinsmen's National Club held their annual conventions in Banff. The Rotary Convention and the Physical Education Conventions were held in Jasper. The Cosmopolitan Club and Bowman Bros. Ltd. held their annual conventions in Prince Albert Park. Riding Mountain National Park was the scene of conventions and meetings held by the following organizations: Anglican Clergy of Brandon Diocese, Manitoba Agricultural Representatives, North West Dental Association, Manufacturer's Life Insurance Company, Lions Club, Co-operative Commonwealth Federation, Manitoba Rotary Clubs, Manitoba Fish and Game Association, and the North West Manitoba Druggists. The District Convention of the International Lions Clubs of Alberta and Montana was held in Waterton Lakes National Park.

PUBLICITY

The first full year of peace after the cessation of hostilities was marked by an increased interest in the National Parks as vacation areas and resulted in a keen demand for information regarding recreational facilities, accommodation, camp-grounds, and a variety of other details. Most of these inquiries are answered in the information folders, but some requests for specific information required individual replies.

The following quantities of literature were distributed:

Booklets—	
Playgrounds of the Prairies	7,669
Canada's Mountain Playgrounds	12,108
Playgrounds of Eastern Canada	34,544
Elk Island	273
Annual Report	865
Geology of the National Parks	750
Folders—	
Jasper	10,633
Kootenay, Yoho, Glacier, and Mount Revelstoke	11,150
Waterton Lakes	6,650
Banff	4,320
National Parks	20,701
Prince Albert	8,180
Riding Mountain	1,515
Elk Island	1,317
Cape Breton Highlands	3,814
Prince Edward Island	15,537
Point Pelee, Georgian Bay Islands, and St. Lawrence Islands	9,050
Miscellaneous—	
Banff-Jasper Strip Map	31,625
Sport Fishing in Canada's National Parks	7,100
Mount Eisenhower Postcards	10,000
	197,801

Motion pictures and still photographs from the Bureau library depicting the scenery, wildlife, and recreational facilities in the National Parks were lent to many individuals and organizations requesting them. In this manner 5,715 films were distributed, 4,966 in the United States and the remainder in Canada. These films were displayed at 20,982 showings, with a total of at least 2,119,616 persons attending. Two wildlife films were televised from stations in the United States.

In addition, seventy-four articles and press releases, accompanied in many cases by half-tone cuts, mats, or photographs, were sent to the daily and weekly press, to various magazines, and to several radio stations in Canada and the United States. Emphasis was placed upon the camping facilities in the parks with the object of relieving pressure on hotel and cabin accommodation.

Addresses on Canada's National Parks were given to service clubs and Boards of Trade in Belleville and Picton, Ontario; Winnipeg, Manitoba; Calgary and Edmonton, Alberta; Victoria, British Columbia; Montreal, Quebec; Malone, New York; and in Columbus, Ohio.

During the latter part of the year all films and equipment were transferred to the National Film Board, and all exhibition material to the Canadian Government Exhibition Commission.

USE OF ALTERNATIVE SERVICE WORKERS

On July 15, 1946, all Alternative Service Work Camps in the National Parks were officially closed. These camps were first established in 1941 for the employment of conscientious objectors exempted from military training, and most of them had been in operation ever since.

By the beginning of April transfers to agriculture and industry had so reduced the numbers of men in these camps that it was decided, in the interests of economy, to close the camps in Kootenay and Jasper Parks and concentrate the remaining workers at Banff. This reduced the camps to two, one at Banff and one at Riding Mountain, both of which continued in operation until July 15, 1946.

During the three-and-a-half-month period that these camps remained in operation 139 conscientious objectors were employed. This number gradually decreased until, by July 15, only 70 men remained. Work projects were limited by the small number of men available, and were concentrated mainly on the maintenance of park facilities. Although some exceptionally good workers were noted, the majority were men of poor quality who had been brought to camp under police escort. As a result of their attitude and the small number of men available the return of work was not as satisfactory as in former years. In spite of these handicaps much useful work which otherwise could not have been done was completed.

DOMINION FOREST SERVICE

The contribution to the war effort made by Canada's forests and the subsequent interest in forestry matters created by Royal Commissions in British Columbia, Saskatchewan, and Ontario have focused public attention on the need for the application of scientific principles in the conservation and development of forest resources. In the main the forest areas are controlled by the provinces, which are responsible for their administration and protection. Nevertheless, their economic importance to the development of Canada as a nation is such that their proper management is a matter of prime concern to the Dominion Government.

Federal responsibility in forestry is mainly expressed in the contributions made by the Dominion Forest Service through fundamental research in silviculture, forest protection, aerial photography, and wood utilization. Since certain forestry problems are common to several provinces, research work by the Dominion is complementary to provincial activities and integrated for the development of a national forest policy.

The increased interest of the public in the conservation of forest resources was recognized by Parliament in the granting of increased appropriations for research. The staff has been considerably enlarged through the return of former employees from the armed services and the hiring of additional technical foresters: more facilities have also been made available. The result has been the expansion of the work of the Dominion Forest Service during the year under review to a scale greatly in excess of that undertaken in the past sixteen years.

Silvicultural research is conducted chiefly on five forest experiment stations but also extends to provincial lands; investigations in all phases of wood utilization are carried out by three forest products laboratories.

Research problems as regards forests and forest products are worked out in co-operation with the provincial forest services, with forest industries, and with the Department of Agriculture in the fields of entomology and pathology. The results obtained from such investigations are made available to all interested agencies.

During the past year, a substantial beginning was made on an enlarged program of fundamental research work which, it is hoped, will be expanded as technical staff and facilities become available. Such a program is essential if the Dominion is to supply the vigorous leadership required for the development of a much-needed national forest policy, the objective of which is to grow and maintain forests on all lands available in Canada for forest management, and to develop types of management that will assure maximum yields in terms of wood products, protection of stream-flow, and other forest values.

FOREST ECONOMICS DIVISION

Production in the forest industries of Canada was maintained at a higher level in 1946 than in any other peace-time year. Despite a five-week shutdown in the lumber industry on the west coast, lumber production for the year was estimated at about 4,776,000,000 ft. b.m. The continued demand for housing and other forms of construction at home, coupled with increased export demand, will provide a stimulus for even greater lumber production in 1947.

The great differences existing between domestic ceiling prices and world prices necessitated rigid control of exports by the Timber Control of the Department of Reconstruction and Supply. It was found expedient, however, to make certain upward price adjustments in order to encourage increased production.

Control of the pulp and paper industry by administrators of the Wartime Prices and Trade Board was discontinued in November, 1946, bringing an unrestricted market in the United States for Canadian newsprint and pulp. Newsprint production for the year reached an all-time high, totalling over 4,100,000 tons. Ninety-three per cent of this production was exported, eighty per cent going to the United States.

The following table shows the average rate of utilization and destruction of merchantable timber during the ten-year period 1935-44. In order to make Canadian statistics directly comparable with those of foreign countries, converting factors are used which give cubic volumes of merchantable wood only, excluding stumps and tops.

Average Annual Depletion, 1935-44

	Millions of cubic feet of usable wood
Volume used	2,380
Merchantable timber burned	348
Destroyed by insects and tree diseases	500
Total depletion	3,228

About 74 per cent of the total depletion was used and 26 per cent wasted. Replacement of this depletion requires an average annual growth rate of about 11 cubic feet of merchantable wood per acre over the 278 million acres of accessible productive forests of Canada. Since the accessible stand of merchantable timber is estimated at 191,348 million cubic feet, average annual depletion during the decade amounts to 1·7 per cent of total volume. While this does not seem an excessive rate of depletion, it must be remembered that the abnormal demand for forest products since 1939 has resulted in severe overcutting in certain localities, whereas the annual growth is not being used on the more inaccessible areas.

The relative importance of the principal branches of the forest industries in 1944 is indicated in the following table:—

FOREST INDUSTRIES

Summary of Principal Statistics, 1944

—	Employees	Salaries and Wages	Net Value of Products	Gross Value of Products
	No.	$	$	$
Woods operations	118,500[1]	195,000,000	237,000,000	301,570,823
Lumber industry	43,516	51,516,085	96,528,955	216,556,623
Pulp and paper industry	37,896	75,833,408	174,492,103	369,846,086
Wood-using industries	48,771	64,467,588	105,060,380	214,088,355
Paper-using industries[2]	18,927	25,784,320	55,990,228	125,342,444
Total	267,610	412,601,401	669,071,666	1,227,404,331

[1] Man-year basis. [2] Not including printing trades.

The net value of the products of the forest industries in 1944 was 11·0 per cent greater than in 1943 and 93·7 per cent greater than in 1939.

The work of the Economics Division of the Forest Service was seriously handicapped owing to the loss in June of the two senior members of the staff. In addition to the normal activities of the Division, a report entitled "Canada's Forests and the War" was prepared for presentation to the Fifth British Empire Forestry Conference. This report included chapters submitted by the Forest Products Laboratories and by the National Selective Service of the Department of Labour, and a history of the Canadian Forestry Corps.

FOREST AIR SURVEY DIVISION

The work of the Forest Air Survey Division concerns the use of air photographs in the survey of the forests of Canada. As no natural resource is better adapted to detailed study by air photographs than the forest, this work has assumed special importance. 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.

The training of new men in the technique of forest typing was an important feature of the year's activites. It was greatly facilitated by numerous ground investigations carried out to amplify interpretation of air photographs. Experience acquired on active service by these men in the use of air photographs substantially aided and simplified the training program.

During the year, a total area of some 50,000 square miles was photographed for forestry purposes at the request of the Dominion Forest Service in the national program of air photography. This included forestry tri-camera photography on 2,800 square miles carried out under winter conditions.

Forestry tri-camera photography, initiated by the Dominion Forest Service, was first employed this year in an effort to provide a method of air photography which will meet the special needs of the forester for maximum forest detail at lowest cost under conditions where it is desirable to rephotograph periodically in order to record the changes that take place in the forests. Advantage has been taken of the fact that the comparatively rigid requirements of air photography for basic mapping do not apply in the field of forestry. The chief feature of the method is the low-angle or steep oblique photograph. The forestry tri-camera photographs taken during the year have demonstrated both the economy of operation and clarity of detail that are possible with this new style of forest photography. For instance, it was shown that both hardwoods and softwoods can be photographed to best advantage in winter photographs. Also it became evident that by variations of lens and tilt the forestry tri-camera mount could be adapted to obtain simultaneously two sets of photographs covering the same ground, thus satisfying in a single photographic operation the scale requirements of both the mapper and the forester, the former desiring a smaller scale to facilitate the preparation of the basic map.

In continuation of work done during the previous year, a part of the year's activities was devoted to the preparation of general forest inventory map sheets in various provinces, the intention being to illustrate the possibilites of air photographs for the purposes of a national forest inventory and to obtain a more definite basis for discussion of inventory problems with the provinces. As a result, a development of considerable significance occurred in the form of photolithographed forest inventory maps which are prepared largely from air photographs, and which require a minimum of ground work. This development, which was made possible by the co-operation of the Geographical Section, General Staff, Department of National Defence, is of particular importance, as it enables quantity production of maps in full colour at a very cheap rate. The maps, as recently standardized, show the forest classified according to type, crown cover, and height, these being the factors most readily derived from air photographs. The maps are printed on a scale of one mile to one inch. Broad estimates of timber quantities can be derived from such maps. If supplemented by field data covering species, quality, age, and site, the maps will provide a very comprehensive picture of the forest conditions obtaining. These general forest inventory sheets were compiled for an area totalling 6,350 square miles. At the same time, three map sheets, totalling about 1,200 square miles, came off the press.

In preparation for inventory work in Manitoba, provisional maps covering 144 square miles were prepared for delivery to provincial forest survey parties. These maps, supplemented by ground data secured by the field parties, will be used as the basis for photolithographed forest inventory map sheets.

In the case of federally administered lands, where special maps are usually required, showing more detail than those used for general forest inventory mapping, forest maps were prepared for a total area of 465 square miles. These covered 400 square miles in Prince Albert National Park, the 30-square-mile Waterhen Lake Indian Reserve, and 35 square miles on the borders of the Petawawa Forest Experiment Station.

During the year, there was considerable acceleration in the application of the special methods which have been developed as a result of research by the Dominion Forest Service in the use of air photographs for forestry purposes. Foresters from provincial forest services and forest industries studied the Division's methods, and some of them visited Ottawa for considerable periods to obtain information on its latest developments. Visits were made by members of the forest air survey staff to other forest organizations in order to correlate the techniques being developed. A general article was prepared for submission to the Fifth British Empire Forestry Conference, and papers were written for presentation to photogrammetric societies. The work of gathering data in the field to supplement quantitative estimating of the forests was proceeded with, particularly in co-operation with the Brompton Pulp and Paper Company.

An instrument for visual measurement of the percentage of crown cover was developed. This device, which because of its shape has been named the "Moose-horn", is used in gathering data on the ground. A shadow height calculator has been developed to carry out graphically and mechanically all the processes necessary in the determination of tree heights from shadows in air photographs. Incorporated in this calculator is an adaptation of a centuries-old device known as the "Mathematicall Jewell", a description of which may be found in "Astrographics", written by Frank Debenham, Professor of Geography at the University of Cambridge. Rheostats have been mounted on instruments of the duoscope-monoscope type and have been very successful as a means of regulating the illumination.

In order to promote the use of air photographs as an aid to site classification, field trips were made to the forest survey parties of two timber holding companies, and studies were carried out which resulted in the preparation of reports that are of general scientific interest for forest working plan purposes.

SILVICULTURAL RESEARCH DIVISION

During the year, silvicultural research was reorganized on a more effective basis than was previously possible, as a result of the return of foresters from the armed services, and the acquisition of additional technical and non-technical staff. This made possible the resumption of work on many projects previously under way, and the undertaking of new ones. For this work the Division was fortunate in securing the services of several promising young foresters capable of doing much of the original thinking in connection with the projects assigned to them.

Reproduction Surveys:—One of the most important new projects undertaken was a comprehensive investigation of reproduction and forest growth on disturbed stands. This undertaking resulted from a resolution passed at the annual summer meeting of the Woodlands Section, Canadian Pulp and Paper Association, held at Petawawa in 1945. This work was begun in May, 1946, and was designed to obtain data concerning reproduction on various forest sections across the Dominion. Surveys were conducted in Nova Scotia, New Brunswick, Quebec, and Alberta; standardized methods of collecting data were employed, so that direct comparisons will be possible. It is expected that this work will continue for at least another year before sufficient data will be available to allow judgment of the rate at which the forests are repro-

ducing. When these facts are known, the second stage of this investigation will involve a study of why certain areas are not reproducing satisfactorily, following which steps will be taken to determine action required. Reports on 1946 surveys are not yet complete, but an examination of the data so far available indicates that certain important conclusions may be drawn, particularly with respect to spruce and balsam.

Rate of Growth Surveys:—Work on rate of growth surveys during the year was confined to the remeasurement of line plots established during the past 20 years. Remeasurement surveys were conducted as follows: New Brunswick, Acadia Forest Experiment Station and Salmon River; Quebec, Lake Edward Station; Ontario, Goulais River, Algoma District; Manitoba, Riding Mountain National Park; Saskatchewan, Carrot River area; Alberta, Kananaskis Forest Experiment Station. Final reports on the results of these surveys are now in course of preparation.

Maritimes District

One of the most promising forest management projects in the Maritimes District is the Green River budworm project in New Brunswick. This is a joint undertaking by the Dominion Forest Service, the Dominion Entomological Service, the Province of New Brunswick, and the Fraser Companies. Its purpose is to investigate silvicultural methods of controlling the budworm epidemic. In 1945, a series of permanent line-plots was established on a block of some 4,000 acres, and information on all existing forest conditions, particularly age-classes, reproduction, and rate of growth, was gathered. In the year under consideration a further block of 4,000 acres was established, on which a selective cutting was carried out. The following quantities (cords) of spruce and balsam were removed:—

	Section 1	Section 2	Section 3	
Sap-peeled	5,006	1,317	2,000	
Rough	31,965	3,928	6,652	
Total	36,971	5,245	8,652	
Grand Total				50,868

This whole area is being made accessible by roads, and by cutting on a 10-year cycle it is hoped to build up the stocking and growth so that one cord per acre per year may eventually be harvested.

The Salmon River experimental cutting area, which has been established for 22 years, was again remeasured, and it is expected that on the basis of this work a research note on the management of such areas will be issued.

The Woodlot Management Project, which is a co-operative undertaking with the Federal Department of Agriculture, Experimental Farms Division, is progressing satisfactorily. The Dominion Forest Service each year marks the trees to be cut, and the co-operating farmer does the actual cutting. Working plans are now in operation for some 16 woodlots in the Maritime Provinces.

Acadia Forest Experiment Station.—At the Acadia Station, the working plan sample plots established 10 years ago were remeasured, and the cutting budget will be revised in accordance with the findings. Three demonstration woodlots were established here for management on a sustained yield basis. All permanent sample plots in experimental cutting areas and in plantations due for such treatment were remeasured.

Quebec District

A new project undertaken by the Division in Quebec during the past year was the examination of the result of 20 years of planting conifers at Proulx by the Laurentide Pulp and Paper Company, now owned by the Consolidated

Paper Company, Grand'Mère. These plantations, if ultimately successful, should yield valuable information, not only on growth but on the economic possibilities of reforesting areas adjacent to mills.

Valcartier Forest Experiment Station.—The Valcartier Station, which had been closed during the war, was re-opened in the autumn of 1945. Initial activity involved the remeasurement of projects due and overdue, including the working plan, sample plots, and intermediate harvest cuttings and plantations. A demonstration woodlot was established and placed under a working plan, and the first annual cutting was completed. The Lake Edward Experimental Area was resurveyed by means of line plots, and a periodical report of growth in this former cut-over area will be issued.

Petawawa Forest Experiment Station

During the past year, the Petawawa Station was, for purposes of management, divided into some 60 compartments, varying in size from 1 to 2 square miles. To determine the merchantable stock and the factors affecting growth, composition, site, age-class, and density, a series of permanent line plots will be established in each compartment. These will be used to lay out cutting operations and many research investigations. Plots were established on two compartments operated during the past winter for multiple use—saw-timber, match-stock, pulpwood, and fuel-wood all being removed in a single operation. Pine and poplar match-stock was removed from another area to demonstrate selective cutting. Some 60 permanent sample plots for study of growth and reproduction were measured. Tests of the relative values of various forms of permanent sample plots are being made, and seem to indicate that rectangular plots are most generally desirable.

Tree-breeding projects were conducted with white pine, spruce, and poplar. Preliminary work was commenced in studies of many factors concerned with the reproduction of pine and spruce. The demonstration woodlot established on this area under a five-year working plan was remeasured and the cutting budget revised.

Manitoba-Saskatchewan District

Forest research in this district has been reorganized on an expanded basis. In Riding Mountain National Park, approximately half an area of some 25 miles set aside during the year for a research station was sampled by permanent line plots. With the completion of this survey, a working plan will be made to provide for the removal of the increment in the form of demonstration cuttings. Some 600 new permanent line plots were established for study of growth. Permanent sample plots established five years or more ago were remeasured.

The Carrot River experimental cutting area was remeasured and a report prepared summarizing the results of cutting carried on 23 years ago. Many seeded and planted plots as well as permanent sample plots were remeasured.

Alberta District

Kananaskis Forest Experiment Station.—With the close of the internment and alternative service work camps, forest research work was resumed. The principal project on the Station during the past season was the remeasurement of 1,000 permanent line plots, the data being essential to the development of a working plan for this area. Plots established in intermediate cutting areas were also remeasured. A new project, that of classification of soil types, was

initiated in co-operation with the University of Alberta, and covered about one-third of the Station area. The salvage cutting in the 1936 burn on the Kananaskis Station was continued until the close of the alternative service work camps there.

FOREST PROTECTION DIVISION

During the fire season of 1946, some 860,000 square miles of forest and wild land throughout Canada were protected by the various forest authorities. This area is more than 100,000 square miles greater than that protected in 1945, the increase being due, almost entirely, to the inclusion of the Yukon and Northwest Territories.

In 1946, for the first time, estimates of forest-fire losses in the Territories became available. These statistics are shown in the accompanying tables, but are listed separately from those of the provinces (including Dominion Lands within provincial boundaries) so as to provide a basis for comparing Dominion totals with those of former years. Such comparisons as are noted hereunder do not include fires in the Yukon and Northwest Territories.

Fire Losses

Although the number of forest fires in 1946 was slightly greater than the average for the past ten years, the total area burned and estimated values destroyed were less than half the average figures (See Table I). Merchantable timber losses included 102,102 thousand feet board measure of saw timber and 454.468 cords of small material, comprising only about one-sixth of the previous ten-year average.

Forest-fire losses in the Maritime Provinces were somewhat higher than normal, although not as serious as in the exceptionally severe fire season of 1944. Elsewhere in Canada the damage caused by forest fires was well below the average. Fire losses for each province and for lands under Dominion administration are shown in Table III. Only one death resulting from a forest fire was recorded during the year.

The cost of fire-fighting, $897,940, was a little lower than the average for the previous ten years. Actual fire-fighting costs, however, represent only a fraction of the total cost of forest-fire protection, which includes such items as salaries and wages of permanent employees, purchase and maintenance of equipment and improvements, and fire-prevention expenditures. Estimates of total fire-protection costs are now being compiled, but, owing to differences in the fiscal year used by the various forest authorities, complete estimates for 1946 will not be available until next year.

Causes of Fires

Forty per cent of all forest fires in 1946 were caused by carelessness on the part of campers and smokers (Table II)—an increase of 6 per cent over the ten-year average. Settlers were responsible for 11 per cent, and railways for 12 per cent of the total number. Although the proportion of railway fires was smaller than in 1945, it was still considerably higher than in pre-war years. Sixteen per cent of the fires were attributed to lightning, the only unpreventable cause.

Legal Proceedings

Prosecutions under the forest-fire laws were instituted in 197 cases, and resulted in 182 convictions (Table IV). Both figures were somewhat higher than in the previous year.

Weather Conditions

Nova Scotia.—The 1946 season was generally one of high fire-hazard. The long dry periods were, however, broken by occasional showers and dull weather, bringing temporary respite.

New Brunswick.—Weather conditions during the first half of the fire season were normal, and no serious fire losses occurred. From early July until the middle of October, precipitation was generally deficient throughout the Province, especially in the eastern counties. Rain in the latter part of October relieved the hazard in most areas, although drought conditions in the southeastern section persisted until early winter.

Quebec.—During the spring hazard period precipitation was normal over most of the Province, although drier weather than usual was experienced in the Lake St. John district. June was a relatively dry month in most regions, but during the remainder of the season rainfall was generally adequate, especially in the northern and western areas. The Lake St. John and Gaspé districts, however, suffered from a deficiency of precipitation in August, which in Gaspé continued through September.

Ontario.—The fire season on the whole was a moderate one. Warm weather caused a short period of fairly high hazard in the eastern districts toward the end of March, but conditions were generally favourable during April and May. A high hazard developed in western Ontario in the first part of June, and in the Sudbury and Parry Sound districts during parts of July, August, and October. Otherwise no acute or prolonged periods of fire danger were experienced in the latter part of the season.

Manitoba.—The fire season started two weeks earlier than usual, and rainfall was generally deficient until past midsummer. By the end of August conditions approached normal and did not alter radically during the remainder of the season. Fortunately the rains were well spaced, which helped in keeping down fire losses.

Saskatchewan.—Weather during the 1946 season was extremely variable. Periods of cool, damp weather, with slightly lower than average precipitation, alternated with very high temperatures accompanied by strong, drying winds. The highest hazard occurred in two such periods—one in April and one in September; the greatest fire losses occurred during the latter period.

Alberta.—A high fire-hazard developed in the spring over wide areas in the northwestern part of the Province, a condition which lasted with little respite until the middle of November. Elsewhere in Alberta the hazard was generally well below normal throughout the season, except for a warm, dry period in the southwestern districts which lasted from early July until the latter part of August.

British Columbia.—Considering the Province as a whole, the weather during the 1946 fire season was more favourable than average. Although high-hazard periods occurred in all districts, notably in the early spring and at midsummer, timely precipitation generally prevented the build-up of prolonged drought conditions. An exception occurred in the northern part of the Kamloops district, where an unusually severe spring hazard developed; this condition remained almost unabated throughout the season.

Yukon.—High fire-hazards prevailed in the southern Yukon throughout the month of June, and for a short period in September. At other times weather conditions were generally favourable.

Northwest Territories.—No information is available regarding weather conditions during the 1946 fire season.

Forest Fire Research

Since 1929, the Forest Protection Division has carried out research on fundamental problems relating to forest-fire control. Perhaps the most important contribution in this field has been the development of forest-fire danger tables, by means of which the prevailing degree of fire danger can be determined according to weather conditions and seasonal influences.

A revised and somewhat simplified edition of these tables was published in 1946, and was adopted by a number of forest protection services in Canada and Newfoundland. The adaptation of the system to regional and local conditions is still in progress. Work has also been started on a study of adequate forest-fire protection standards for the various forest regions of Canada.

After a lapse of four years, intensive fire-hazard studies were resumed at the Kananaskis Forest Experiment Station, where a fire-danger rating system suitable for use on the east slope of the Rocky Mountains is being developed. Particular attention was devoted to the study of abnormal temperature conditions which cause low night humidity at the higher altitudes on steep slopes. Other projects included the use of hygroscopic chemicals in an effort to develop a simple fire-hazard indicator; an investigation of the effect of site and method of exposure on wet- and dry-bulb hygrometer readings; efficiency tests on portable fire pumps in several of the western National Parks; and further studies of the effect of altitude and other factors on fire-pump performance.

Forest-fire research at the Petawawa Forest Experiment Station was mainly devoted to the development of fire-control planning methods and techniques. A fire plan for the Station was prepared, which establishes fire-control objectives, and specifies the equipment and organization required, together with the state of preparedness to be maintained by the protection force according to the prevailing degree of fire danger. Maps are provided showing fuel types, risk areas, travel routes and travel-time zones, areas visible from lookouts, and fire-fighting facilities.

Studies of weather and fuel moisture content were continued at Petawawa in 1946. An investigation of the value of certain chemicals for retarding the growth of vegetation on fire-guards and roads, which was suspended during the war, was resumed. Tests were also made of the performance of 10-metre "walkie-talkie" radio sets under forest conditions.

TABLE I

Forest-fire losses in Canada, 1946, compared with 10-year average, 1936-45

Item		Provinces*		Yukon and Northwest Territories Year 1946
		Annual Average 1936-45	Year 1946	
Fires under 10 acres	No.	3,811	4,372	17
Fires 10 acres and over	"	1,702	1,531	57
Total number of fires		5,513	5,903	74
Area burned—				
Merchantable timber	acres	553,455	109,478	296,396
Young growth	"	660,059	190,914	24,880
Cut-over lands	"	357,650	128,591	3,880
Non-forested lands	"	858,226	587,723	1,148,591
Total area burned	acres	2,429,390	1,016,706	1,473,747
Merchantable timber burned—				
Saw timber	M. ft. b.m.	779,565	102,102	8,669
Small material	cords	2,442,265	454,468	257,297
Estimated values destroyed—				
Merchantable timber	$	2,579,973	635,268	270,064
Young growth	$	899,177	384,069	3,210
Cut-over lands	$	294,634	94,426	3,895
Other property burned	$	545,259	710,949	.....
Total damage	$	4,319,043	1,824,712	277,169
Actual cost of fire-fighting	$	914,903	897,940	7,659
Total damage and fire-fighting cost	$	5,233,946	2,722,652	284,828
Area under protection	sq. mi.	.....	750,000	110,000

* Includes Dominion Lands within provincial boundaries.

TABLE II

Forest fires in Canada, 1946, by causes, compared with 10-year Average, 1936-45

Cause	Provinces*				Yukon and Northwest Territories Year 1946	
	Annual Average 1936-45		Year 1946			
	No.	%	No.	%	No.	%
Camp-fires	961	17	1,068	18	62	84
Smokers	961	17	1,293	22	3	4
Settlers	763	14	622	11	.....	.....
Railways	368	7	691	12	.....	.....
Lightning	1,025	19	956	16	3	4
Industrial operations	155	3	293	5	.....	.....
Incendiary	302	5	163	3	1	1
Public Works	48	1	57	1	1	1
Miscellaneous known	467	9	439	7	.....	.....
Unknown	463	8	321	5	4	6
Totals	5,513	100	5,903	100	74	100

* Includes Dominion Lands within provincial boundaries.

TABLE III

Statistics of forest fires by regions, 1946

(Averages given are those for 10-year period 1936-45)

—		British Columbia		Alberta		Saskatchewan		Manitoba		Ontario		Quebec	
		Average	1946	Average	1946	Average	1946	Average	1946	Average	1946	Average	1946
Fires—													
Total number		1,686	1,707	349	275	256	97	373	392	1,220	1,739	1,033	992
Caused by lightning	%	36	30	3	4	6	0	9	7	21	17	7	6
Area burned—													
Merchantable timber	acres	49,281	18,701	176,047	34,220	60,968	3,950	41,215	9,052	125,799	20,746	84,692	9,529
Young growth	"	60,567	33,045	212,599	50,387	246,075	5,856	34,600	31,510	55,092	21,169	19,447	5,380
Cut-over lands	"	117,211	57,120	18,577	7,945	19,941	897	4,071	4,029	32,216	10,407	143,106	23,477
Non-forested lands	"	117,200	194,529	276,499	179,731	192,140	53,249	157,672	85,174	69,755	24,447	20,185	17,378
Total area burned	"	344,259	303,395	683,722	272,283	519,124	63,952	237,558	129,765	282,862	76,769	267,430	55,764
Damages	$	869,323	306,265	1,099,584	247,733	227,653	20,258	151,301	68,631	753,084	381,480	934,586	278,730
Cost of fire-fighting	$	259,061	156,451	91,638	49,216	71,219	12,805	29,746	34,495	219,716	294,769	184,049	153,778
Total damage and fire-fighting cost	$	1,128,384	462,716	1,191,222	296,949	298,872	33,063	181,047	103,126	972,800	676,249	1,118,635	432,508

—		New Brunswick		Nova Scotia		Dominion Lands							
						National Parks		Indian Lands		For Expt. Stations		Yukon	Northwest Territories
		Average	1946	Average	1946	Average	1946	Average	1946	Average	1946	1946	1946
Fires—													
Total number		216	284	253	309	64	49	58	53	5	6	16	58
Caused by lightning	%	7	5	1	1	14	33	10	4	0	17	0	5
Area burned—													
Merchantable timber	acres	4,003	5,924	1,111	3,287	6,432	232	3,502	3,837	405	.....	10,513	285,883
Young growth	"	2,853	16,486	4,754	1,701	20,897	41	2,504	24,925	671	414	.....	24,880
Cut-over lands	"	16,537	16,594	1,026	7,582	4,262	348	661	91	42	101	3,860	20
Non-forested lands	"	2,722	4,179	4,141	7,521	10,271	1,156	7,287	19,957	354	402	6,887	1,141,704
Total area burned	"	26,115	43,183	11,032	20,091	41,862	1,777	13,954	48,810	1,472	917	21,260	1,452,487
Damage	$	183,580	426,900	22,246	78,185	59,427	1,362	12,884	14,968	5,375	200	50,442	226,727
Cost of fire-fighting	$	22,770	133,206	15,324	48,000	15,768	3,958	5,108	11,222	504	40	2,075	5,584
Total damage and fire-fighting cost	$	206,350	560,106	37,570	126,185	75,195	5,320	17,992	26,190	5,879	240	52,517	232,311

TABLE IV

Fire season 1946—Comparative statement by regions

Region	Increase or Decrease in Relation to Average for Period 1936-45			Proceedings Under Fire Laws		Deaths
	Number of Fires	Area Burned, Acres	Fire-fighting Cost Plus Damage	Prosecutions	Convictions	
			$			
British Columbia	+ 21	− 40,864	− 665,668	39	37	0
Alberta	− 74	− 411,439	− 894,273	51	47	0
Saskatchewan	− 159	− 455,172	− 265,809	0	0	0
Manitoba	+ 19	− 107,793	− 77,921	5	4	1
Ontario	+ 519	− 206,093	− 296,551	17	14	0
Quebec	− 41	− 211,666	− 686,127	10	10	0
New Brunswick	+ 68	+ 17,068	+ 353,756	58	53	0
Nova Scotia	+ 56	+ 9,059	+ 88,615	12	12	0
Yukon	.....	.....	.....	1	1	0
N.W. Territories	.....	.....	.....	4	4	0
Other Dominion Lands	− 19	− 5,784	− 67,316	0	0	0
Canada	+ 390	−1,412,684	−2,511,294	197	182	1

FOREST PRODUCTS LABORATORIES

The year 1946 saw the resumption by the Forest Products Laboratories of their peace-time functions after a long period during which their staff and facilities were largely engaged on special war problems. Activities continued to be closely associated with industrial problems which arose in the wood-using industries; there was an exceedingly heavy demand for timber for housing and for rehabilitation of public utilities, to which only limited attention could be devoted in war years; there was also a very keen demand for pulp and paper products of all kinds. In such matters the assistance and advice of the Laboratories were in demand, in many cases to such an extent as to impede progress on important research projects.

A notable feature was the great amount of attention which members of the staff were called on to devote to scientific and technical committees set up to promote industrial standards, to consider new fields of research, and to apply to peace-time problems the experiences of war-time research, where such application seemed practicable. Much time was also spent in planning new research projects. The launching of some of these had to be delayed because of difficulty in obtaining qualified personnel, so greatly in demand in industry.

Another important feature in the industrial utilization of timber resources in the past year was the keen interest shown by industry in the better use of raw materials. This was manifested in the many inquiries from industry regarding wood waste and other industrial by-products, the use of species of timber to which previously little attention has been given, and the grouping and planning of industry so as to eliminate as far as practicable wasteful methods of utilization of raw wood. This interest has developed on account of (1) increasingly high costs of raw materials (2) the cutting out of more readily accessible timber supplies, and (3) keen demand for all types of forest products.

The following is a brief description of a few of the more important activities in the Laboratories during the year.

MAIN LABORATORIES—OTTAWA

DIVISION OF TIMBER MECHANICS

An investigation of the strength of prefabricated wall panels of plywood glued to a framework was undertaken to determine the strength factors to govern the construction of such panels for use in domestic housing. Several types of panels were tested, and the results indicated their suitability as building units capable of being prefabricated for domestic housing. A tentative specification for glued prefabricated construction for inclusion in building codes was prepared in conjunction with the Central Mortgage and Housing Corporation.

During the war, permissible building stresses for structural timber were increased in the United States by 20 per cent, in view of the shortage of materials. Considerable interest has since been taken in making this a permanent measure in Canada and the United States. Accordingly, during the year, data from tests made by the Laboratories on structural timbers were re-analysed to determine to what extent an adjusment in safe allowable working stresses is justifiable.

Strength values for yard lumber were examined to provide data for the design of buildings for which structural grades of lumber are not available. Tables of permissible spans for beams made from lumber graded in accordance with the practices of various lumber associations were prepared for inclusion in a proposed building code for smaller municipalities.

A scale model of a 45-foot span beam designed for use in a new building was constructed with laminated flanges and plywood webs. Under test, this beam withstood stresses over five times the design stress before failure occurred. indicating that adequate safety factors had been incorporated in the design.

The effect of prolonged high temperatures upon the strength of casein and urea-formaldehyde glued joints was studied to determine the durability of these joints when exposed to conditions similar to those found in exterior construction. Experiments on the use of infra-red lamps for producing rapid initial set in urea-formaldehyde glues showed that this use of infra-red heat could be satisfactorily applied to certain types of laminated construction.

Materials for extending the coverage of resin glues were investigated to obtain the most suitable extender of domestic origin. Present experiments indicate that rice hulls and cedar bark powder have some value for this purpose and may serve within limits as substitutes for the more expensive starch, or for extenders now imported from abroad.

The investigation of the practicability of bonding hardwood veneers to low-cost softwood backing for use as flooring strips and as flooring panels was continued. A test floor made of different types of this hardwood veneer flooring, including some of sufficient thickness to obviate the need for sub-floors, has been installed at the Laboratories. This floor has been in service for 16 months and no deterioration has been observed.

The collection of data on the strength properties of Canadian woods was continued, two shipments of Eastern hemlock and one of red pine being obtained for testing. The investigation of the relative strength of rock elm and white elm was also continued to determine whether the inclusion of white elm of high density in commercial shipments of rock elm is justifiable.

The results of a study of the effect of red-stain and pocket-rot upon the strength of jack pine poles indicate that staining resulting from early stages of *Fomes pini* infection does not decrease the load-carrying ability of the poles. In the later stages of *Fomes pini* infections, where pockets of rot have developed, there is little reduction of strength of the poles in the cases where rot is segregated around the longitudinal axis of the pole and does not exceed twenty per cent of the cross-section area.

Assistance was given to manufacturers in connection with container design and in improving the packaging of their products; also to the Department of Agriculture in the preparation of specifications for poultry boxes. Some testing of containers for specific commodities was also undertaken to determine their suitability for domestic and export transportation. A report on packaging for export was prepared.

The Laboratories were active on Committees of the American Society for Testing Materials set up to deal with container specifications. A good deal of assistance was also given in the organizing of the Committee on Protective Packing, which has been set up under the Canadian Standards Association.

DIVISION OF WOOD PRESERVATION

The creosote treatment of poplar ties was studied. This is part of an investigation which has as its objective the increased utilization of the so-called inferior species for railway cross-ties in order to reduce the drain on the stands of recognized tie species, such as jack pine, Douglas fir, and the heavier hardwoods.

Steeping in solutions of copper sulphate is a cheap process for the treatment of fence posts and is extensively used in portions of the Western Provinces with low rainwall. Tests were made on five different species of woods grown and treated at the Forest Nursery Station, Indian Head, Saskatchewan.

Service tests of full-size timber products are still required to obtain the final answer as to the effectiveness of a wood preservative. Such tests, however, take from 20 to 30 years, and considerable time was spent in developing and improving methods for accelerated laboratory testing of preservatives so that some information on new preservatives may be obtained in a shorter time. Accelerated laboratory tests were made and service tests set up to determine the effectiveness as wood preservatives of pentachlorophenol and copper naphthenate, which were used extensively during the war and are now used to relieve the present shortage of other preservatives such as creosote. A report was prepared.

Wood tar creosote produced in Western Canada was tested to determine its suitability for use as a wood preservative. Old and new cedar poles treated by those methods while in use were examined after six years' service to determine the penetration of the preservatives and the effectiveness of the treatments in preventing decay at the critical point, the ground-line. This work is supported by member companies of the Canadian Electrical Association.

To assist engineers and others interested in computing the annual charge of timber structures, work was continued on recording the life of treated and untreated timbers in service. Tests recorded number 981, of which 747 were active and 234 have been concluded. These include such items as cross-ties, telephone poles, piling, posts, caps stringers, sheathing, and wharf decking.

DIVISION OF WOOD CHEMISTRY

Experiments on the hydrolysis of wood for the production of sugars were carried out in a small pilot plant which has a capacity of about 20 to 25 pounds of wood per run. These experiments, based on the Scholler process, are being undertaken with a view to increasing yields and developing new hydrolysis techniques. It was found that the yields of reducing sugars obtained from the hydrolysis of Douglas fir chips varied from 35 to 49 per cent, depending on the modifications employed, the highest yields being obtained when there was no rest or steaming period between cycles. In runs made on white pine and black spruce, the yields of reducing sugars obtained by the most efficient modification tested were lower, being 45 per cent and 37 per cent respectively. A report has been prepared and experimental work is continuing.

Work on the chemical composition of Western red cedar bark has been completed and a final report published. In this study, the inner and outer bark fractions were analyzed by the methods usually applied to wood. With the exception of a higher lignin and higher one per cent sodium hydroxide-soluble content in outer bark, the two fractions show similar compositions. Pentosans are present to the extent of about 10 per cent. Pulp, which was obtained in a yield of 33·6 per cent, contains about 74 per cent glucose, 8·9 per cent xylose, and a trace of mannose.

A preliminary investigation was carried out on the preparation of structural boards from Western red cedar bark. The method used consisted of chipping the bark, steaming the chips for a short time with low-pressure steam, and disintegrating them in a laboratory beater. The pulp obtained was formed into thick mats in a sheet-forming machine and the mats were subjected to 400 p.s.i. pressure at a temperature of 190°C. until a hardboard was formed. As the water absorption of these boards was high, tests were carried out on boards prepared in the same manner but with the addition of a small amount of rosin size. The addition of this size greatly reduced the water absorption. Work with various types of size is in progress.

Experiments were continued on the production of structural boards from sawdust. The materials used to bond the sawdust were blood, castor pomace, drip oil (a waste oil from the production of water gas), urea-formaldehyde resins, and sulphite waste liquor in combination with oxalic acid. Some of these boards show tensile strength values comparable with those of commercial boards. Work is continuing.

In another series of experiments, sawdust was treated in various types of mills such as a hammer mill, a ball mill, and a burr mill. Sawdust ground in a burr mill without previous treatment was suitable as an extender for groundwood pulp for fibreboard and may have possibilities as a substitute for inorganic fillers such as talc, clay, and kieselguhr. A report has been written describing the properties of sheets obtained from mixtures of commercial groundwood pulp and the material obtained by treating sawdust in a burr mill.

Valuable products can be derived from the reduction of lignin with hydrogen gas under high pressure in the presence of catalysts. Experiments on the reduction of lignin in solution by electro-chemical treatment might also yield valuable products. Accordingly the electrolysis of sulphite waste liquor in a diaphragm cell was studied. The first series of experiments was carried out with ordinary sulphite waste liquor obtained from a local mill. This material contains approximately 2 per cent sugars which might be transformed into various products during electrolysis. In order to simplify conditions, waste liquor, which had been fermented and distilled for the production of ethyl alcohol, was used for the latest experiments.

Methoxyl determinations were carried out on the dry residues from untreated waste liquor, on the dry residues from treated liquors taken from anode and cathode compartments, and on deposits formed on the cathode. Considerable changes in methoxyl content were found, indicating that the electrolysis has a marked effect on the lignin. Further analytical work is under way.

DIVISION OF WOOD UTILIZATION

This Division, which was inactive during the latter part of the war, was reorganized early in the year and a long-term program was developed. This program comprises a series of investigations having as their objectives the reduction of waste and improvement in utilization in the lumber manufacturing and wood-using industries.

Detailed plans were prepared and, with the co-operation of the Canadian Lumbermen's Association, arrangements completed for a study of sawmill waste and its utilization at thirty-one softwood sawmills in Ontario and Quebec. Of the mills selected, twenty-seven are cutting spruce and four are cutting pine. This will provide comprehensive data for the spruce mills of this region and enable a start to be made on the collection of similar data for the pine mills. A satisfactory study procedure was developed, based on somewhat similar investigations carried out at sawmills in the Maritime Provinces in 1939.

Plans were prepared and preliminary arrangements made for a series of investigations on the relationship of diameter to efficient log utilization, to be carried out concurrently with the study of sawmill waste at sawmills in Ontario and Quebec.

An investigation was carried out, in co-operation with the Fuel Research Laboratory, on the feasibility of so modifying the fire-box of the type of steam boiler used in portable and small stationary-type sawmills that sawdust could be used for fuel instead of the slabwood now used. A more widespread utilization of sawdust for boiler fuel at these small mills would enable large quantities of slabwood mill-waste now used for this purpose to be sold for domestic fuel, or as pulp chips, where the sawmill is suitably located. Details of a suitable type of Dutch oven attachment for the fire-box were worked out and a report is being prepared with a view to publication.

Preliminary to more intensive work in the future, a short survey of the secondary wood-using industries in Quebec and Ontario was undertaken as a means of gaining general information on the type and character of problems being encountered.

Short articles on nine commercial woods of Eastern Canada were prepared for the Department of Trade and Commerce. These articles are intended for trade promotion work overseas, particularly in the United Kingdom.

Miscellaneous matters dealt with during the year had reference to the manufacture of wood flour, hardwood flooring, matches, excelsior, toothpicks, shoe heels, barrel bungs, handles, furniture, and coffins. Information was also supplied regarding possible uses for sawdust, shavings, trimming waste, and waste veneer.

DIVISION OF LUMBER SEASONING

The extension of the activities of this Division and the resumption of active project work have been handicapped by lack of staff. Technical service to the wood-using industries continued as an important part of the work. This service included the supplying of information on the prevention of certain defects during kiln-drying, modifications of kilns and kiln equipment in order to increase the output of seasoned lumber, volume of steam required for kiln-drying various sizes, drying schedules for different species and sizes, conditioning treatments to remove or reduce certain kiln defects, and moisture content specifications and tests.

A survey of manufacturing firms in some of the secondary wood-using industries of Ontario and Quebec was made in order to obtain information on seasoning practices and problems. The firms visited were representative of different phases of woodworking, such as the manufacture of musical instruments, coffins, furniture, sporting goods, farm equipment, plywood, barrels, and baskets. The seasoning and storage problems encountered during this survey were noted in connection with the long-term program of seasoning projects to be investigated.

A special investigation was carried out to determine whether it would be possible to straighten crooked 2" x 4" spruce. Most of the material tested, cut from small logs, contained box heart and knots. Although the lumber was comparatively straight after it had been subjected to steaming for an extended period, little improvement was noted after it had been re-dried.

Charges of 12/4-inch white pine and beech were dried to check the efficiency of existing drying schedules and for comparison with similar material that had been dried by high-frequency electric heating. The experimental kilns were also used for drying special charges of lumber for use by government organizations.

DIVISION OF TIMBER PATHOLOGY

Laboratory tests on the relative decay-resistance of rock elm and white elm were continued. This investigation is to determine whether dense white elm would prove a satisfactory substitute for rock elm, the supply of which is insufficient to meet the demand. The wood of both species showed a wide range of variation in resistance to decay, and no correlation was found between the specific gravity and decay-resistance in either species. The position of the wood in the tree was also unrelated to the degree of fungal attack. Further tests on the rock elm are necessary before definite conclusions can be drawn.

Fungi isolated from green elm and from green jack pine were studied in agar plate cultures. Fungi of each group were grown in association, their effect on one another was observed, and photographic records were made. In addition, the fungi isolated from jack pine were grown on wood blocks and the rot development and discolorations noted.

A study of fungi present in lumber seasoning yards has been made by means of spore traps placed in two yards. More than 1,300 cultures of the fungi obtained from these traps were examined microscopically and the potential wood-rotting, wood-moulding, and wood-staining fungi separated into three groups. Cultures of the wood-rotting type were paired in the hope of obtaining diploid mycelia. Five wood-rotting species and several wood-staining and moulding fungi were identified.

Fungi causing blue-stain and a brown surface disfiguration on rough white pine lumber were studied. The brown discoloration was found to be due to the development of brown conediphores of a fungus which penetrated the wood without staining it. This fungus was very tolerant of a proprietary "sap-stain" chemical treatment used at the mill from which the samples were submitted. However, *Cadophora fastigiata,* which caused the blue-stain, was inhibited to a marked degree.

Cultures and specimens which included defects in birch, maple, oak, poplar, hemlock, spruce, and white pine were added to the reference collection.

Examinations were made of wood specimens, containing defects, which were submitted by inquirers from time to time. These inquiries had reference to rot in boats, building timbers, wood pipes, storage bins, and churns, the identification and causes of rot and discolorations in various species of furniture wood, and the control of moulds and stain in fruit baskets and spoolwood.

DIVISION OF TIMBER PHYSICS

Considerable time was devoted to an investigation of the chemical treatment of trees to facilitate the removal of bark. In testing spruce and aspen poplar of pulpwood size and cedar of suitable size for posts and poles, it was found that material from trees treated in spring or early summer with suitable chemicals could be felled in late autumn and peeled cleanly with greater ease than by the usual "sap-peeling" methods in which no chemical treatment is

used and which cannot be successfully employed much later than the first week of August. In view of the decreased weight noted in logs of treated trees allowed to stand for a year after treatment, amounting to some 5 to 10 pounds per cubic foot, the process should be of importance in reducing shipping costs and in improving the buoyancy of river-driven pulpwood.

Reports of the work to date were published and discussed at the annual meeting of the Canadian Pulp and Paper Association, Woodlands Section. Arrangements have been made for a large scale co-operative investigation on a commercial pulpwood operation to observe the effect of chemical treatment on the barking and weight reduction of three softwood and three hardwood species.

Specimens of wood that had failed in service for unexplained reasons under relatively light loads were examined in an effort to determine the cause of failure. Detailed microscopic examinations were made. In some cases it was found that the presence of microscopic fractures in the cell walls was the cause of the brashness. A report was prepared on methods of inspection by which such material might be detected. Further work is in hand to determine the frequency with which this defect occurs and the kinds of wood in which it is prevalent.

Measurements of basic density were made on samples of five species grown at the Dominion Forest Nursery Station, Indian Head, Saskatchewan. The fuel value of the various species was determined on the basis of their relative densities, and a report prepared.

Additions were made to the reference collection of important timbers of the world. This collection is maintained for use in identifying specimens of Canadian and foreign woods submitted for species identification and as an aid in assessing the qualities of foreign woods with which Canadian woods may compete in world markets.

Other work included the cause of wear on cutting tools in the machining of plywood, the weight and volume of bark on pulpwood bolts of various Canadian species, the variation in properties within a species, and the effect of such variation on commercial uses.

RADIO FREQUENCY HEATING

A program of research on radio frequency heating has been initiated by the Laboratories to study its application to the wood-working industry and to meet the demand for information on this subject. A tour of American factories was made to determine to what extent radio frequency was being applied industrially. It was found that, while radio frequency heating gives promise of a wide variety of applications, much research is required before its ultimate value can be realized. During the past year, the Laboratories were active in developing improvements in the technique of current industrial applications; at the same time, exploratory work was done towards finding new uses for radio frequency heating.

Several moulding forms for bonding curved plywood were constructed to study the practical problems of electrode and pressure system design. The plywood sections produced demonstrated the scope of plywood products which could be mass-produced by means of radio frequency heating.

In recent years, the shortage of large structural timbers has stimulated a growing interest in heavy laminated construction. However, the problem of providing heat to cure the glue lines has impeded more general adoption of this form of construction. The application of radio frequency heating to the seasoning of thick lumber was studied by means of experimental 12/4-inch pine and beech. Radio frequency heating shows promise as an expeditious method of drying high-value material for special uses. This work is continuing.

A procedure for measuring the dielectric properties of woods and glues was developed to meet the need for these data which has resulted from the industrial use of radio frequency heating for bonding and drying of wood.

Exploratory investigations were carried out on other applications of radio frequency heating, including the drying of impregnated wood, the drying of pulp products, the edge-gluing of lumber and veneers, and the assembly gluing of prefabricated house panels.

PUBLICATIONS

Circular 62—Chemical Composition of Western Red Cedar Bark.

Mimeograph—

110—Fire-retardant treatment of structural timbers.
113—Strength properties of glued laminated beams.
114—Improved wood, brief review of various developments.
115—Effect of exposure on strength of Douglas fir cross-arms.
116—Effect of chemical treatment on the ease of peeling bark from trees felled in November, 1946.
118—Effect of season of cutting on durability of jack pine saplings.
119—A summary of experiments on chemical barking of trees.
120—Effect of high temperatures on casein and cold-setting urea-formaldehyde glues in close contact joints.
121—Tension normal to glue line plywood tests (Revision).
124—Ethyl alcohol from wood—(Reissue).
125—Packing for export.

Papers prepared for presentation at the British Empire Forestry Conference

Conservation by better utilization.
Forest products research in Canada.

In addition to the above, several articles were prepared by members of the staff for publication in various trade and technical journals.

VANCOUVER LABORATORY

The Vancouver Laboratory provides regional facilities for service to the lumber and wood utilization industries of British Columbia. For the past 29 years, this Pacific Coast research unit has been associated with the University of British Columbia. Post-war planning in all phases of forest products utilization has shown the necessity for an expansion of staff and facilities. During the year, additional temporary accommodation was obtained and plans were made for an increase in the number of divisions, effective in the new year.

DIVISION OF TIMBER MECHANICS

Standard tests on small, clear specimens were completed on one shipment of mountain hemlock (*Tsuga Mertensiana, Bong.*, a species occurring in the higher mountain areas of the southern coastal region) and one of Amabilis fir from the lower coastal area.

Many standard mechanical and physical tests were made to meet the demand of the British Columbia woodworking industry for information on the comparative properties of secondary British Columbia species and of woods imported for local use. Arrangements were made for shipments of second-growth Douglas fir which will be used in determining basic properties of this material, the demand for which is increasing.

An analysis was completed of the results of tests made on Douglas fir and Western hemlock structural timbers, comparing the effect of grading these timbers under the Domestic and the Export Grading Rules of the British

Columbia Lumber Manufacturers' Association, the Canadian Standards Association Specifications for Structural Timbers, and the No. 12 Standard Grading and Dressing Rules of the West Coast Lumbermen's Association. This analysis is being made in connection with the review of allowable building stresses for structural timbers that is being undertaken in co-operation with the United States Forest Products Laboratories.

Testing was completed and a final report prepared for publication on a study to determine the effect of kiln-drying upon the strength of Western hemlock of aircraft quality and to establish satisfactory drying schedules which would not damage the mechanical properties of this wood when used for this exacting purpose.

The strength of new and improved adhesives and the merits of new techniques of applying these adhesives were determined for the guidance of manufacturers and wood-using plants. Doors with pieced, glued stiles and single-sheet plywood faces were tested in diagonal compression and showed practically the same resistance to distortion as similar doors with one-piece stiles.

An analysis was made of strength data obtained from standard tests of small clear specimens of Douglas fir and Western red cedar, to determine the comparative specific gravity and the mechanical strength properties of material cut from the north, east, south, and west sides of the tree. There was no apparent difference in the strength functions which might be attributed to position in the tree.

Committee work for the Canadian Standards Association was commenced on the preparation of a standard specification covering Douglas fir poles. A working plan was prepared for an investigation of the taper in Douglas fir and Western red cedar poles and piling.

Some study was given to the problem of using creosote-treated Western hemlock wood-stave pipe as a substitute for Douglas fir pipe in large diameters up to 10 feet, for certain specialized supply lines, and also to means for preparing and testing sections of the larger diameters, using the sand-box loading method.

DIVISION OF TIMBER PRODUCTS

A study was carried out under laboratory conditions, in co-operation with the British Columbia Research Council and the British Columbia Forest Service, in an effort to determine the effect of various humidities at night temperature on the inflammability of forest floor litter, as indicated by fire-indicator sticks. Groups of hazard sticks were dried to equilibrium moisture content with a range of relative humidities at 50°F. and were tested at 9 per cent and 6 per cent initial moisture content. In neither case was the absorption in eight hours sufficiently rapid to indicate much change in the fire-hazard conditions, even when comparatively high relative humidities were maintained. The preparation of Douglas fir indicator sticks for use by the British Columbia Forest Service during the 1947 fire season was continued.

The comparative moisture pick-up during storage of air-seasoned and kiln-dried Western red alder furniture stock was studied. Results showed that the equilibrium moisture content of the kiln-dried materials in storage was from $3\frac{1}{2}$ to 5 per cent lower than for similar air-dried material.

Special seasoning problems receiving attention included the kiln-drying of broom handle stock made from Western hemlock mill waste, the kiln-drying of black cottonwood for use as core stock, and the development of a substitute for a steam-heated dry-kiln for use by small mills where a continuous supply of steam is not available.

A survey was made at a number of coast sawmills of average production capacity to determine what changes had occurred since 1931 in the volume of sawmill waste produced and utilized. The indications pointed to a higher volume of waste than in the 1931 studies which covered, in detail, the volume of mill waste produced and its utilization for a representative number of British Columbia mills. It was found, however, that practically all the mill waste was being used for fuel, the amount going into the mill burners being negligible.

Floor tiles made with a sawdust filler and a magnesium-compound binder were tested, and a number of improvements suggested. The resultant product showed a hardness comparable to that of certain asphalt tiles and of Douglas fir flooring.

An investigation was undertaken in co-operation with the British Columbia Research Council in an effort to find some means of rapid preliminary drying of Western hemlock sawdust, in order to improve its calorific value. The use of infra-red drying was not satisfactory, owing to the opaqueness of the material, while tests using pressure only, by passing the sawdust under rollers, gave no conclusive results but indicated that only a small part of the moisture was expelled.

A mill study, carried out to determine the relation of production costs to the selling price for Engelmann spruce logs of different grades and diameters, showed little difference in the value per M. ft.b.m. for logs of different sizes within the log grade; however, the sawing time per thousand feet increased rapidly for small logs, so that the net recovery per thousand is largely a function of the sawing time. A similar study of the recovery of solid wood from cull logs, made at a northern coast sawmill, indicated that the scaler's estimates of the volume of solid wood in such logs are low on the average. The percentage of sound wood recovery showed no relation to the log diameter and the indicated sawing time per cubic foot of sound wood for all cull logs was approximately four times that for sound logs.

Studies were made to determine the lumber recovery value of Douglas fir logs of various sizes and grades as cut per 8-hour shift by sawmills of medium to average capacity, and to compare the cost of operating gang and circular sawmills. An interesting result of the study was the considerable increase in the sum of the scale of two or more short logs bucked from long logs before sawing.

The extent to which fluorescence in wood-destroying fungi occurring in Sitka spruce could be used for determining the presence of incipient decay in lumber was studied, using ultra-violet light. The results indicated that this was not a satisfactory method of detection as the fluorescence was observed only on those areas where decay was sufficiently advanced to be detected by visual inspection.

An investigation of the toxicity to certain wood-destroying fungi of a copper naphthenate wood preservative was undertaken, this substance having been suggested as a substitute for creosote where a highly efficient or expensive preservative is not required. Preliminary tests, using agar plates and exposed, impregnated wood blocks, show a toxic point between ·360 and ·320 per cent of copper naphthenate.

The collection of service data on the durability of wood under British Columbia Coast conditions was continued by means of site inspection of many wood installations, both preservative-treated and untreated.

Other pathological problems receiving attention included the prevention of stain and decay during storage of large, green hemlock cants; the determination of means of arresting decay in red cedar Indian totem poles; the prevention

of deterioration in sap lumber when shipped to Australia in deckloads; the finding of the relation of wood density to the pathological condition of wood; and the development of methods for improving penetration of preservatives in refractory hemlock.

Serious plaster staining over Western red cedar lath in coastal areas was the subject of preliminary investigation, and possible means for partial sealing of the lath were considered.

Assistance was extended to the British Columbia Research Council in a survey of the manufacture of cascara extract, from both the wood and the bark.

PUBLICITY

Articles dealing with certain specific problems under investigation at the Laboratories were prepared by members of the staff for publication in trade and technical journals.

Pulp and Paper Research Institute of Canada
Montreal

The Montreal Laboratory of the Forest Products Laboratories is a part of the Pulp and Paper Research Institute of Canada, which is supported jointly by the Dominion Government, the Canadian Pulp and Paper Association, and McGill University. The work of the Institute is under the supervision of a General Director who is responsible to a Joint Administrative Committee representing the three constituent bodies.

FUNDAMENTAL RESEARCH STUDIES

Following the development of a method of preparing lignin from solvent-extracted spruce wood by dissolving the carbohydrate constituents with specially prepared aqueous periodic acid, the resulting "periodate" lignin, when pulped under standard conditions with sulphite liquor, acted in a manner practically identical with that of lignin in spruce wood flour. It also pulped normally by the soda process, and reacted similarly to almost all other isolated lignins when subjected to other tests. Hence it should prove most useful for pulping studies in which it is desirable to avoid the complicating effects of holocellulose constituents.

The extraction of wood by liquid ammonia under high pressure is being studied as a method of isolating as much lignin as possible with the minimum chemical change. This is also the object of the work with periodic acid.

An attempt was made to ascertain if the expensive periodate or the lead tetra-acetate methods of oxidizing glycol groups in carbohydrate hydrolysates, sugar alcohols, and cyclohexane diols could be replaced by a cheaper electrolytic method. Some preliminary success has been achieved in oxidizing ethylene glycol to formaldehyde.

A successful method was finally devised for esterifying a hydroxyethyl cellulose with paratoluene sulphonate, and an analysis of the series of tosyl esters obtained by this method is being made in connection with the study of the distribution of hydroxyethyl units in a hydroxyethyl cellulose.

A study of the chemical nature of bark was begun. A quantity of white spruce bark was subjected to extraction with methanol, which was then evaporated. The residue from this, as well as the extracted bark, was subjected to further extraction with certain solvents and the extracted substances are being identified as far as possible.

In the general investigation of lignin, several studies are being made on the oxidation of less complicated analogues of lignin such as vanillin, parahydroxybenzaldehyde, and pyrogallol. Oxidation studies are also being made on starch and cellulose to ascertain the exact mode of attack on the glucose units.

APPLIED RESEARCH STUDIES

Much of the work on printing studies during the past year was devoted to an investigation of the penetration of oil into paper. Measurements were made of the void fraction available for oil penetration. Measurements of the penetration of paper by oil, air, and carbon tetrachloride were made for the purpose of studying the structure of the sheet. Further work on a new smoothness tester showed the reproducibility of the test to be good, but revealed the necessity for providing some means of approximating the effect of the ink film in printing. The instrumental equipment was improved and the work facilitated by the use of a galvanometer of more modern design.

The detailed examination of methods of analysing sulphite waste liquor was continued. These studies are for the purpose of distinguishing between the various compounds in the liquor when methods of utilizing it are developed. Some success was achieved in finding a method which would give a proper characterization of the concentration of the so-called free sulphur dioxide. It was also found possible to separate the ligno-sulphonic acid group of components from the carbohydrate group by fractionation. This facilitates the study of these materials. A direct method for the determination of the sulphonic acid group which involves conductometric titration is now available for the first time.

In the study of alkaline pulping, means were found for enabling mill conditions to be duplicated with the small experimental digester and auxiliary equipment being used. Work was carried out to determine the effect of varying the maximum temperature, the time at maximum temperature, the alkali charge, and the sulphidity. Bombs heated in an oil bath were used to determine the rate of delignification for various cooking times, temperatures, and liquor strengths.

Changes were made in the miniature grinder to enable measurements to be made with the stone rotating in either direction. A study of the grinding conditions and the pulp characteristics with the stone running for some time in the normal direction and then in the reverse direction showed that grinding produces a marked unidirectional conditioning of the stone. The investigation of the "longitudinal" grinding of wood, where the fibres are parallel to the movement of the stone, was continued. Sitka spruce was used because pieces of wood with growth rings of small curvature could be obtained from it for longitudinal grinding. Comparison of these results with those obtained with the conventional "transverse" grinding showed that, at the same grinding pressure, the power requirement was much greater and production and freeness were much less with the former, while certain strength tests showed higher results. Better longitudinal grinding was done on an unconditioned stone.

Work on the measurement of the surface area of a pulp was interrupted for a time, but a related study was made of the variation in the concentration of wet pulp with the pressure to which it is subjected. This is of importance in studying the packing of a pulp on a screening medium.

Some time was spent in studying means of improving the tests for determining the freeness of pulp and the bursting strength of paper.

The study of the efficiency of present methods of driving pulpwood in rivers was completed and published in book form. This was supplemented by the preparation of a practical guide for long-term systematic planning of river improvements and water regulation for driving, on the basis of complete drainage areas.

A detailed study was made of the regeneration of spruce to determine the favourable and the unfavourable factors so that silviculturally desirable cutting practices may be adopted.

The feeding of woods workers was investigated to ascertain what improvements could be effected in the interests of their health and of sound economy. Much valuable information was obtained regarding proper choice of foodstuffs, preparation of a balanced diet, waste elimination, proper eating practices, and other aspects of feeding.

An investigation was made to determine practical procedures for studies of the rates of forest growth to permit more accurate planning for future wood supply.

The conveying of wood by gravity down a rough steep slope by means of a suspended wire was studied to ascertain if it was better than the conventional technique.

A compilation and analysis were made of available data on the design and construction of permanent and portable logging camps, including a survey of various suitable building materials.

SERVICES

The usual service was rendered in testing samples of pulp and paper and in checking instruments for making such tests. Information was provided in response to questions on pulp and paper technology.

Articles on various aspects of the work under way were contributed to a number of technical journals.

SURVEYS AND ENGINEERING BRANCH

J. M. WARDLE, DIRECTOR

The fiscal year ended March 31, 1947, was a very active one for all the services of the Branch. Although work projects that had been planned in case an unemployment situation developed were not needed for this purpose, the back-log of operations held up during the war years and the initiation of several very important projects associated with the development of Canada's natural resources greatly taxed the capacity of the staff of the Branch. Such work, together with routine activities, could have been dealt with without too much pressure if technical and clerical staff could have been secured for the positions established in the Branch. However, the position of the Branch in regard to personnel has deteriorated owing to the retirement of exceptionally well-trained technical men and the inability to secure competent successors, even in the lower ranges. This condition will apparently continue until the great demand of private enterprise for staff of all kinds is fairly well satisfied.

The Dominion Observatory at Ottawa further improved its Dominion-wide time service which is so valuable in connection with exploration surveys and the development of the North. A notable feature was the expansion of the geophysical activities of the Ottawa Observatory. During the war these could not be proceeded with, but in 1946 it was possible to undertake geophysical surveys that were badly needed in the fields of magnetism and gravity. During the winter of 1946-47, a satisfactory program of field work was developed and long-range plans were given consideration.

At Victoria, the Dominion Astrophysical Observatory continued its investigations and research work in regard to stars, paying particular attention to star orbits, radial velocities, and the physical characteristics of stellar atmospheres. Several papers of international interest were prepared and published by the staff.

The Dominion Water and Power Bureau experienced a very busy year, the two main projects being the continuation of construction of the Snare River hydro-electric power project in the Yellowknife area and the further investigations into the potential uses of the waters of the Columbia River Basin in Canada. The latter work is now well organized, with the Bureau utilizing the services of other branches and departments for such operations as contour surveys and investigations of dam sites and geological formation.

Important hydrometric stations were established along the Columbia River and readings were taken during the winter months at points where the river could be easily reached from the Golden-Revelstoke Highway.

It is interesting to note that the anticipated drop after the war in electric power output across Canada did not materialize to the extent expected. While 1944 was the peak year, there was only a slight drop in electrical consumption in 1945, and in 1946 consumption increased by 3½ per cent over 1945. Shortage of electric power has become evident across Canada and new hydro-electric developments are either planned or under construction in British Columbia, Alberta, Ontario, and Quebec. On January 1, 1947, Canada's water-power development totalled 10,312,123 horse-power, which is slightly less than 20 per cent of the total development estimated to be possible.

The Engineering and Construction Service continued its work during the fiscal year of making surveys and engineering investigations of various projects proposed or under way in the National Parks and Indian reserves across

Canada. Many surveys were made to meet demands for greatly improved highways in the National Parks, since these suffered greatly during the war through lack of funds and man-power. At the same time the demands of modern traffic require high standards of highways. Numerous inspections of projects on Indian reserves, including maintenance of municipal services and of buildings such as schools and residences, were undertaken and reports made. Highway work was undertaken as required. Work continued on two major highway projects, one of these being construction of the all-weather road from Grimshaw in Alberta to Hay River on the Great Slave Lake. That section of the road in Alberta, totalling some 245 miles, is under the direct supervision of the Province, with the Dominion contributing two-thirds of the cost. General supervision is exercised by officers of the Engineering and Construction Service. The section through the Northwest Territories, eighty-one miles long, is being directly handled by the Service. Grading at the end of the 1946 season was behind schedule, due to difficulties in securing equipment and to unfavourable weather conditions. Contractors on both sections of road endeavoured throughout the winter months to increase their equipment on the project. In Manitoba, a road to the Snow Lake mining district, some thirty-one miles long, from the railhead at Wekusko on the Hudson Bay Railway, was under construction by the Province, with the Dominion and the Province each paying one-half the cost. It had been hoped to have this work done by contract, but as no reasonable bid could be secured, it was decided that the Province would at least begin the project by day labour. Progress has been encouraging.

The Geodetic Service of Canada had a busy year on projects associated with its main activities, namely primary and secondary triangulation, astronomical fixations, and precise levelling. Field parties were engaged in triangulation on the Edmonton-Jasper section, the St. Lawrence area along the north shore, a section of the Alaska Highway, and a section between Sudbury and Sault Ste. Marie in Ontario. Precise levelling was continued along the Alaska Highway and this project is nearing completion. Precise levelling was also undertaken in the Columbia River Basin in connection with that project. The determination of latitude and longitude at selected points in northern Canada for map control was continued, and a very successful season was experienced.

The International Boundary Commission continued its work of maintaining the boundary lines between Canada and the United States, and Canada and Alaska in an effective state of demarcation. Canada has been able to assume her full share of the cost of this work, which lagged for a time during the early part of the war. Maintenance work was undertaken on the Maine-New Brunswick boundary and on the Alaska-Yukon boundary. The Boundary Commissioners for Canada and the United States made inspections of work in Alaska and on the Pacific Coast.

Work on the surveying and charting of Canada's water routes was continued by the Hydrographic Service. The 1946 season marked the return to active survey work of the Hydrographic ship *Acadia*, which had been overhauled in 1945-46 after six strenuous war years with the Naval Service. On the Atlantic Coast, hydrographic surveys were carried out in the Gulf of St. Lawrence, Northumberland Strait, and the Great Bras d'Or Lake area. Important work was continued on Great Slave Lake and the Mackenzie River route. This work, which not only provides accurate charts for water navigation in the North but indicates where channel improvements can be made, is of particular importance in view of the responsibility of the Department of Mines and Resources in developing the Yukon and Northwest Territories. On the Pacific Coast the hydrographic ship *Wm. J. Stewart* continued its operations, concentrating on further charting of the inside passage from Vancouver and Victoria to Prince Rupert. Work was done in Grenville Channel, in the vicinity

of Port Hardy, and on Queen Charlotte Sound. The yearly Tide Tables were prepared and issued well in advance of requirements, and new volumes of Pilots and Sailing Directions were issued covering areas on both the Atlantic and Pacific Coasts.

The Legal Surveys and Map Service continued its work of producing and distributing maps, including air navigation charts, that will cover all Canadian territory. Various legal surveys of Dominion areas were carried out as required. These included several important surveys in the Yellowknife district, not only of particular areas but in extending control by the survey of meridians and base lines. The legal survey of the Alaska Highway continued throughout 1946, and it is expected that this work will be completed in 1947. Legal surveys were made of several airfields and two townsites in the North. A large amount of work was undertaken in connection with surveys of Indian reserves and of Indian reserve boundaries. Owing to the lack of qualified surveyors, all the program that had been planned could not be undertaken.

During the fiscal year 1946-47, the distribution of maps, plans, and publications was nearly two and a half times greater than at any time prior to the war. The Legal Surveys and Map Service was also actively engaged on a phase of the Columbia River Basin investigations, undertaking important mapping work in the Kootenay River and Lake area from which the amount of water storage could be computed. The plotting of trimetrogon photography for air navigation charts continued at a faster pace, with some 177,000 square miles of plotting being completed, most of this covering northern areas.

In addition to all the work undertaken by the above Services as part of their routine functions, a large amount of time and energy was applied to special projects and to the consideration of improved methods of surveying and mapping. Many of the senior officers of the Branch serve on interdepartmental committees, dealing with such matters as construction in the permafrost areas; radio communications in the Northwest Territories; the Provisional International Civil Aviation Organization; the establishment of weather stations and magnetic observatories in northern areas, and numerous Water Control Boards.

The Surveys and Engineering Branch undertakes its work with funds provided through its own votes or through those of other branches of the Department of Mines and Resources or other Government departments which require work that comes within the functions of the Branch.

The following table gives an outline of the Branch expenditures from its own funds and from funds made available to it:—

Statement of Expenditures, Fiscal Year 1946-47

Regular Votes	$3,444,229 53	
Statutory Votes	1,020 00	
Demobilization and Reconversion—		
Post-War Reconstruction Program—Planning—		
Branch Administration	3,738 69	
Dominion Observatory, Ottawa	16,679 11	
Dominion Water and Power Bureau	34,776 95	
Engineering and Construction Service	124,283 18	
Geodetic Service	157,133 89	
Hydrographic Service	27,540 47	
Legal Surveys and Map Service	117,803 18	
Japanese Nationals	44,882 23	
Alaska Highway	11,713 56	
Legal Survey of Alaska Highway	13,103 67	
	$3,996,904 46	$3,996,904 46

Statement of Expenditures, Fiscal Year 1946-47—Con.

Moneys made Available by other Branches and Departments

—	Regular Votes	Demobilisation and Reconversion	Open Account	
	$ cts.	$ cts.	$ cts.	
To Engineering and Construction Service from:				
Lands, Parks and Forests Branch	227,854 29			
Indian Affairs Branch	198,720 87			
Central Mortgage and Housing Corporation			21,996 68	
To Dominion Water and Power Bureau from:				
Department of Fisheries	9,824 00			
To Legal Surveys and Map Service from:				
Department of Transport	5,345 98			
To Hydrographic Service from:				
Department of National Defence (Navy)		48,188 15		
To Geodetic Service from:				
Department of National Defence (Air)		1,226 91		513,156 88
Totals	$441,745 14	$49,415 06	$21,996 68	4,510,061 34

DOMINION OBSERVATORIES

Following the cessation of war and the return of staff members who served with the armed forces or were engaged in other war tasks, the Dominion Observatories at Ottawa and Victoria have fully resumed their normal activities of astronomical and geophysical research. As in the past, the aim has been to combine fundamental studies of the laws of nature having as their object the general advancement of science, with more immediately practical activities such as the astronomical determination of time, and the application of astronomical and geophysical observations to such diverse problems as navigation and surveying, economic geology, and the relation of seismology to safety in the mines and building construction in seismic areas. A special effort has been made to assemble and prepare for publication the results of observations made during the war years when publication was suspended, although it is expected that several years will elapse before all publications are brought up to date.

DOMINION OBSERVATORY, OTTAWA

R. Meldrum Stewart, Dominion Astronomer and head of the Observatory for 22 years, began retiring leave on August 15, 1946, after 44 years' service, his retirement taking effect on February 15, 1947. Dr. Ralph E. DeLury had charge of the work from August 15 to November 23, when he also began his retiring leave after 40 years in the service of the Observatory. He was succeeded as Acting Dominion Astronomer by Dr. C. S. Beals, formerly of the Dominion Astrophysical Observatory, Victoria, B.C. Orville Sills, Head Clerk, who had been associated with the Observatory for 41 years, retired on December 9, 1946, because of ill health.

The work of the Dominion Observatory in Ottawa has in the past been organized into six divisions, but during the past year two of the former divisions, namely, Solar Physics and Photoelectric Photometry, together with a new branch of work on meteoric astronomy, have been combined into a single division of

Stellar Physics. The five divisions as at present constituted, with the names of their respective chiefs, are as follows: Position Astronomy, which includes the Time Service, W. S. McClenahan; Stellar Physics, C. S. Beals; Terrestrial Magnetism, R. G. Madill; Seismology, E. A. Hodgson; and Gravity, A. H. Miller. The work of the Observatory will be described by divisions.

Position Astronomy and Time Service.—Astronomical observations for the correction of clocks were carried out on 204 nights, 2,596 separate star transits being made. The combination of a Shortt pendulum clock and a quartz crystal clock proved satisfactory for controlling the time system of the Observatory, although the crystal clock occasionally gave trouble by stopping. It would be highly desirable to have an additional crystal clock, since experience at other observatories has shown that more than one of these timekeeping devices are necessary to realize in practice the high theoretical accuracy of the crystal controlled timepiece.

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 over VAA on 8330 kc. from June to October continuously from 7 p.m. to 5 a.m. E.S.T. for the benefit of survey parties; and through the Canadian National Telegraphs for broadcast over the Department of Transport station VAP at Churchill. Time signals were also broadcast continuously from Station CHU at the Observatory on 3330 kc., 7335 kc., and 14670 kc.

Foreign signals were received daily from WWV and NSS on receivers located at 50 Perth Street, Ottawa, 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.

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.

Meridian Circle observations were made on 57 nights, 1,341 observations being secured and 102 sets of instrumental constants computed. Computations were kept up-to-date and various plans for improvement of instrumental technique were studied. The Meridian Circle instrument was out of use for a period of two months for general overhaul and repair. Tests were made of two heated flying suits loaned by the Office of Defence Research for winter observing. They were found to contribute greatly to the comfort and efficiency of observers.

The computations for the list of Meridian Circle observations secured in the period 1912-23 were completed and prepared for publication. The list comprises over 3,000 stars, and many thousands of individual observations are involved. These results constitute an important contribution to our knowledge of exact stellar positions.

Tables of sunrise, sunset, moonrise, moonset, phases of the moon, and eclipses were supplied as in other years. Detailed computations relating to the circumstances of the partial eclipse of the sun were carried out at the request of E. A. Covington, of the National Research Council, in connection with his studies of radio-frequency radiation from the solar surface. One hundred time pieces, including watches, clocks, and chronometers from other services, were received for repair by the Observatory watchmaker.

Stellar Physics.—The scientific work of this division includes the theoretical interpretation of stellar spectra and other astronomical observations, the study of meteoric phenomena, and the study of the sun.

Solar work carried on during the year included studies by Dr. DeLury of the physical interpretation of the limb effect on solar wave lengths and an investigation of solar distance based on precise measures of radial velocity. Direct photographs of the solar surface were made regularly, and co-operation was maintained with the Canadian Radio Wave Propagation Committee in the correlation of solar activity with the state of the ionosphere.

Dr. P. M. Millman, formerly of the David Dunlap Observatory, and Squadron Leader in the R.C.A.F., joined the staff of the Observatory on June 15, 1946. Part of the work planned for Dr. Millman was concerned with the photographic telescope, and this instrument, which had been idle during the war, was thoroughly overhauled and placed in working order. Dr. Millman's main program was concerned with meteoric research, in particular the observation and interpretation of meteor spectra. A new camera mounting was designed and constructed for the observation of the Perseid meteor shower of August 10-14. Nine direct and three spectrographic photographs of meteors were secured. A more elaborate program of observation was prepared for the Giacobinid meteor shower of October 9, 1946, when 204 direct photographs and 24 meteor spectra were obtained. Analysis of the spectra indicated the presence of atomic lines due to neutral sodium, iron, magnesium, manganese, and calcium. The spectra were of low ionization, lacking the lines of ionized metals of the Perseid meteors. Plans were drawn up in co-operation with Harvard College Observatory and the United States Bureau of Naval Ordnance for an elaborate program of meteoric research, having as its object not only a study of the physical nature of meteors but also an investigation of the upper atmosphere in its relation to the flight of long range projectiles.

A new determination of the colour temperature of the solar corona was made on the basis of the spectrograms secured by R.C.A.F. Operation Eclipse on July 9, 1945. The colour temperature was in the neighbourhood of 9000° K., distinctly bluer than indicated by the results of previous investigators.

A program of study and measurement of stellar spectrograms secured at Victoria was initiated by Dr. Beals, aided by Miss M. S. Burland and J. L. O'Connor. One part of the program had as its object the determination of the physical conditions existing on the surfaces of emission line stars, while another part was concerned with the physical state of interstellar matter.

Terrestrial Magnetism.—Field operations for the re-occupation of former magnetic stations and the establishment of new stations were carried out in Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia. Base stations for standardizing measurements of vertical force and other magnetic elements were established in certain mining areas of northern Ontario and Quebec.

One observer accompanied the Eastern Arctic Patrol on the Hudson's Bay Company steamship *Nascopie* into Arctic waters for the purpose of occupying magnetic stations as close as possible to the Magnetic Pole. Six repeat stations and two new stations were occupied, and the results of these observations gave further confirmation to other indications that the Magnetic Pole was moving northward.

One observer accompanied the gravimetric survey party in western Canada, occupying approximately 550 stations for the measurement of vertical force. Over 600 observations of magnetic declination were supplied by parties of the Geodetic Service and Topographical Survey in northern and western Canada and in the Arctic regions.

Plans were drawn up for the construction of a temporary magnetic observatory at Baker Lake to operate until it was possible to establish a permanent magnetic observatory at Churchill.

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 were completed up to January, 1947, and progress was made in the preparation of results for publication.

A statistical analysis was made of observations made since 1943 at over 200 stations north of latitude 60° for the purpose of computing the position of the North Magnetic Pole. Of special importance in these computations were the magnetic observations secured by Exercise Musk-Ox in 1946 and the stations occupied by the observers with the *Nascopie* in recent years, although very valuable information was also provided by values of declination supplied through the courtesy of the Geodetic Service. The computed position of the Pole was latitude 73° 15′ N. and longitude 94° 30′ W. While this position is still regarded as of a preliminary character, it is undoubtedly the most authoritative now available since corresponding calculations made by English and United States scientists were made without the benefit of observations in latitudes north of 60°.

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. New recorders using synchronous motor drives were installed at Victoria and at Seven Falls.

The continuous records of the several stations registered 627 earthquakes. All major shocks were reported to the press and to Science Service at Washington, D.C. Local shocks were reported regularly to Weston, Mass., 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.

Through the co-operation of the Associate Committee on Geophysics of the National Research Council, a laboratory test of the microseismic method of determining rock pressures in mines was conducted, with confirming results, in the laboratory of the United States Bureau of Mines, at College Park, Maryland, using rock specimens from Canadian mines. With the same co-operation, a seismic survey in the Precambrian Shield was planned and instruments were purchased. The survey will use the energy releases of rockbursts in Kirkland Lake, Ontario. It will run as a profile from that town to Ottawa, and will probably be maintained for four years.

Dr. E. A. Hodgson made a field study of the severe earthquake which occurred in British Columbia at $10^h\ 13^m\ 19^s$ Pacific Daylight Time, June 23, 1946. The epicentre was approximately defined, instrumentally, as 49·9° N, 125·3° W, —a point about ten miles southwest of Campbell River on the east side of Vancouver Island. The region of most severe damage ran through the Alberni canal, across the height of land to Parksville, thence up the west side of Vancouver Island to Campbell River and above. This earthquake was easily the most severe which has occurred in any part of Canada within historic record. It was recorded on seismographs almost to the antipodes of the epicentre. The seismograms have been collected at the Observatory to be used in a further study of this earthquake.

Gravity.—Two major projects were carried out by the Gravity Division during the year. One was the establishment of base stations with the pendulum apparatus in northern Ontario, northern Manitoba, southern Saskatchewan, southern Alberta, the Gaspé peninsula, and Nova Scotia, using rail transportation. The stations are for the purpose of controlling observations by the new gravity meter, which is much more rapid and highly accurate but requires comparison with stations established by the more fundamental method.

The second project consisted of two traverses by automobile with the new gravity meter purchased in the spring of 1946. The capabilities of this instrument and its speed of working in comparison with previous methods are well illustrated in the results of the summer's work. During a 3-month period over 600 new stations were established with an estimated accuracy of 1/10 milligal or better per station. The gravity meter was specially mounted in an automobile purchased for the purpose, and the mileage covered was 10,000, with a station on the average every 8 miles. It is usually necessary to occupy a station twice, and sometimes more often, before it can be regarded as established. The result of these traverses was a gravity profile of the prairie region, indicating decreasing density of the earth's crust in a westerly direction and suggesting more or less complete isostatic compensation. Irregularities in the profile indicated a very interesting geological formation running in a north-south direction which it is hoped to investigate further in subsequent years.

Publications, Public Lectures, and Demonstrations Arranged for Visitors.—The following publications have been issued: Bimonthly Clock Corrections and Wireless Time Signals; Bibliography of Seismology; British Columbia Earthquake June 23, 1946, in the Journal of the Royal Astronomical Society of Canada; Laboratory Tests of Microseismic Method of Detecting Critical Rock Pressures; monthly Seismological Bulletins; Magnetic Stations in Mining Areas in Quebec. "Sky-Facts" continued as a weekly feature of the Ottawa *Citizen* until February, 1947, when the series ended after more than seven years of publication.

A lecture entitled Canadian Time Service was delivered to the R.A.S.C. by Mr. McClenahan. Two lectures on atomic energy were given by Dr. Millman at the R.C.A.F. Staff College, Toronto, and one at the Army Staff College, Kingston. Dr. Millman also spoke on "The Stars Fall" to the R.A.S.C., and addressed the Canadian Association of Scientific Workers on the topic, "Exploring the Super-Stratosphere". A paper on "Spectrophotometry of the Solar Corona—R.C.A.F. Operation Eclipse July 9, 1945", was presented to the American Astronomical Society and one on "Giacobinid Meteors" to a seminar at the David Dunlap Observatory. Under the direction of Miss Burland, six meetings of the Junior Astronomical Club were held at the Dominion Observatory.

The regular custom was continued of making the telescope available to the public every clear Saturday evening, and, in addition, the various divisions were in turn open for inspection. In the spring of 1947, an open night was held, when members of the R.A.S.C. and their friends were entertained and special displays were arranged by each division. The Chambers of Commerce of Ottawa and Hull spent an evening at the Observatory in the autumn. The telescope was made available to them, and staff members explained the various phases of the work.

DOMINION ASTROPHYSICAL OBSERVATORY, VICTORIA, B.C.

With one exception, the regular Observatory staff remained unchanged. In November, Dr. Beals, Assistant Dominion Astrophysicist, was transferred to the Dominion Observatory to be Acting Dominion Astronomer. During the summer, C. D. Maunsell, graduate student at the University of British Columbia, was employed temporarily as Technical Officer, Reconstruction, Grade 1.

Observing Statistics and Programs.—The telescope was employed on 169 nights and 1,119 photographs were taken. During the spring, experimental direct photography was carried out on 12 nights at the Newtonian focus. A total of 46 direct photographs were secured.

Apart from the direct photography the telescope was devoted entirely to stellar spectroscopy. High-dispersion instruments were employed in the study of line intensities in solar-type stars and for the determination of fundamental wave-length standards for radial-velocity determinations. The extensive observational programs of (*a*) faint B-type stars, (*b*) R- and N-type stars, (*c*) North Galactic Pole Stars, and (*d*) spectroscopic binaries were continued with single-prism dispersion. An interesting experiment was carried out in May when one three-night exposure for a total of 17 hours and one four-night exposure with a total of 24 hours, the longest ever attempted at this Observatory, were made for the purpose of securing high dispersion spectra of an 8th magnitude star. The quality of the spectra obtained by these exposures exceeded expectation, amply justifying the time and labour expended in securing them.

During the Giacobinid Meteor Shower on October 9, meteor counts were carried out by Dr. Andrew McKellar and Dr. K. O. Wright.

Visitors to the Observatory.—Expectations of a large increase in the number of persons visiting the Observatory were fulfilled. An estimated 26,000 visitors were received, including the general public and various societies and groups. As in the past, the public was admitted each Saturday night and permitted to observe for two hours with the large reflector. During the month of August, three visitors from France, Dr. B. Lyot, Dr. P. LaCroute, and M. Desroches, visited the Observatory and discussed with the staff recent advances in observational techniques and problems in design of telescopes and spectrographs.

As an aid to public relations, descriptive placards were prepared and mounted in the dome. These direct the attention of the visitor to the main items of the equipment and explain their several functions. They have been found useful in conveying to the visitors a better understanding of the Observatory and the objects of astronomical research.

Maintenance and Alterations.—The telescope, dome, seismographs, and scientific instruments were maintained in good repair and operating condition through routine inspection and necessary repairs and alterations by S. S. Girling and E. L. Jakeman. The dome turning mechanism was overhauled and improved controls with limit switches were installed for operating the dome shutters and the wind curtain.

During the year, the dome and Observatory buildings, the residence of the Dominion Astrophysicist, and the garages were painted by the Department of Public Works. Extensive alterations were carried out to the work space in the dome. The workshop was improved in the matters of insulation and wiring. A carpentry shop was built above the workshop and additional storage space has been provided.

Telescope and Instrumentation.—The resources of the workshop were, as in the past, utilized to the utmost. It may be noted that the acquisition of new machine tools, in particular a milling machine, has increased the ability of the Observatory personnel to build and modify apparatus and instruments.

The camera for direct photography at the Newtonian focus was rebuilt with improved means for guiding, and a shutter for short exposures was installed.

A new spectrograph was completed during the year by the combination of a short focus lens of focal length 8·5 cm., and aperture ratio of 1·5 with the two-

prism ultra-violet instrument. The linear dispersion is 390 A/mm. at Hγ and very faint stars may be photographed with reasonably short exposures.

During the year, new slit jaws were acquired and installed in the spectrograph, replacing the original set which had become marred through continuous use during nineteen years.

The projection comparator for the rapid measurement of radial velocities has continued under study and experiment. An improved technique for the ruling of the necessary scales has been developed, and intensive trials give satisfactory results for the performance of the new machine.

At the request of the Hydrographic Survey, five tide-recording machines were repaired and improved in the Observatory shop.

During the month of June, the Cassegrainian secondary was aluminized, and it and the primary mirror have been inspected and cleaned periodically. An improvement in spectroscopic speed has resulted from the coating of the optical parts with non-reflecting films.

An important instrumental project was initiated with preliminary discussions of a new spectrograph. Some tentative designs were made and discussions were held with other astronomers and with persons having experience in the design and construction of astronomical equipment.

Astrophysical Researches.—The research programs of the past few years have been continued with satisfactory progress. No new major programs have been initiated, but several lengthy investigations have been brought to an advanced stage. Some shorter researches have been completed and prepared for publication.

(*a*) *The P Cygni Stars.*—The description and study of the spectra of the P Cygni stars have been virtually completed by Dr. Beals. In all, sixty-eight stars are included in the study, of which forty have been observed at Victoria. Twenty-four spectra have been studied in considerable detail, supported by measurements of line intensities, spectral line profiles, and apparent radial velocities. A large body of data has been assembled and the discussion will, it is expected, throw a good deal of light upon the nature and physical conditions of these peculiar stars. The material is in process of preparation for publication.

(*b*) *The R- and N-type Stars.*—Dr. McKellar has continued his researches into the spectra of these cool stars. The carbon bands of the Swan system are being studied in the spectra of forty R and N stars; detailed studies have been completed for fifteen of these objects. The analysis of the main ($C^{12}C^{12}$) and isotopic ($C^{12}C^{13}$ and $C^{13}C^{13}$) bands leads to the important result that the abundance ratio of C^{13} and C^{12} varies among these stars.

A study of certain unidentified bands in N-type spectra has increased the knowledge of the features and contributed to their ultimate identification. Two new strong bands and three weaker ones have been added to the six previously known. The general nature of the carrier molecule has been established and tentative identifications have been suggested. The results of this investigation have been published.

(*c*) *Solar-Type Stars.*—The detailed study of line intensities in solar-type spectra has been continued by Dr. Wright. Analyses based upon theoretical, laboratory, and "solar" line-strengths have been made from which are derived excitation temperatures, electron pressures, and the chemical composition for the atmospheres of the sun, γ Cygni, α Persei, and α Canis Minoris. This research is now completed and the results are in preparation for publication.

Current investigations in this field are directing attention to certain departures from the simple theory of line intensities in stellar absorption spectra. During the year, studies have been made on the variation of turbulent velocity

as a function of excitation and the differences encountered in the spectra of normal (dwarf), and supergiant, stars. Studies of (i) Fe I lines in the spectrum of α Persei; (ii) Vanadium lines in the solar spectrum (in collaboration with R. B. King of Mount Wilson Observatory); (iii) Spectral lines in the F component of ε Aurigae; have been prosecuted during the year, and interesting observational results have been established. Some of these studies are now in manuscript form prior to publication.

Double Stars.—General and specific studies of spectroscopic binaries have made progress. Miss J. K. McDonald has completed her investigation of the important system H.D. 193793, which is composed of an O-type star and a Wolf-Rayet companion. Spectrophotometric studies of the composite spectrum have given the spectral types of the components and their relative luminosities, and radial velocity measures have established the binary nature. The material has been prepared for publication.

Dr. J. A. Pearce has completed his study of the system of H.D.E.228911 (*see* Annual Report 1945-46). The orbits and absolute dimensions have been determined. Spectrophotometric and radial-velocity data, combined, predicted an eclipse which was verified from photographs made at the Harvard College Observatory, thus confirming the absolute dimensions determined at Victoria.

The system of H.D.43246 has been investigated by Dr. R. M. Petrie, by a combination of radial-velocity, and line-intensity, measurements. Absolute dimensions have been determined. The system is peculiar in that the fainter star is an under-luminous, highly-compressed object. The material has been prepared for publication.

Dr. McKellar has continued spectroscopic studies of RY Geminorum, H.D.110533, DI Herculis, and δ^1 Lyrae. The first-named object was observed during total eclipse and the changing spectrum studied. Valuable information concerning the dimensions of the component stars and the nature of the body emitting the emission lines will be derived from the plates.

Several additional spectroscopic, and eclipsing, binaries have been followed during the year so that orbital determinations will be possible in the near future.

The spectroscopic measurement of the relative luminosity of binary components has been continued by Dr. Petrie. Values have been derived for 17 additional systems and the program has been brought nearly to completion. A paper on this research was presented at the meeting of the I.A.U. Panel on Eclipsing Binaries in December, and has been submitted for publication.

Radial Velocities.—Approximately 300 spectrograms have been measured for radial velocity during the year, the majority referring to the spectroscopic binaries mentioned above. The rest of the radial-velocity work has been concentrated upon the determination of fundamental wave-lengths. Solar type wave-lengths for high and moderate dispersions have been determined by Dr. Petrie and the results published. The study of low-dispersion spectra of solar-type stars has been commenced by Miss McDonald, and high-dispersion wave-lengths for A-type spectra are being determined by Dr. Petrie.

The use of the ultra-violet spectrograph for radial-velocity purposes has been investigated by Miss McDonald. Dispersion constants and reduction tables have been computed so that this fast spectrograph is now available for studies of faint stars.

Absorption Line Studies in B Stars.—The principal absorption lines in the spectra of approximately one-hundred B-type stars have been measured by Mr. Maunsell and Dr. Petrie. The results will form the basis for studies of spectral type and absolute magnitude criteria in the B stars.

Relations with Scientific Societies and Other Observatories.—The Observatory was represented at three scientific meetings. In May, Dr. Pearce attended the Royal Society of Canada meeting and presented ten technical papers from the Observatory. The September meeting of the American Astronomical Society was attended by Dr. Wright, who presented two papers. Dr. Petrie attended the December meeting of the American Astronomical Society as a member of the Council, and presented an invited paper to the symposium on Close Double Stars. Dr. Beals was appointed a Collaborating Editor of the Astrophysical Journal for the term 1946-48.

In February, Dr. Pearce visited the Lick and Mount Wilson Observatories and the Department of Astronomy of the University of California to discuss astronomical problems of mutual interest and to arrange for co-operation and collaboration in studies undertaken at more than one observatory. Dr. Beals visited the California institutions in September to discuss scientific problems and to study recent advances in technique and equipment.

Publications, Addresses.—A vigorous publication policy was maintained during the year in order to give general distribution to results obtained, but not published, during the war years. Seven "Contributions" (Nos. 3 to 9 inclusive) were prepared for publication and submitted, and three numbers were prepared for the Publications of the Dominion Observatory, (Vol. VII, Nos. 16, 17, 18). One invited paper was prepared for inclusion in a volume to be published by the Harvard College Observatory, and one popular article was prepared for the Journal R.A.S.C.

Nineteen semi-popular addresses were delivered by the Observatory staff to scientific and educational organizations in the Victoria and Vancouver areas.

Seismology.—Regular seismological observations were continued and records forwarded. Thirty-one earthquakes were recorded.

DOMINION WATER AND POWER BUREAU

There was a marked increase in Bureau activities during the year, chiefly in connection with the Snare River power development and the Columbia River Basin investigations. There was also a gradual extension of the hydrometric work throughout the Dominion. Construction of new hydro-electric power plants was undertaken by provincial governments, public utilities, and private companies during the year, and though only 27,760 horse-power of new installation was completed in 1946, new installations which will aggregate over 300,000 horse-power are under construction. The consumption of electrical energy during 1946 exceeded that of 1945 by over 3·5 per cent.

WATER AND POWER

Lake of the Woods Regulation.—The regulation of Lake of the Woods was continued by the Dominion Water and Power Bureau acting under the authority of the Lake of the Woods Control Board. The run-off during the year was well above normal, particularly during the winter months. Lake level rose from elevation 1060·08 on April 1, 1946, to a peak elevation of 1060·78 on July 10, and fell to elevation 1059·17 on October 1. As a result of above-normal precipitation in October and November the run-off increased and lake level rose again to elevation 1060·30 on January 14. The rate of outflow was then increased and the level was drawn down to elevation 1059·62 on March 31, 1947. Accordingly, the regulation of the lake did not become subject to the approval of the International Lake of the Woods Control Board at any time during the year.

Lac Seul Regulation.—The regulation of Lac Seul was continued by the Hydro-Electric Power Commission of Ontario acting under the authority of the Lake of the Woods Control Board. The run-off during the year was well above normal, particularly during the winter months. Lake level rose from elevation 1166·93 on April 1, 1946, to a peak elevation of 1171·61 on August 4 and was drawn down to elevation 1167·35 on March 31, 1947.

Snow Survey.—The nineteenth annual snow survey in the Winnipeg River 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 close to average for the 19-year period.

Water Power Administration

The agreement between the Governments of Canada and Alberta made on September 25, 1945, for the purpose of defining the interests and obligations of Canada and Alberta with respect to three developed power sites on the Bow River operated by the Calgary Power Company came into effect on April 1, 1946, having been confirmed by the Alberta Natural Resources Transfer (Amendment) Act, 1945, of Canada, and the Alberta Natural Resources Amendment Act, (1946), of Alberta. Thus a controversy which had complicated administration of these developments for a number of years was satisfactorily ended.

Under the terms of this agreement, final water-power licences for the Horseshoe Falls and Kananaskis Falls developments were issued by the Minister of Mines and Resources on May 28, 1946, and that for the Ghost development will be issued as soon as the fixation of cost has been completed. Under the terms of the Horseshoe and Kananaskis licences, the Indians of the Stony Band have received $66,384.80 in rental made retroactive for these two sites.

These 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 available water. Output for the past two calendar years was as follows:—

Calendar Years	Cascade	Kananaskis	Horseshoe	Ghost
1945 kw.hrs.	44,471,200	65,204,700	73,751,500	127,086,200
1946 kw.hrs.	60,652,700	74,013,500	83,477,800	142,471,100

In connection with the Lake Minnewanka development the diversion canal from Ghost River to Lake Minnewanka was further improved and additional clay was sluiced into the power canal to check leakage. Early in January, the Calgary Power Company resumed clearing the shore of Lake Minnewanka to the high-water level, and plan to complete this work during the present year. When work was resumed there remained about four miles to be cleared on the north shore from the east end of the Lake and about three miles on the south shore. About half the combined distance had been cleared, but final clean-up had not been made by the end of March.

Comparative level and storage figures for Lake Minnewanka during the past two years are as follows:—

Year	Low Level	Date	High Level	Date
1945	4805·80	May 3	4836·50	October 23
1946	4807·90	May 4	4836·88	October 15

The level on October 15, 1946, is the highest so far recorded.

Usable storage in acre-feet—

October 31, 1945	March 31, 1946	October 31, 1946	March 31, 1947
160,137	41,514	154,704	30,839

The power development on the Yellowknife River in the Northwest Territories operated under licence by the Consolidated Mining and Smelting Company of Canada Limited, having an installed capacity of 4,700 horse-power, produced 21,025,000 kw.hrs. of electricity during 1946, as compared to 17,181,300 kw.hrs. in 1945, showing a considerable increase in activity among the gold mines served by this development.

Snare River Power Project

To assist and expedite 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, some 90 miles northwest of the townsite of Yellowknife, and, in the event of a favourable report being received, to arrange for the immediate construction by the Crown of an initial development for the supply of power to mining companies and other users, and to make an agreement with Giant Yellowknife Gold Mines Limited for the construction by that company of the main transmission line extending from Snare River to Yellowknife.

Under this authority, the services of Montreal Engineering Company Limited were retained as consulting engineers and after field and office studies the company reported favourably on the construction of an initial development on Snare River below Big Spruce Lake to produce approximately 8,000 horsepower at an estimated cost of about $2,425,000, including engineering services.

An agreement was made with Montreal Engineering Company Limited to prepare plans of the necessary structures and to supervise the construction of the work, and an appropriation of $950,000 was placed in the Supplementary Estimates for the fiscal year 1946-47 to cover expenditures during that year.

By authority of Order in Council, the Minister of Mines and Resources entered into a contract with Northern Construction-Mannix Companies for the construction of dams, power plant, and all other necessary related and auxiliary works. Some construction equipment had been assembled at the site of the works by Giant Yellowknife Gold Mines Limited and certain preliminary construction had been started. This equipment was acquired by the Crown and, on August 15, Northern Construction-Mannix Companies assumed control of construction operations.

The development consists essentially of an earth-fill dam about 900 feet in length, with a maximum height of 65 feet, spanning the Snare River at a point where it is divided into two channels by a rocky island; a main tunnel, 16·5 feet by 16·5 feet in section, about 136 feet in length through the island to supply water to the main turbine; a smaller tunnel, 4 feet by 6 feet in section, to supply the small turbine-driven generator exciter; intake works at the upstream end of the tunnels containing trash racks and steel gates to control the flow; and a power-house located immediately at the foot of the dam to house a turbine of 8,360 horse-power under a head of 56 feet driving a 7,000-kva. generator and a small 200-horsepower turbine for standby station service. Four 2,500-kva. transformers situated adjacent to the power-house will raise the voltage to 115,000 volts for transmission to Yellowknife. In addition to the main dam, two small containing dams will be required to complete the closure of the head pond when Big Spruce Lake is raised.

During the summer and autumn of 1946, a cofferdam was built across the right channel, the tunnels were driven through the island, some rock excavation was made for the power-house foundation, rock was stripped of overburden for the foundation of the main dam, borrow pits for the earth fill were stripped, camp buildings were built to house the construction force, and a large quantity of construction equipment and supplies was hauled by water to the north shore of Great Slave Lake and left there for winter haul to Snare River. At the same time orders were placed by the Department for the manufacture and fabrication of the power generating and accessory equipment, such as the main and auxiliary turbines, generator, switchgear, transformers, head gates, penstocks, power station steel, and travelling crane.

During the winter of 1946-47, the principal activity was the hauling of construction equipment and supplies to Snare River over winter roads from Grimshaw, Alberta, and from various places on the north shore of Great Slave Lake. More than 1,500 tons were successfully transported, thus ensuring the program of construction for 1947.

Construction of the transmission line by Giant Yellowknife Gold Mines proceeded during the winter of 1946-47. Work was concentrated on the first half of the line leading out of Yellowknife, and the remaining half will be undertaken during the winter of 1947-48.

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, four conditional water licences were obtained, one each in the Lytton and Williams Lake Agencies for irrigation, one in the Lytton Agency for storage, and one in the West Coast Agency for domestic purpose. An agreement was made for the construction of a joint irrigation ditch in the Williams Lake Agency. At the request of the Indian Commissioner for the Province, several protests were made against the granting of new applications for irrigation and storage purposes which, if granted, would reduce the Indians' share of water under existing licences. Conferences were held with the provincial Comptroller of Water Rights in regard to these and other matters affecting Indian interests. 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 25,722,900 horse-power under conditions of ordinary minimum flow, with 40,124,300 horse-power ordinarily available for six months of the year, providing for a commercial installation of some 52,000,000 horse-power. The present installation aggregates 10,312,123 horse-power, which is slightly less than 20 per cent of possible development.

Census of the Central Electric Station Industry

The central electric station industry installation is almost 91 per cent of the complete total for all purposes, while more than 97½ per cent of all electricity produced is generated from water power. The hydraulic production during 1946 was 40,591,220,000 kilowatt hours as against 39,161,567,000 in 1945.

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 southern Saskatchewan.

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 occurred in the coastal and northern areas of British Columbia, in Alberta, southern Manitoba, and northwestern Ontario. New minimum rates of run-off were recorded in New Brunswick and Nova Scotia.

In the Pacific drainage, typical stations showed a range in run-off from 78 per cent of the long term mean in the Bridge River in central British Columbia, to 114 per cent of the long term made 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 72 per cent of the long term mean in the Assiniboine River at Headingley, Manitoba, to 161 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 60 per cent of the long term mean in the Saugeen River at Port Elgin, Ontario, to 98 per cent of the long term mean in the Missinaibi River at Mattice, Ontario. In the Atlantic drainage, typical stations showed a range in run-off from 74 per cent of the long term mean in the St. Mary River in eastern Nova Scotia to 97 per cent of the long term mean in the St. John River at Pokiok in New Brunswick.

Power and Special Investigations

Special investigations undertaken during the year were concerned largely 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 substantially expanded 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 additional gauges and metering stations on the Columbia and its principal tributaries, observation of groundwater conditions in the Kootenay Flats area, further reconnaissances of potential storage areas, and preliminary examination of potential dam sites in the Kootenay River drainage. Plans were prepared of all surveys made during the 1945 and 1946 field seasons. Hydraulic investigations were continued with respect to the following problems: 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; backwater effect on Osoyoos Lake from obstruction on Okanagan River in United States territory, and similar effects from works in prospect on Skagit River; and the supply of water from Phillips Creek for irrigation purposes in British Columbia and Montana. A Dominion-Provincial Joint Board of Engineers, on which the Bureau was represented, submitted its final report in connection with flood control studies on Okanagan Lake and River. Other engineering studies of importance were undertaken for various federal departments and for other branches of this Department, including the collection of hydrometric data for the Pacific Biological Station and the International Pacific Salmon Fisheries Commission, irrigation problems of the Department of Agriculture at Kamloops, assistance to the Department of Public Works in connection with the development and maintenance of permanent ship channels in the Fraser River from Fraser Mills to the sea, and assistance in administration problems of the Lands, Parks and Forests Branch of this Department at various reserves and properties and in the construction of monuments for the Historic Sites and Monuments Board.

In the Northwest Territories the assignment of an inspecting engineer by the Bureau to the Snare River Power Project enabled the extension of systematic hydrometric investigations in the Great Slave Lake area.

In Alberta and southwestern Saskatchewan extensive studies were continued 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-fifth Annual International Snow Survey on the St. Mary River in Glacier National Park, Montana, was conducted on May 2 and 3, 1946, in co-operation with the United States Geological Survey; and on March 26 and 27, 1947, the Eleventh Annual Bow River Snow Survey was made in the vicinity of Lake Louise, Alberta. An engineer of the Bureau took part in a reconnaissance survey of power possibilities on the Rocky River in Jasper National Park and, 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. Close attention was again given to ice conditions on the Bow River in the vicinity of Calgary, and the Bureau was represented on a committee of engineers which submitted a report to the City of Calgary on the flood of the early winter of 1945-1946. The use being made of the waters of Sage Creek received further attention in connection with the Reference now before the International Joint Commission in connection with this matter.

The Souris River problem in southeastern Saskatchewan and southern Manitoba, being the matter of a Reference to the International Joint Commission, received continued attention, and a joint inspection by a Bureau engineer and an engineer of the United States Geological Survey was made of Long Creek in connection with an application of the Prairie Farm Rehabilitation Administration to create storage on Maxim Lake.

In Ontario, a detailed survey was made of the first and second pitches of Whitedog Falls on the Winnipeg River in connection with studies to improve flow conditions in that reach of the river during extreme floods. In co-operation with the Hydro-Electric Power Commission of Ontario, special investigations were continued in rating the discharge of the channels diverting water from the Ogoki River and from Long Lake toward Lake Superior. Snow surveys were again made for the Commission in the watersheds of the Wanapitei, Sturgeon, South, Muskoka, and Madawaska Rivers. Special attention was given to hydraulic problems arising from the construction of a submerged weir in the Niagara River above the falls, jointly undertaken by the Governments of Canada and the United States, and studies of the Niagara River were continued with respect to river slopes and the discharge of the river as referred to the Morrison Street gauge. At the request of the Grand River Conservation Commission a reconnaissance was made in the Grand River Valley preliminary to the establishment of a number of hydrometric stations on the main river and its tributaries.

In Quebec, hydraulic studies were 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, a joint inspection of the Grand Falls dam on the St. Croix River was made in May 1946 by an engineer of the Bureau and a representative of the United States member of the International St. Croix River Board of Control. A subsequent inspection of repair work on the dam was made in September and a report was submitted to the Board of Control. At the request of the Department of Transport an engineer of the Bureau, in co-operation with officials of that Department and of the National Harbours Board, reviewed the demolition work on the wreck of ss. *Beaverhill* in Saint John Harbour, the disposal of which was successfully completed.

In Nova Scotia, studies of run-off and storage on certain streams were made for the Department of Biology, Dalhousie University, in connection with an investigation of inland fisheries for the Nova Scotia Government. An inspection of foundation conditions was made of a dam on the St. Croix River in co-operation with officials of the Nova Scotia Light and Power Company and the Minas Basin Company. Investigations of two small power sites near Guysborough for the Nova Scotia Power Commission were made, as well as inspections of two large marshland dykes recently constructed.

Glacier Investigations.—The study of the recession of glaciers in British Columbia and Alberta, initiated last year, was continued. Nine representative glaciers in the Rocky Mountains and in the Selkirk and Coast Ranges were again visited and the changes in the forefoot noted. The recession of the glaciers was reported to be below normal.

INTERNATIONAL WATERWAY MATTERS

Reference has already been made 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 attention is directed to the extensive studies which are being conducted for the International Joint Commission in the Columbia River basin. The Bureau has continued and expanded its activities 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 public purposes involved in the studies of the International Columbia River Engineering Board of which the Controller is Chairman for Canada. Through the medium of the staff of the Bureau and arrangements made with the Legal Surveys and Map Service, the Geodetic Service of Canada, the Geological Survey, the Department of Public Works, and the Royal Canadian Air Force, an extensive program of hydrometric work, levelling, mapping, and damsite investigations, pertinent to these problems, was carried out 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 four meetings during the year and attended public hearings held by the International Joint Commission in the matter of the regulation of Rainy and Namakan Lakes.

An engineer of the Bureau continued as a member of the engineering subcommittee 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 $38,500 in support of co-operative water-resource studies; $98,204.66 was received from the Province of Manitoba in connection with capital and operating costs of Lake of the Woods and Lac Seul storages as provided in the Natural Resources Transfer Agreement; $6,685 was the revenue secured from water-power licences; and miscel-

laneous revenue brought the total to $144,220.99. Revenue to the extent of $3,500 in connection with the Ghost water-power development on the Bow River was received on behalf of the Indians of the Stony Band and was remitted to the Indian Affairs Branch. This was in addition to the rental for the Horseshoe and Kananaskis licences previously mentioned.

PUBLICATIONS

During the year, Water Resources Papers Nos. 89, 91, and 94 were published. These water resources papers present the results of hydrometric investigations of the St. Lawrence and Southern Hudson Bay drainage in Ontario and Quebec from October 1, 1939, to September 30, 1941; of the Atlantic drainage in New Brunswick, Nova Scotia, and Prince Edward Island from October 1, 1940, to September 30, 1942, and of the Pacific drainage in British Columbia and the Yukon Territory from October 1, 1940, to September 30, 1942.

The annual mimeographed bulletins "Hydro-Electric Progress in Canada" and "Water Power Resources of Canada" were issued as usual.

ENGINEERING AND CONSTRUCTION SERVICE

The varied activities of the Engineering and Construction Service, which functions as the general engineering and architectural agency of the Department, were continued during the period under review. The Service also undertook work for other departments of the Government, or acted in an advisory capacity as called upon. The work included all phases of contract and day labour construction and maintenance operations including investigations, inspections, reports, preparation of plans, estimates, specifications, designs, calls for tenders for contract work, examination of tenders received, and necessary recommendations to be made in this connection. Organization for works to be carried out is also undertaken, and supervision provided for larger projects, or on occasion, for groups of smaller projects as required.

To provide a program of worthwhile projects which would contribute to the natural development of the country, a number of surveys were continued from previous seasons with a view to obtaining information on work required for the improvement and reconstruction of existing highways and water supply and sewage disposal systems, and on highway bridge sites in the National Parks. Surveys were also undertaken for highway routes leading to scenic points in the parks at present inaccessible to motor traffic.

A staff of architects was engaged in preparing plans, specifications, and estimates in connection with a program of future development works, as well as for normal departmental requirements.

A summary of work done in connection with the foregoing is given later in the report.

JAPANESE WORK CAMPS

Following cessation of hostilities, it was decided that the carrying on of work camps employing persons of Japanese origin removed from restricted coastal areas was no longer necessary, and the last of such camps, located near Blue River, B.C., from which road construction operations had been carried on, were closed on May 31, 1946, with the removal of the remaining 35 Japanese. Men were first placed on this project in February, 1942, and by April of that year the number of Japanese located there had reached the maximum of 1,561 individuals. Changes in policy resulting in the taking away of married men, allowing men to take other employment, and transfers to other localities, reduced

the force rapidly until by September, 1942, only some 300 men were left. By this time, the prime objective of the work had been reached, namely, a passable tote road between Jasper and Rainbow, B.C. The reduced force made it impracticable to operate camps throughout the whole distance between Yellowhead and Blue River, so the remaining Japanese were concentrated north of Blue River with the objective of improving the road in this vicinity.

During the operation of the project, 290,238 man-days work was provided for Japanese persons. The following work was accomplished: 18·5 miles of abandoned railway grade were cleaned up and made suitable for truck travel; 32 miles of pioneer road and 1½ miles of standard highway grade were constructed; and one 3-span king truss timber bridge, 3 single-span king truss timber bridges, 4 permanent stringer bridges, and 12 temporary stringer bridges were built.

HIGHWAYS

Northwest Territories

Transportation is a major item in the development of the Northwest Territories, and the opening of highways would be of great assistance in this connection. From Grimshaw, a town in the Province of Alberta located on the Canadian National Railways some 350 miles from Edmonton enroute to Peace River, to Hay River on Great Slave Lake, the distance is approximately 387 miles. Of this total, some 80 miles is within the Northwest Territories.

The Governments of the Dominion and the Province of Alberta are both interested in the development of the Northwest Territories. Under these circumstances it was realized that the completion of a highway between Grimshaw and Hay River Settlement was necessary to assist in such development. As a result of negotiations during 1945, it was agreed by the Dominion and the Province that such a highway should be completed as quickly as possible, with the cost of the section of highway within the provincial boundaries being shared by both Governments and the cost of the highway in the Northwest Territories being borne by the Dominion.

Tender calls for the section of highway in the Province of Alberta were issued in January, 1946, by the Provincial Government, and contracts awarded. Contract for the Northwest Territories section was awarded in July, 1946, to the Bond Construction Company, of Edmonton, Alberta. Operations were started during the summer and at the close of the period under review the following work had been accomplished on the Dominion-Provincial section: clearing and grubbing, 150 miles; rough grading, 86 miles; fine grading, 59 miles, first gravel coat, 25 miles. A steel bridge with a 175-foot span was built across the Meikle River, and 80-foot span bridges were built over Kemp and Keg Creeks. On the Dominion section clearing and grubbing were done on 71·4 miles, and grading was carried on through 300 cubic yards of solid rock and 30,476 cubic yards of other material.

Alberta

An investigation for gravel, clay, and suitable rock for road surfacing purposes was made in the vicinity of Fitzgerald, Fort Smith, and Bell Rock. A reconnaissance survey was made to determine the cost of improving the road between the aforementioned points to an all-weather macadam standard.

Manitoba

Under an agreement with the Province whereby the Dominion contributed to the construction of a mining road to Snow Lake, approximately 40 miles from

Wekusko on the Hudson Bay Railway, the following work was carried out by day labour: grading, 9·4 miles, (169,980 cu. yds.); clearing, 113·79 acres; timber box culverts, 22; and bridges, 2.

Yukon Territory

A location survey was made for a road between Jake's Corner on the Alaska Highway and Atlin Lake, 58 miles. Plans, profiles and estimates of cost were prepared in anticipation of construction operations.

A reconnaissance survey of the Whitehorse to Mayo section of the Whitehorse-Dawson road was made, and a preliminary estimate of cost prepared.

Alaska Highway

Two engineers were stationed on this highway as Departmental observers on all phases of maintenance and reconstruction operations, with headquarters at Whitehorse, Yukon Territory, and Fort Nelson, British Columbia, respectively. Periodic reports were furnished by these officers covering the above matters so that full information on this subject would be available at any time.

WORK FOR LANDS, PARKS AND FORESTS BRANCH

Engineering

Following research into the necessity for chlorination of the water supply at Banff, a plant was purchased, installed in a specially constructed building, and connected to the supply main. However, the system was not put into operation pending further investigation into the effects on fish hatchery operations.

Designs were prepared by a consulting engineer for a new 150-foot span concrete arch bridge over the Spray River near its junction with the Bow River.

Surveys were made and plans, profiles, and estimates of cost prepared for water and sewer system extensions in the St. Julien subdivision of Banff townsite.

In Yoho Park, the construction was completed of a steel and concrete girder bridge over the Kicking Horse River at Leanchoil on the Trans-Canada Highway.

In Cape Breton Highlands Park a survey was made of a section of the Cabot Trail along the east coast with a view to relocating the road where damage to the sea-wall protection was caused by storms.

Investigations were made of the Jasper water supply system and reports prepared covering suggested improvements. An investigation was also made in connection with a suggestion by the Canadian National Railways for a new water supply for the Jasper Golf Course.

Tenders were prepared and called on four steel spans, 109 feet 6 inches each, for the bridge over the Athabaska River, Jasper Park, 12·2 miles east of Jasper, and also for two steel spans for the crossing over the Rocky River, 21·6 miles east of Jasper.

Future Development Program

SURVEYS AND INVESTIGATIONS

Banff Park.—Preliminary surveys were made for a 35·3-mile road from Banff to Mount Assiniboine. A reconnaissance was run from Simpson Pass to Egypt Lake, Pharaoh Creek, Redearth Creek, and Bow River for a circle tour. A preliminary survey was started for a second route to Mount Assiniboine from Banff via the Spray River, 25·8 miles of line being run. A survey was made of the road from Banff to the camp-ground preparatory to paving.

Jasper Park.—A location survey of 13 miles was run from Medicine Lake to Maligne Lake, following the west side of Medicine Lake. Topography was taken at the north end of Maligne Lake at the site for future development.

A five-mile revision survey was run on the Jasper-Edmonton Highway east of Jasper, and a two-mile revision survey completed on the Edith Cavell Highway.

Riding Mountain Park.—A 29·7-mile survey in connection with preparation for paving No. 10 Highway was completed. A location survey was started for a connecting road between No. 10 Highway and the Strathclair Trail.

Elk Island Park.—In connection with the improvement of the main road, 14·7 miles were surveyed. Topography at Sandy Beach development was completed.

Plans, profiles, and estimates of cost for the above surveys were prepared during the off-season. The office staff also completed similar work for surveys carried out in previous seasons.

Architectural Work

Drawings were prepared, tenders were called and the contract was let for a group of twenty cabin houses and a service building to be erected as a veterans' housing project in Banff Park. Work was started in July, 1946, at which time it was expected that the project would be completed within six weeks. However, progress was hampered owing to shortages of material, and completion of the buildings, with minor exceptions, was delayed until the end of the period under review.

Plans and specifications were prepared for an addition to the Fort Beauséjour Museum, including heating and plumbing systems.

Plans for extra accommodation in the Superintendent's residence at Elk Island Park were redrawn and working plans made.

Drawings were made for a heating layout in buildings at Fort Wellington, Ontario.

Drawings were made for a bunk-house and for one- and two-unit staff houses at Waterton Lakes Park.

Drawings were made for a registration building, and revised drawings of a meat-dressing and storage building were prepared for Riding Mountain Park.

Plans were prepared for a tourist and registration building and for an extension to the firehall at Jasper.

A report was prepared, with sketch plans, for landscaping of grounds and renovations at Champlain's Habitation, Nova Scotia.

Sketch drawings were prepared for a garage and workshop building and for a vehicle storage building at Cape Breton Highlands Park.

Screens for the art gallery at Fort Malden, Ontario, were designed and drawings made.

A start was made on drawings for an isolation hospital at Jasper.

Inspections were made of the sites and materials for meat-dressing plants at Jasper and Elk Island Parks.

WORK FOR INDIAN AFFAIRS BRANCH

Engineering

British Columbia

Okanagan Agency

Osoyoos I.R. No. 1.—Rehabilitation materials for the irrigation system were ordered, but no work was undertaken.

LYTTON AGENCY

Fountain I.R. No. 3.—Repairs to the irrigation flume necessitated by operations of the P.G.E. Railway were completed by the latter on the right of way and by the Department on the section outside railway property.

Shalalth Residential School.—Installation of a water supply was completed.

KAMLOOPS AGENCY

Niskonlith I.R. No. 1 and Adams Lake I.R's. 4 and 4A.—Improvements to the irrigation system were proceeded with, including temporary repairs to the wooden chute flume, installation of an iron spillway gate on the 46-inch flume line, completion of the flume from the lake outlet, and certain minor repairs.

NICOLA AGENCY

Lower Nicola I.R. No. 1.—Preparations were made to start ditching work on the drainage scheme. Rehabilitation work on the irrigation system was completed, including the construction of 1,250 feet of flume, three 16-foot timber culverts and 5,350 feet of ditch cleared to grade and brushed out.

Lower Nicola I.R. No. 2.—Construction of a trestle 1,750 feet in length for carrying irrigation flume was continued, but work was closed down before completion owing to weather conditions.

Lower Nicola I.R. No. 10.—Construction of some 2,550 feet of flume, 12 inches by 12 inches, supported on trestles and a 16-inch concrete culvert under the Provincial Highway was completed.

Cook's Ferry I.R. No. 9.—A report including plans and profiles was prepared in connection with repairs to the storage dam on Pinaus and Calling Lakes.

STUART LAKE AGENCY

Lejac Residential School.—The water supply intake was repaired.

WILLIAMS LAKE AGENCY

Williams Lake I.R. No. 15.—Reconstruction of the Carpenter Lake dam was undertaken.

NASS-SKEENA AGENCY

Kitkatla I.R. No. 1.—Installation of a water supply system for this reserve was undertaken with materials salvaged from National Defence camps.

VANCOUVER AGENCY

Musqueam I.R. No. 2.—A new floodgate was constructed at this reserve.

Squamish I.R. North Vancouver.—A survey was carried out looking to the location of water and sewer pipelines.

Stawamus I.R. No. 24.—A portion of the water supply main was relocated to meet requirements of property owners.

Chekwelp I.R. No. 26.—Relocation of a part of the water main supplying the reserve was made.

BELLA COOLA AGENCY

Bella Bella I.R. No. 11.—Work was undertaken in connection with the reconstruction of the water supply dam and pipeline trestle.

Klemtu I.R. No. 1.—Some work was done on the construction of a water supply for the Indian village, but owing to local labour conditions progress was limited.

Alberta

HOBBEMA AGENCY

A report was prepared, with bill of material, covering improvements to the sewage disposal system and materials purchased for same in preparation for work.

ST. PAUL'S RESIDENTIAL SCHOOL

A new 300-gallon pressure tank was purchased for the water supply system at this institution.

Saskatchewan

GORDON RESIDENTIAL SCHOOL

Investigations were made regarding the possibilities of securing a permanent water supply for the institution. Temporary measures were taken to provide water for domestic purposes pending the results of the investigations.

ONION LAKE AGENCY

The gravity water supply to the Agency Buildings was completed, the task involving the construction of an earth fill dam and some 3,650 feet of piping, with necessary connections to buildings.

Ontario

TYENDINAGA AGENCY

Calls for tenders were issued twice during the period for the construction of a timber bridge over Mud Creek, but no acceptable bid was received.

CARADOC AGENCY

A report was prepared on the drainage lines at the school. A draft memorandum to Council was prepared covering construction of a road to the school by cost plus fixed fee contract.

WALPOLE ISLAND AGENCY

A reconnaissance survey was made in connection with a proposal to drain marsh areas, and a comprehensive report prepared.

Quebec

ST. REGIS AGENCY

Plan and profile were prepared covering the remodelling of the sewage disposal system. Surveys were carried out for reconstruction of the road on Cornwall Island and work put in hand under contract.

LORETTE INDIAN VILLAGE

The water supply distribution system was replaced and extended, the work involving the laying of some 4,400 feet of pipe and 100 house services. A well was drilled at the reservoir and a pump was purchased and installed to augment the water supply.

OKA AGENCY

Following an inspection of the Middle Road, the line was straightened, fences were moved, and culverts were placed preparatory to regrading operations.

Maritime Provinces

SHUBENACADIE AGENCY

Specifications, bills of materials, and estimates of cost were prepared for replacement of the water supply mains at the Shubenacadie Residential School. Installation of the new lines was done by the Indian Affairs Branch.

At the agency development area, the concrete reservoir and the pump-house were constructed, pumping equipment was purchased, an electric power line to the area and to the pumping well was erected, the supply pipeline was cleared, a collecting basin was constructed at the springs, and some 1,750 feet of pipeline were laid.

ESKASONI AGENCY

Work was continued from the previous year in laying supply and pumping pipelines. A concrete reservoir and a pumphouse were built, and an electric pumping unit was installed. Electric power lines were extended to the pump-house and reservoir and buildings connected to the water supply lines. A standby gasoline engine was also purchased and installed in the pump-house.

ARCHITECTURAL WORK

An inspection of the site for bulidings at Eskasoni Indian Agency (day school and teachers' residence) was made, tenders were called, the contract was awarded and the construction of buildings was practically completed in the period.

Drawings and specifications for Agency buildings at the Shubenacadie Indian Reserve (office and warehouse, principal's residence, teachers' residence, and agent's residence) were completed and tenders called. Contracts were awarded and construction was well under way at the end of March, 1947.

Drawings were completed and specifications revised for an Agent's residence at Lennox Island Agency. Tenders were called but no contracts awarded.

Work proceeded on drawings for a central heating plant and for a 12-room senior school for the Caughnawaga Indian Agency. Detailed inspection was made of the site in connection with foundation conditions and sewage disposal. Heating, electrical, and plumbing layout plans were prepared.

A report was made on proposals to make additional connections to the lighting plant and to install electrical appliances at Norway House Agency.

A report was prepared regarding the structural condition of the barn and conditions at the sewage disposal area at the Cecilia Jeffrey Residential School.

A report was prepared covering the installation of fire escapes for Sandy Bay Residential School.

A report was prepared on electric lighting proposals at Pointe Bleue Agency.

A report was prepared covering wiring of the Agent's residence at Seven Islands Agency.

Plans were prepared for water and plumbing systems for the Agent's residence at Fort Norman.

Plans were prepared for an addition to the R.C.M.P. quarters at Bersimis Indian Agency.

Revisions were made to sketch plans for converting the Agent's residence at the Touchwood Hills Indian Agency to a two-family unit.

Sketch plans were made for an addition to the Farm Instructor's residence at Muscowpetung Indian Agency.

Tenders were received and examined for new warehouses at Red Pheasant and Little Pine Reserves.

Plans were prepared for a proposed power-house at Fort Chipewyan, Athabasca Agency.

Drawings were made for a pump-house for the water supply system of the Shubenacadie Agency.

A report was made and specifications were prepared for new basement floors at the Blood Residential School, Cardston, Alberta.

Drawings were made for R.C.M.P. quarters at Norway House.

Drawings were made for alterations to the warehouse-office building at Hobbema Agency.

Plans were prepared for enlarging the power-house at Fisher River Agency.

Tenders were called and contracts awarded on structural repairs and on heating and hot water plants at the Portage-la-Prairie Residential School.

Tenders were received and examined on additional electrical equipment for the Fisher River Agency Buildings.

Plans and specifications were prepared for a four-classroom addition to the Alberni Residential School. Tenders were called, the contract was awarded and construction was commenced. The building was approximately 70 per cent completed at the end of the fiscal year.

Inspections of heating and plumbing installations were made at the following points: Shingwauk Residential School, Sault Ste. Marie Agency; St. Margaret's Residential School, Fort Frances Agency; Portage-la-Prairie Agency Residential School; Gordon's Residential School, Touchwood Agency; St. George's Residential School, Lytton Agency; Alberni Residential School, West Coast Agency. Reports on the various inspections were prepared.

Miscellaneous

Sketch plans were prepared for a seismograph station at Kirkland Lake.

Drawings were made for a standard two-chamber septic tank for various points.

Sketches were prepared for a layout of the office space to be occupied by the Engineering and Construction Service in the Motor Building at Ottawa.

GEODETIC SERVICE OF CANADA

During the fiscal year, the Geodetic Service of Canada continued its basic function of establishing horizontal and vertical control in various areas across Canada. Following a curtailed program during the war years, substantial progress is now being made in advancing the system of control into the regions to the north of the existing framework. The resources of the Geodetic Service of Canada have also been utilized in providing urgently needed control for post-war projects initiated by Federal and provincial survey bureaus in a number of widely scattered areas across Canada.

For the mapping services the astronomic program has increased the available control in Ungava and Keewatin for aerial photography for the production of small-scale flying maps. Triangulation operations progressed satisfactorily

toward placing control stations at intervals on or near the International Boundary (Labrador) and toward the potential mineral districts farther north. Elsewhere, as in Ontario, Alberta, and the Yukon, each project is associated with mapping programs under way or under consideration. Precise levelling operations were conducted intensively, with the result that 1,360 miles of precise levels were completed, being the greatest mileage run by this service in any year since 1916. A notable contribution was the levelling done by the hydraulic investigations of the International Columbia River Engineering Board.

A relevelling of precise level lines in a region of Vancouver Island near Courtney was made to ascertain the changes in elevation, if any, resulting from the earthquake of June 23, 1946, which had its epicentre in that vicinity. The greatest vertical shift of a bench mark caused by the earthquake was found to be 0·87 feet, and was on Goose Spit at Comox.

The application of electronic devices to surveying was closely studied. It is expected that within a comparatively short time instruments will be developed which will permit a more rapid extension of geodetic control into outlying regions than is possible under present methods.

TRIANGULATION

During 1946, triangulation operations were carried on in five main areas, all of them related to the development of northern Canada or to basic areas from which geodetic operations into northern Canada may be launched.

In the first category are triangulation nets which are being extended northward from the Gulf of St. Lawrence to provide control for boundary surveys between Quebec and Labrador and for other surveys in progress, or contemplated, in and adjacent to the potentially important mineral areas in the centre of Ungava. Triangulation along the Alaska Highway also falls in this class because of its proximity to portions of the British Columbia-Yukon boundary.

In the second category are operations in Alberta between Edmonton and Jasper, which, by 1947, will connect Alberta and British Columbia triangulation nets, and which will form a basis for extensions into northern British Columbia. In Ontario, preliminary triangulation work was carried on westerly from Sudbury towards Sault Ste. Marie, thence northerly for about 60 miles. This net will extend control into and ultimately through northwestern Ontario to effect a connection between the eastern and the western Canadian work. At present there remains one gap of some 700 miles in the coast-to-coast triangulation project through the southern areas of Canada.

Details of various triangulation operations follow:—

Gulf of St. Lawrence

The operations in this area are designed to serve two purposes: to make available a number of accurate survey points at suitable intervals on or near the Quebec-Labrador boundary, and to extend an accurate survey system into the area of mining development in the centre of the Ungava peninsula, as a basis for mapping, cadastral, and boundary operations.

During 1946, primary and secondary triangulation in the various stages—reconnaissance, station preparation, and angle measurement—were continued toward the northern interior. These operations were in charge of J. W. Menzies, assisted by K. H. Ewing, A. M. Deschenes, V. H. Cullen, J. E. Lilly, J. Russell, and N. E. Kelly.

As in 1945, operations were carried on in two separate localities, one, north of Seven Islands, known as the Moisie River area, and the other the Valley of the Natashquan River to the Quebec-Labrador boundary in latitude 52°. The

work in these areas was a continuation of triangulation carried on in 1945. On the whole the spring was late in both areas, and consequently the season was shortened by about two to three weeks.

It had been hoped that the season's work on the Natashquan River would complete the triangulation to the 52nd Parallel Labrador boundary, but due to high water in the spring the work was delayed and had to be stopped in the autumn some ten miles short of the objective. A small amount of work in this area still remains to be completed in 1947. In all, seventeen new stations were selected and twenty-three prepared for observation, and at twenty-four stations angle measurements were completed. Supplies were flown in to convenient points to service the Natashquan River parties.

The country is very rough in the Moisie River area with hills averaging 2,500 to 3,000 feet in elevation; there are no roads. Canoe routes are difficult. Lines of sight from 25 to 40 miles in length were necessary. As a result of these conditions, all transportation for the parties was provided by a plane based near the mouth of the Moisie River. Weather conditions were generally quite different in the survey area and at the base area, necessitating frequent delays in transportation to secure suitable flying conditions for going and return trips. An additional cause of delay was the discovery that certain stations were not intervisible. With considerable experience the conclusion is reached that plane transportation should be resorted to only in areas where the nature of the watercourses compels long and dangerous canoe trips.

Work proceeded from north to south, and the connection to the primary network of the St. Lawrence River system was completed except for observations at one station. This will be finished in 1947 and will complete the Moisie River net as far north as latitude 52°. In all, six new stations were selected and seven prepared for observation, and angle measurements were completed at twelve stations.

Northward from latitude 52° this net will follow a river and lake system for 250 miles with easy canoe transport. Supplies and men will have to be brought in by plane from the St. Lawrence River to base camps throughout this area.

In both the Natashquan River and Moisie River areas communication with the plane base and between parties was maintained by radio.

Ontario

In the area west of Sudbury, reconnaisance and tower building operations were conducted in preparation for an angle measurement program in 1947. Good progress was made, selection of stations being completed westward to Sault Ste. Marie, thence to a point some sixty miles north. Towers were built as far as the area surrounding the Sault Ste. Marie. This control system is urgently needed in the area to the northward, where an extensive provincial aerial-photographic mapping program, with forest inventory, is under way. Throughout the work the greatest assistance and co-operation were given by the Ontario Forestry Service within the locality. In all, ten new stations were selected and twenty-one stations prepared for observations, with the operations in charge of L. G. Bangs and K. C. Dennis.

Alberta

To effect a junction between the Prairie triangulation and that carried from Vancouver through central British Columbia, operations were extended in the Edmonton-Jasper area to a point slightly west of Edson, through a section of country requiring high towers because of tall trees and plateau country of relatively low relief. The use of a portable reconnaissance tower proved its effectiveness in that an economical balance between line-cutting and tower

building could be assessed at each of the stations, with a corresponding saving in costs of material and time. Numerous delays were, however, experienced due to a wet season which made roads very difficult for transport.

To the west of Edson the relief becomes more pronounced and transportation more difficult. It is necessary to direct the work towards effecting a junction with Geological Survey minor triangulation at the foothills of the mountains and then continue westward to a junction with Geodetic Service stations in the Jasper area. Several reconnaissance trips were made to obtain information required for effective planning of the 1947 season's operations.

The observational program was completed throughout the area. The use of many high towers was necessary, as was the stepping-down of the triangulation lengths to allow a base line to be included in the scheme. In all, fourteen stations were observed, and at ten of these connections were made to the Dominion Lands Surveys system. Eleven towers ranging in height from thirty to eighty feet were erected, and the sites of twenty-three new stations selected. The operations were in charge of J. M. Riddell, assisted by J. H. Kihl and R. W. Serviss.

Yukon

The completion by the United States Coast and Geodetic Survey in 1943 of a net of primary triangulation from the summit of the White Pass, through Yukon Territory, to the vicinity of Big Delta, Alaska, placed all connected surveys in the Yukon and Alaska on the continental 1927 North American Datum. In 1945, the extension of triangulation southerly and easterly from Whitehorse, Yukon (following the Alaska Highway), was initiated, and by the end of 1946 the triangulation had been extended to the British Columbia-Yukon boundary south of Teslin village. Operations were impeded in 1946 by lack of transport and by forest fires and bad weather. Nevertheless, angle measurements were completed at eight primary stations and one secondary station, and two stations were established on the Alaska Highway for the correlation of surveys along the highway performed by other services and departments. The work was in charge of F. P. Steers, assisted by G. D. Hueston, and an opportunity was given two West Indian commissioned surveyors, H. F. Edwards and F. E. Farrell, to study Canadian geodetic methods.

Newfoundland

W. M. Dennis was again seconded to the Commission of Government of Newfoundland to aid in the organization and training of personnel of the Geodetic Survey of Newfoundland to extend that service's triangulation system. Further progress has been made, a nucleus of personnel has been established, and it is anticipated that there will be an expansion in the Newfoundland geodetic service as a result of the co-operation.

Investigations

The underlying causes of the deterioration of glass circles used on precision theodolites are still under investigation. These theodolites are from eighteen to twenty years old, and some of the circles are showing progressive deterioration from season to season, but not of a character similar in all circles. The effect of the change is being recorded, and the investigation of the causes is being continued in co-operation with the National Research Council

The war has provided a number of devices with geodetic application, and new and promising methods in the rapid extension of geodetic horizontal control into northern Canadian areas appear to be in sight. One of the most

promising of these developments is in the field of radar and various allied electronic devices. It is hoped that distances, beyond the limits of visual triangulation methods, as great as 200 or 300 miles, may be measured with geodetic precision. With some improvements in the devices and further study in methods, it is anticipated that triangulation systems based on the new techniques can be extended into northern Canadian areas many years sooner than by present-day methods.

TRIANGULATION ADJUSTMENTS

Demands for adjusted triangulation data pertaining to widely scattered areas extending from the Atlantic to the Pacific Oceans necessitated adjustment computations on two formerly-observed nets and six others of recent date. About one-half of the year's work involved nets in Newfoundland and in the Province of Quebec north of the Gulf of St. Lawrence. The other half comprised the Yukon net, the Edmonton-Jasper net, the Brandon Spur secondary net, and the City of Edmonton secondary net.

The Adjustment of Primary Nets

Mauger-Parent Net.—The primary net extending from Mutton Bay to the Strait of Belle Isle and forming part of the loop of triangulation encircling the Gulf of St Lawrence was adjusted between the fixed terminal positions of station "Mauger" at the west end and station "Parent" at the east end of the net. The fixed positions of these two stations had been determined in 1945, when most of the loop had been adjusted.

Yukon Primary Net.—The preliminary adjustment and computation of the Yukon primary net were carried out to the full extent of the current field observations. To provide control data for mapping and other survey organizations sending parties into the area during 1947, secondary intersection stations were also computed.

Edmonton-Jasper Net.—The preliminary adjustment of the primary net extending from Edmonton westward toward Jasper was commenced and a considerable part of the undertaking completed by the end of the fiscal year. As the field observations for this net are not yet completed, the adjustment cannot be finished until some future time.

The Adjustment of Secondary Nets

Natashquan River Net.—The adjustment of the secondary net extending from the north shore of the Gulf of St. Lawrence up the Natashquan River was completed as far as latitude 51° 20′. A measured base and a Laplace azimuth control incorporated into the net near this latitude during the 1946 field season made possible the adjustment of the southerly 80-mile section of the net as a unit. Although the observations of the horizontal directions were made on daylight signals over lines which averaged about 8 miles in length, the average correction to an observed direction for the entire net was only 0·64 seconds.

Newfoundland West Coast-East Coast Net.—In accordance with the agreement between Canada and Newfoundland, the computation and adjustment of geodetic data pertaining to the Newfoundland triangulation were continued. Two contiguous secondary nets extending from the Bay of Islands area on the west coast along the Newfoundland Railway belt to the City of St. Johns were completed. The accuracy of this 300-mile chain of secondary triangulation was controlled by two measured base lines and three Laplace azimuths. A selected chain of triangles extending over the entire length of the net was used in the formation of the length and azimuth control condition equations.

The absolute terms of the two length equations computed in this manner gave closures on the measured bases of 1/75,000 and 1/33,000, respectively. As these closures are dependent on the route chosen for the selected chain of triangles, they should be interpreted only as approximate indications of the true accuracy attained. However, the ability of the system to carry distances correct to one part in 33,000 before any adjustment was made lends assurance that the accuracy in scale through the net is better than the usual standard set for secondary triangulation.

St. Augustin River Net.—The adjustment of the secondary net extending northward along the St. Augustin River from its outlet into the Gulf of St. Lawrence was completed. This net, involving twenty-six stations, was controlled by a measured base and a Laplace azimuth station near the northern extremity of the net in approximate latitude 52° 00′.

Brandon Spur Net.—To provide control data for the Department of National Defence, the secondary net extending from the 49th parallel northward to the City of Brandon was adjusted and the geodetic positions were computed on the 1927 N.A. datum.

City of Edmonton Net.—To permit accurate computation of the position of the Edmonton radar monitor station, a large part of the City of Edmonton secondary triangulation had to be recomputed on the 1927 N.A. datum. To place the entire network in the area on the same basis, the whole net was then recomputed.

Trigonometric Elevation Computation.—To provide vertical control over the triangulated areas covered by the Yukon, the Natashquan River, and the west-coast Newfoundland nets, trigonometric elevations were computed for each triangulation station from vertical angle field measurements. Over lines of about 30 miles in length, the probable error of such elevations seldom exceeds 2 to 2½ metres. On shorter lines the probable error may be expected to be correspondingly lower.

Computation of Probable Error.—The probable and mean square errors for the six nets comprising the Newfoundland triangulation were computed and tabulated in a form suitable for publication.

Special Computations.—At the request of various agencies, special geodetical computations have been made. Among others were the computations of the geodetic positions of the Edmonton Loran Monitor station and the Hamlin Loran station, the computation of the 950-mile Loran base line joining Gimli and Baker Lake, and a number of computations of inverse solutions in connection with the survey of hydro-electric power lines in Ontario and Quebec and the Des Joachims power development.

Development of 30-mile Modified Lambert Projection

At the special request of the R.C.A.F. and in co-operation with the Subcommittee on Navigation, Associate Committee on Aeronautical Research, National Research Council, an experimental polar map was designed on a scale of 30 nautical miles to the inch, based on the Modified Lambert Conformal Projection. This map was finally produced through the co-operation of the Hydrographic and Map Service. After a number of polar flights on which maps of various types were tried out, navigational officers of the R.C.A.F. and U.S.A.A.F. reported that the 30-mile Modified Lambert Projection was the most satisfactory map for aerial navigation in polar latitudes.

REQUESTS FOR GEODETIC DATA

During the course of the year many replies to requests for geodetic data were sent to Federal, provincial, commercial, and private survey bureaus. In some cases, special computations were made in order to provide the required information.

PREPARATION OF PUBLICATION ON NEWFOUNDLAND TRIANGULATION

Progress has been made in writing the text and compiling the data for a publication covering the Newfoundland west coast and Strait of Belle Isle triangulation.

LEVELLING

During the fiscal year, 1,360 miles of precise levels were run, being the greatest mileage run by this Service in any year since 1916. This was accomplished in the face of a shortage of such essential commodities as trucks, cars, many staple lines of provisions, cement, and tires. During the regular season, four double-unit parties were in the field and, later, two single-unit parties carried on.

The 1946 levelling operations provided vertical control for the St. Lawrence Ship Channel, for the International Columbia River Engineering Board, and for investigations by the Dominion Seismologist of the earthquake of June 23, 1946, on Vancouver Island.

The line of precise levels from Edmonton, Alta., to Whitehorse, Y.T., was completed this season. This line, 1,400 miles long, connects at Whitehorse with United States levels from Skagway and Seward, Alaska, and provides important vertical control in northern territories where none previously existed.

In the Columbia River Basin the Geodetic Service of Canada and the United States Coast and Geodetic Survey co-operated in their respective levelling operations adjoining the International Boundary in order that the combined level net would be in shape to permit a local adjustment which will remove all anomalies between the two national level systems in this Basin.

QUEBEC

A line of precise levels was run on the southeasterly shore of the St. Lawrence River from Cornwall, Ontario, to Levis, Quebec. The work was started on May 13 and ended on September 22, and the party was in charge of D. McMillan, assisted by R. W. Arnett and R. J. Cyr. The route levelled was entirely along highways and the standard motor equipment of two trucks and one passenger car permitted the work to be carried on economically and expeditiously. Between Beauharnois and Levis the route followed lines of levels which had been run by the Department of Public Works between 1885 and 1928, but on which the ground record, bench marks, had deteriorated to such an extent that relevelling and remonumenting were necessary. This line of levels was inspected in 1933 and 262 bench marks were found to be in good order, but in 1946 only 206 of these were found to be in good condition. The relevelling revealed that roughly 75 per cent of the bench marks exhibited local changes in elevation of a magnitude of one- or two-tenths of a foot. A number of isolated cases had changes over a half a foot, and a bench mark in the cathedral at Nicolet showed a subsidence of 1·15 feet. In the vicinity between Les Fonds and St. Antoine, an error in the original levels amounting to 6 feet was discovered.

At the request of the Chief Engineer of the St. Lawrence Ship Channel, Department of Transport, a number of massive concrete piers erected between Nicolet and Levis by the Department of Transport and the Hydrographic Ser-

vice were connected to the level system. In these operations, 265 miles of precise levels were run and 82 new bench marks were established. Two fundamental bench marks were built at St. Lambert and Sorel.

Alaska Highway

A party in charge of G. S. Raley, assisted by L. P. Robertson and G. Bird, continued the levelling operations on the Alaska Highway. The party organized at Dawson Creek on May 22 and started work at Mileage 674 where the previous year's operations had stopped. Levels were continued eastward and southward to Mileage 452 at Muncho Lake, where connection was made to levels brought from Dawson Creek in 1945. This year's operations completed a line of precise levels from Edmonton, Alta., to Whitehorse, Y.T., a distance of some 1,400 miles. During the season, branch lines were run to Watson Lake Airport, to the Smith River Airfield, and to United States Army flight strip No. 4. The British Columbia-Yukon boundary crosses the highway several times and bench marks were established at each crossing, the most easterly crossing being at Contact Creek, Mileage 588. After the gap had been closed at Muncho Lake, the party moved to Mileage 73, and levels were started on the Beaton River Airfield road. Some 31 miles of levels were run by September 18, when the party was disbanded. The standard motor equipment of two trucks and one automobile was used on this work and proved satisfactory. A total of 285 miles of precise levels was run and 118 bench marks were established.

British Columbia

The levelling operations in southern British Columbia were a continuation of the work started in 1945, and were carried out at the request of the International Columbia River Engineering Board. The purpose of these operations was to provide vertical control for the hydraulic investigations of the Board, and for topographic mapping, and also to remove anomalies between the United States and Canadian level nets along the International Boundary in order that a local adjustment of the combined net in the Columbia River Basin may be carried out in the near future.

One party, in charge of E. W. Berry, assisted by F. J. Horgan and G. Mather, started work on May 29 at Donald, where the main line of the Canadian Pacific Railway crosses the Columbia River. Levels were carried over the Big Bend Highway, which follows the Columbia River to Revelstoke where the river again crosses the main railway line. Branch lines were run and bench marks were established at proposed gauging stations of the Dominion Water and Power Bureau at Donald, Surprise Rapids, Potlatch Creek, Six-Mile Cabin on Canoe River, and at the first rapids on Wood River. On August 22, the line was completed to Revelstoke and the party moved to Kelowna.

Levels were then run from Kelowna over a road some 22 miles to McCulloch on the Kettle Valley Railway; in this distance there was a rise of 3,000 feet. The party then moved to Westbridge and relevelled over the Kettle Valley Railway from Midway to Carmi, which was reached on September 17, when the party was disbanded. Owing to the non-delivery of new motor vehicles, the party was seriously handicapped for the first half of the season, but the acquisition of a panel truck enabled the work to be completed. During the season, this party ran 264 miles of precise levels and established 105 bench marks.

On September 26, a new party was organized at Penticton in charge of G. S. Raley and L. P. Robertson to continue the relevelling on the Kettle Valley Railway from Carmi to Glenfir. This party used a railway motor car for transportation over the railway, while camp equipage was moved by trucks or railway box cars. On account of high altitude in this section, between 3,000 and 4,000

feet, the progress was retarded in November by heavy snowfall and low temperatures. This party had run 76 miles of levels when Glenfir was reached on November 26 and the party was disbanded.

Another party worked during the regular season in the proximity of the International Boundary, starting at Cranbrook on May 23 and working westward. This party was in charge of L. O. R. Dozois, assisted by W. J. MacLean and L. J. Walker, and operated in conjunction with a U.S. Coast and Geodetic Survey party working south of the Boundary. Lines of levels were run along the St. Mary River from St. Mary's Lake to Cranbrook, from Yahk to Kingsgate on the Boundary, from Queen's Bay to Nelson along the north shore of the West Arm of Kootenay Lake, and from Nelson to Nelway on the Boundary. In the vicinity of Trail, levels were run from Castlegar, via Trail and Rossland, to Paterson on the Boundary. In the Similkameen River area, levels were run from the Allison Pass on the Princeton-Hope Highway to Nighthawk, Wash., on the Boundary. In the Okanagan Valley levels were run from Glenfir over the Kettle Valley Railway to Penticton and then southward to the Boundary below Osoyoos. At each point where levels were run to the International Boundary, connections were made to levels run by U.S. Coast and Geodetic Survey. Progress of this party was impeded by comparatively long moves and inadequate transport equipment, and its difficulties were increased by shortages in provisions and tires. The work was finished on October 4, when the party was disbanded and the outfit was taken to Vancouver Island.

Operations there involved relevelling of precise level lines for the purpose of ascertaining the changes in elevation, if any, resulting from the earthquake of June 23, 1946, which had its epicentre in the vicinity of Courtney. The party, under L. O. R. Dozois, assisted by W. J. MacLean, was organized at Parksville on October 10 and the section of the E. and N. Railway from Parksville to Courtney and Comox was relevelled. The relevelling was continued northward over the Island Highway to Campbell Bay and Forbes Landing. New lines of levels were carried northward to Brown's Bay and across Menzies Bay and Seymour Narrows to Canoe Pass to connect to tidal gauges maintained by the Hydrographic Service. At Seymour Narrows the levels will provide an accurate means of checking further engineering operations undertaken for the removal of Ripple Rock. Levels were carried across Menzies Bay and Seymour Narrows by the method of simultaneous reciprocal sights. The distance across Menzies Bay was 1·6 miles and is probably a record for length in the use of this method. The line of sight was 160 feet above water and the probable error of the results deduced from the observations was ±01039 foot. The greatest vertical shift of a bench mark caused by the earthquake was found to be 0·87 foot, and was on Goose Spit at Comox. The operations on the Island were concluded on January 1, 1947, when the party moved to Creston on the Kootenay River.

En route to Creston, connections were made to bench marks near Penticton and Balfour. The levelling operations in the Kootenay River flats involved the erection of bench marks at points specified by the Dominion Water and Power Bureau between Porthill, Idaho, and Kootenay Lake. The work was completed on February 18, when the party was disbanded; the outfit was taken to Calgary, Alta., and placed in storage. During the season of 9½ months, this party had run 470 miles of precise levels and established 82 bench marks.

In levelling operations to the extent carried on in 1946, field supervision was an essential function. This was particularly true in regard to the operations carried on in southern British Columbia, where the work was co-ordinated with similar operations being carried on at the same time by the U.S. Coast and Geodetic Survey. It was necessary to select points along the International Boundary where contacts could be made between the two level systems and to ascertain if feasible routes for levelling existed at these points from both

countries. Of five points investigated, four were found to be accessible; the fifth, at Flathead in the southeast corner of British Columbia, although accessible from the United States could not be reached from Canada, and had to be abandoned. Circuits in the joint net along the Boundary with closures over the allowable limit for precise levelling had to be investigated, and the amount of relevelling necessary to obtain the required accuracy could only be determined as the work developed. An unusual problem peculiar to this season developed in the non-delivery of new motor vehicles at the start of the field-work, and this had to be solved by securing additional vehicles while the work was in progress.

Inspection of precise level bench marks on Vancouver Island was carried on within a fortnight of the earthquake of June 23. Lines of levels were inspected in the Vancouver district, along the Cariboo Trail, and in the vicinity of the International Boundary in British Columbia. During September, the regular inspection of iron-pipe bench marks on secondary levelling along base lines and meridians in the area lying east of Calgary, Alta., to the Alberta-Saskatchewan boundary and south to the International Boundary was continued. The supervision and inspection were carried out by R. H. Montgomery.

Detailed Statement of Precise Levelling Run in 1946

QUEBEC

	Miles	B.M's.
Cornwall, Ont., to St. Anicet, Que.	42·3	
Beauharnois to Lévis	223·2	82

BRITISH COLUMBIA

Columbia River, Big Bend, Donald to Revelstoke with branches	193·6	96
Midway to Carmi	47·9	
Kelowna to McCulloch	22·5	9
Cranbrook to St. Mary's Lake	33·8	
Yahk to Kingsgate	15·0	
Queens Bay to Nelson	25·0	
Nelson to Nelway	44·0	
Castlegar to Trail	22·3	
Trail to Paterson	12·0	
Princeton to Nighthawk	68·0	
Penticton to U.S. Boundary	39·6	
Penticton to Glenfir	13·8	
Princeton to Allison Pass	43·2	
Kootenay Flats to Creston	41·0	67
Carmi to McCulloch	33·9	
McCulloch-Glenfir	42·1	
Parksville to Forbes Landing with branches	84·2	
Campbellton to Brown's Bay with branches	17·0	15
Branch Lines	11·9	

ALASKA HIGHWAY

Alaska Highway, Mile 674·2 to Mile 453·4	220·8	
Branch to Watson Lake Airport	8·2	
Branch to Smith River Airport	24·9	
Branch to Beaton River Airport	30·7	118
Total	1,360·9	387

Summary

	Miles	B.M's.
Precise Levelling—		
Prior to 1946	28,145	10,143
1946	1,241	450
Total	29,386	10,593
Secondary Levelling—		
Prior to 1946	12,057	4,282
Relevelled to Precise standard 1946	128	63
	11,929	4,219

Note.—In southern British Columbia, lines aggregating 128 miles in length and containing 63 bench marks have been transferred from secondary to precise levelling, thus reducing the former secondary figures by this amount. The total of 1,360·9 miles of precise levels run in 1946 includes 248 miles of relevelling that had previously been included in the precise levelling total for Canada.

The total mileage of levelling in the Canadian level net, distributed by provinces at the end of the fiscal year 1946-47, 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	3,668	1,288	2,021	6,977
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	5,302	52	—	5,354
Yukon	701	—	—	701
Minnesota	89	—	—	89
Vermont	6	—	—	6
New York	15	—	—	15
	29,386	11,929	4,858	46,173

Note.—In the course of the season's work, some 128 miles of secondary levelling and 210 miles of Public Works levelling were transferred to the precise levelling column.

Supplementary Information—

Chief of Party—	Mileage	B.M's. (new)
D. McMillan	265·5	82
E. W. Berry	264·0	105
L. O. R. Dozois	470·8	82
G. S. Raley	360·6	118
	1,360·9	387

Mileage by Provinces—	
Quebec	250
New York State	15
British Columbia	1,045
Yukon	50
	1,360

GEODETIC ASTRONOMY AND ISOSTASY

The field work of the Division of Geodetic Astronomy during 1946-47 comprised the determination of precise longitude, azimuth, and latitude, at North Base near the centre of the Natashquan triangulation; the measurement of a geodetic base line in the same district; and the determination of longitudes and latitudes at thirty-four points in Ungava and Keewatin for aerial mapping control; and at seven stations in western and northern Canada for Loran investigations. The engineers in their field work made observations for magnetic declination at the several points visited and also determined the approximate heights above sea-level by barometer of the several lakes at the observation points.

Laplace Determination

To furnish control for the direction of the triangulation along the Natashquan River north of the Gulf of St. Lawrence, D. J. Fraser made a determination of the longitude and latitude of North Base in the centre Natashquan net, and the azimuth of the line North Base to Petit Pas.

Base Line

To furnish control of the lengths of the geodetic triangulation in the Natashquan net, a base line was measured by K. H. Robb between the North and South Base stations.

Secondary Longitude and Latitude

The program of geographical control for aerial mapping, commenced in 1942, was continued during 1946. In order to accelerate the progress of this work, six observing parties in charge of B. J. Woodruff operated in Ungava and Keewatin. Mr. Woodruff's duties were to organize the work, make arrangements with the R.C.A.F. concerning planes and transportation, and to see that the field operations were carried forward with the greatest dispatch. The engineers engaged in the star observations were W. H. Stilwell, T. H. Manning, G. A. Corcoran, David Ramsay, Allan Rae, and Leonard Stock. Each observer had one assistant.

The parties left Ottawa on June 6 and proceeded to Chicoutimi, Quebec. Here, there was some delay owing to ice conditions on the lakes in the interior. However, shortly afterwards a camp was established on Lake Bienville and the first observations were made on June 20.

As in other years, the transportation for the field parties was provided by the R.C.A.F. This organization placed at the disposal of the Geodetic Service of Canada three Norseman aircraft and one Canso flying boat. The Canso was used as a supply ship, transporting the supplies, food, and gasoline to the base camps of the men engaged in the field work. The Norseman carried the observing parties from the base camps to the observation points and return. The very cordial co-operation of the R.C.A.F., both in making arrangements for the field operations and in carrying out these operations, is greatly appreciated by this organization.

During 1946, base camps were established at Lake Bienville, Gregory Lake near Leaf River in Ungava, and at the eastern end of Baker Lake in Keewatin. The weather conditions during a greater part of the field season were most unfavourable. Owing to the lateness of the spring breakup, the ice conditions greatly retarded progress, and it was well into August before the ice disappeared in the lakes in northern Ungava. However, observations at all the control points required in that region were completed and five parties were carried by

plane via Southampton Island to Keewatin. T. H. Manning, whose long experience in Southampton Island and on Baffin Island makes him most valuable in this northern work, was assigned the task of establishing control on the islands along the east coast of Hudson Bay, and he spent the whole season in this particular section. In all, twenty-five control points were established in Ungava and Hudson Bay; there still remain a few islands on the east side of Hudson Bay in the vicinity of the Ottawa group where positions are doubtful, and verification will be undertaken in 1947.

After arriving at Baker Lake about August 20, the other five parties were able to determine the latitudes and longitudes of nine points in Keewatin before the storms and winds of autumn forced the closing down of operations.

Magnetic Declination

At all the stations observations were made for magnetic declination, and these observations have been forwarded to the Dominion Observatory.

Altitudes

The approximate heights above sea-level of the control points were derived from comparisons of simultaneous readings of aneroid barometers at the field stations and at the base camps, the elevations of the base camps having been determined previously. The field stations are from 50 to 200 miles apart and this introduced a degree of uncertainty owing to variable meteorological conditions. The aneroid readings were generally spread over three days to a week with a minimum of three readings a day. The elevations so determined are approximate, but in a country where there are no known heights above sea-level this information is very valuable. A further study is in progress to determine the average deviation of the computed value from the true value, and hence to ascertain the amount of uncertainty.

Loran

At the request of the R.C.A.F., the Geodetic Service observed latitudes and longitudes at seven stations in western and northern Canada, namely at Gimli and Portage la Prairie, Manitoba; Hamlin, Sask.; Edmonton, Alta.; Dawson Creek, B. C.; and Norman Wells and Yellowknife, N.W.T. These are for purposes of investigations in air navigation being carried on by that organization.

Plant Life

Dr. Nicholas Polunin, of Oxford University, at present Visiting Professor of Botany at McGill University, joined the parties in Ungava and continued with them till the end of the season. Dr. Polunin was interested in plant life and in the mosses which might provide food for caribou. The Geodetic Service did not provide any transportation outside of the base camps, but the observing parties assisted by collecting many samples of plant life. Reports of Dr. Polunin's investigations have been made to the Lands, Parks and Forests Branch of this Department.

Office Work

The computations of all the field observations were completed early in the winter, and full reports, both technical and descriptive, have been sent to the services interested. Since 1942, some three hundred control points have been established by this Service for mapping purposes.

INTERNATIONAL BOUNDARY COMMISSION

The boundary lines between Canada and the United States and Alaska have a combined length of 5,527 miles, and are made up of 10,311 straight-line courses varying in length from 2 feet to 647 miles. The former length is in the Highlands section of the boundary between Maine and Quebec, and the latter is the meridian boundary between Alaska and Yukon, which, incidentally, is the longest straight-line boundary in the world. The boundary is marked or referenced by approximately 8,000 monuments and, in addition, is marked through the timbered sections by a vista 20 feet wide, 10 feet on each side of the line. There are 3,153 miles of land boundary and 2,374 miles of water boundary, most of the latter forming the southerly boundary of Ontario. The geographic positions of all the monuments have been determined on the geodetic datum common to both countries so that, notwithstanding any changes which may take place in the shorelines of the boundary waterways and irrespective of the deterioration or displacement of the boundary monuments, the permanency of the location of the boundary line is assured. Under the Treaty of 1925, the responsibility of maintaining the boundary in a state of effective demarcation is vested in two Boundary Commissioners, one appointed by the Government of each country. The cost of the actual maintenance, apart from the salaries and travelling expenses of the Commissioners and their staffs, is shared equally by the two Governments.

In order to co-ordinate the activities of the Commission, it is customary for the Commissioners, with their engineers, to hold a conference at least once a year to discuss boundary matters and to decide on a program of work to be undertaken during the coming field season. These conferences are generally held in the winter or early spring, alternating at Washington and Ottawa. Two conferences were held during the year; the first in Washington from April 23 to 26, which Noel J. Ogilvie, the Canadian Commissioner, and the engineer to the Canadian Section attended, and the second on January 14 to 18, when John A. Ulinski, the United States Commissioner, and his engineer came to Ottawa. At the April conference, the details of the field work for the coming season were discussed and projects assigned to each of the two sections of the Commission. The proposed erection of a pulp and paper-mill on the New Brunswick-Maine boundary line was investigated and recommendations made to the promoters. At the January conference, the field program for 1947 was agreed upon and the Commissioners discussed the boundary situation in Dixon Entrance and at Point Roberts on the Pacific Coast with the Under-Secretary of State for External Affairs.

Early in July, the Commissioners met in Vancouver to inspect various parts of the boundary on the Pacific Coast and to visit the field parties working on the Alaska boundary. They sailed for Skagway on July 10 and continued from there, over the White Pass and Yukon Railway, to Whitehorse, where they met D. F. Chisholm, who was in charge of the party working on the 141st Meridian. The following day they started on the 300-mile drive along the Alaska Highway to the boundary line, making the return trip in three days and stopping at Burwash Landing for two nights. They inspected the boundary line where it crosses the highway and the preliminary work being done for setting two monuments to mark the crossing.

After coming back to Whitehorse, the Commissioners returned to Skagway, then proceeded by boat to Haines and drove about 40 miles out the Haines Cut-off Road to H. S. Mussell's party at Pleasant Camp. Here they inspected the boundary line and the work being done on it and then returned to Skagway.

They retured to Vancouver, and then inspected the boundary at Point Roberts and near Blaine, Washington. Under the joint auspices of the Historical Societies of Washington and British Columbia, a memorial monument was erected on the line in the Blaine Peace Park on June 15 to commemorate the centennial anniversary of the settlement of that part of the boundary line. After finishing the inspection in this district, the Commissioners returned to Ottawa and Washington.

Maintenance of the Boundary

In line with the accelerated development of northwestern Canada, the Canadian Section of the Commission sent one party to the 141st Meridian portion of the Alaska boundary and a second party to the boundary crossing of the Klehini River near Haines, Alaska. The first party in charge of Mr. Chisholm started work on the boundary line where the Alaska Highway crosses the border from Yukon into Alaska about 300 miles west of Whitehorse. The timber growth in this district is mostly birch and spruce on the ridges, with willows and alder in the low places. There are numerous patches of muskeg, and everywhere the ground is densely covered with moss, labrador tea, and small bushes. The ground is permanently frozen and this vegetable covering forms an insulation which prevents thawing. If the ground is cleared off, it thaws to a soft mud which makes an unstable foundation.

The boundary vista here had not been cleared since 1910, when the line was first surveyed, and was so thickly overgrown as to be hardly discernible. It was recleared from Monument 162 to Monument 164, two miles south of the highway and three miles north of it. Monuments to mark the boundary crossing could not be built on the frozen ground, so shoulders were built out on each side of the highway grade and temporary marks set on them. Two concrete monuments were cast and stored at the Department storehouse in Whitehorse, and when the fill has settled they will be set in place.

Shortly after the party left, a telegram came to Ottawa from J. E. Gibben, Acting Controller, Yukon Territory, asking permission to use one of these monuments as a headstone on the grave of a penniless war veteran. This permission was given.

When this work was completed, the party returned to Whitehorse and was disbanded. Mr. Chisholm and his foreman then travelled down the Yukon River to Dawson, where they engaged a new party, and continued about 80 miles down-stream to the boundary crossing near Eagle, Alaska. This area had last been visited in 1938 by the engineer to the United States Section of the Commission, who reset Monument 112 on the south shore. This monument had been undermined and was in danger of falling into the river, and was moved back 65 feet and set in a new position.

The vista was recleared from Monument 110 to Monument 113, about 1¼ miles on each side of the river, and the four monuments were inspected and found to be in good order. A line cut through the timber up the slope on the south side of the river by William Ogilvie in 1895 to mark the determination of the 141st Meridian is still faintly visible.

When this work was completed, the party returned to Dawson, where they were paid off, and Mr. Chisholm returned to Ottawa.

The second party, in charge of Mr. Mussell, was engaged on maintenance work at the boundary crossings of the Klehini River and Yokeak Creek, at Pleasant Camp about 40 miles up the highway from Haines, Alaska. The vista here had not been recleared since it was originally opened in 1904, and consequently was filled in with dense growth; some of the trees had reached a considerable size. The vista was recleared to the timber-line on the mountains on both sides of the river, a total distance of about 5 miles, and 6 monuments

were inspected. In addition, a new monument was set on the edge of the highway to mark the boundary crossing. At Yokeak Creek, a tributary of the Klehini, about one mile of vista was recleared and the single monument there was inspected and found to be in good condition.

An aerial tramway was built for the men to cross the Klehini River on their way to and from work. A cable was stretched across the river, on which ran a pulley with a rope sling attached, together with a draw line made fast to each shore. A man could then sit in the sling and pull himself across to either shore with a draw line.

On his way back to Ottawa, Mr. Mussell inspected 39 monuments at various points along the 49th Parallel. These were all found to be in good condition except No. 154, near Grand Forks, British Columbia. This monument was found with the shaft broken off, and was filled with concrete, reinforced with steel rods, and reset.

G. T. Prinsep acted as Canadian representative with a party from the United States Section of the Commission working from the source of the St. Croix River to the Atlantic Ocean between Maine and New Brunswick. The boundary triangulation in this section was revised and the connections with the primary nets of both countries were strengthened. All the triangulation marks and boundary reference monuments were inspected and repaired where necessary, as well as the boundary marks on the international bridges over the St. Croix River. All the necessary observations were made to provide for a readjustment of this section of the boundary triangulation on the North American Datum of 1927, and for the determination of the geographic positions of the reference monuments on the same datum. In addition to this work, the vistas were recleared from the head of Monument Brook to the Maxwell-North Amity road; at the first 8 courses along Monument Brook; and at the range marks on Campobello, Pope's Folly and Treat Islands, and at West Quoddy Head.

Miscellaneous

During the year, boundary maps were sent to the Ontario Department of Lands and Forests at Port Arthur; the Ontario Hydro-Electric Power Commission; to the Department of National Revenue; the Bureau of Mines and Geology; and the McColl-Frontenac Oil Company, of Calgary.

Early in the year, the Union Gas Company constructed a pipeline under the Detroit River at Ojibway, Ontario, and asked for data to enable them to determine the intersection of the boundary line with the pipeline for apportioning capital and maintenance costs. This information was supplied to them.

A brief historical sketch of the location of the boundary at the Lake of the Woods and at Point Roberts was sent to Wells Ritchie, Supervisor of the Press and Information Service of the Canadian Broadcasting Corporation.

The District Engineer's office of the Department of Public Works at New Westminster made an inspection of the offshore range mark at Point Roberts in November. They report that no change was found in the settlement of the foundation and that there had been no further movement since the damage to the piles by teredos was first investigated in January, 1943.

HYDROGRAPHIC AND MAP SERVICE

The function of the Hydrographic and Map Service is the production of official sea and air charts, land maps, and legal maps. In accordance with the modern trend towards integration of sea and air transport facilities, the component units, the Hydrographic Service and the Map Service, respectively, are coordinated under a single administration. The work of the dual service extends from sea to sea and occupies an important place in the world transportation picture.

HYDROGRAPHIC SERVICE

The Hydrographic Service of Canada conducts a wide range of marine activities required for the safeguarding of shipping. Primary responsibilities are the charting of the coastal and inland navigable waters of Canada, the analysis of tides and tidal-current phenomena, and the investigation of water-surface elevations of the St. Lawrence-Great Lakes Waterway. The resultant data published in the form of official navigation charts, volumes of Pilots and Sailing Directions, Tide Tables and Water-Level Bulletins, are supplied to the navy, merchant marine, and mercantile interests in general.

The Service is comprised of Surveying and Chart Divisions, a Tidal and Current Division, and a Precise Water Levels Division. They have completely interlocking functions and are administered from Hydrographic Headquarters, Ottawa. The latter office is the clearing centre for general navigational information, but a Regional Hydrographic Office at Victoria supervises the charting, tidal operations, and chart distribution on the Pacific seaboard.

In certain respects, the Hydrographic Service is a scientific plant for the manufacture and distribution of vital aids to navigation. The nautical charts and other publications are prepared from data resulting from original field operations. To supply demands of the mercantile trade, a constant stream of charts is processed; the charts are printed on the presses operated by the Legal Surveys and Map Service, and the finished products are stocked for sale. Catalogues of available nautical publications are supplied. Distribution of charts is effected through Government and commercial agencies in seaports and shipping centres, or from the Hydrographic offices at Ottawa and Victoria. Benefits derived from the operations include added safety to life and property at sea, lower marine-insurance rates, increased navigational efficiency, and assistance in the development of Canadian waterborne trade.

Major activities of the Service fall into two broad categories—chart-construction and chart-maintenance—to adapt well-known engineering terms to the work of a nautical service. On the one hand is the task of producing new navigation charts of hitherto uncharted areas. On the other hand is the work of revising these charts in order to keep them up-to-date both with changes affecting marine transportation and in accordance with improvements in navigational methods. The sciences of navigation and hydrography are closely linked. With the development of such devices as radar and Loran for position-finding at sea, coupled with the pre-war advances in echo-sounding for accurate depth-finding, it is now possible to navigate with more than the sun, moon, stars and a leadline. As older methods of navigation are being superseded, so must outmoded hydrographic aids be replaced by modern cartographic productions.

During the year, the call for new charts exceeded the available means of production. Much of the upsurge in demand for charts and hydrographic field services is attributable to the fact that, because of insufficient hydrographic technical personnel, floating equipment, and printing-press facilities, chart production for over five years was restricted to war work. The abrupt termination of hostilities caused a situation in which the hydrographic organization, geared to the abnormal demands of the defence forces, was suddenly confronted with the needs of peace-time shipping. Urgent calls for nautical charts also resulted from the pent-up demands of a great waterborne tourist trade which followed in the wake of peace. Of the needs for charts of Hudson Bay and the Arctic Islands much could be said, and other horizons where charting is required continually open up.

The immensity of the task involved in modern charting can be grasped by a realization of the extent of Canada's coastal and inland navigable waters. The salt-water shores, including their gulfs, bays, inlets, and off-lying islands, measure

some 50,000 miles. This figure is only approximate, as the mileage varies considerably with the closeness with which the sinuous shore is followed. Of this total, the mainland coast accounts for 15,000 miles, the Arctic Islands 27,000, and other islands including Anticosti, Vancouver, and the Queen Charlottes, 8,000. Added to this is the long Canadian portion of the Great Lakes-St. Lawrence Waterway and the lesser Great Lakes; Winnipeg, Athabaska, Great Slave, and other lakes of importance but of less extent. The coasts and navigable waters of Canada are among the most extensive and intricate in the world, but every mile must be charted; every rock on which a ship might founder must be found.

From the above review of post-war developments as seen against the background of the war period, it is clear that the need for navigation charts is extensive and intensive. It is not incorrect to say that most of the coastal waters of Canada are covered by charts of sorts, but the day when many of them were adequate to meet even elementary needs of navigation has passed. Even less can be said for the chart situation on many of the inland waters, exclusive of the main shipping-routes. A number of nautical charts of important areas are produced each year, but in other parts of the country the dearth of these basic aids-to-navigation handicaps development. As an instance might be cited the attractive inshore waters of Georgian Bay which, if charts were available, would be the mecca of a greatly increased waterborne tourist trade. To enumerate the extensive areas in northern inland waters where navigation charts are required would be to recite the most important commercial developments in the Northwest Territories. The list of other regions where charts are needed is a long one.

Administrative activities in the twelve months under review were focused on converting the equipment and efforts of the Service to meet the needs of peacetime shipping. A moderate increase in the hydrographic appropriation enabled the acquisition and partial fitting-out of two small survey ships, the outfitting and operation of the pre-war hydrographic vessel *Acadia*, the building of a new launch for Great Slave Lake, and the purchase of modern surveying and cartographic equipment. A reclassification of several technical positions offered some encouragement, but it has been found exceedingly difficult to recruit additional junior personnel. A rearrangement of cartographic office space into definite "Chart Compilation" and "Chart Drafting" Sections has helped to streamline work at headquarters. In the general matter of reconversion, there are problems still to meet, but the route traversed in 1946 will assist in charting the course for 1947.

In pursuance of the established program of progressive charting, a number of hydrographic field projects were conducted in coastal, lake, and river areas. In addition, special surveys and emergency undersea examinations were undertaken. The major Atlantic Coast hydrographic ship *Acadia*, after being several years on naval duty, was reconditioned and returned to the Hydrographic Service to perform the functions for which she was originally constructed. An addition to the hydrographic fleet of smaller craft was a modern launch equipped with echo-sounding instruments for use in charting northern lakes and rivers. Structural alterations to convert the navy patrol boat acquired in 1946 for Pacific Coast hydrographic purposes were completed, and plans were drawn up for converting a 126-foot vessel of the minesweeper class for hydrographic and oceanographical purposes in the Gulf of St. Lawrence.

An adequate supply of trained personnel is a first requisite in a comprehensive charting program. During the year, the need for charting was most urgent, but a shortage of technical staffs hampered progress afloat and ashore. In this respect, the situation was somewhat relieved by the employment of several undergraduates as student assistants during the period intervening between their academic years. It is hoped that some of these young men, having gained a first-hand acquaintance with the specialized type of work conducted by this Service,

may decide to pursue the hydrographic profession as a career after university graduation. The necessity for maintaining the Hydrographic Service at a high level of efficiency was brought into bold relief during the war and emphasized by post-war developments.

The Tidal and Current Division continued its function of obtaining and disseminating data pertaining to tides and tidal currents. Mr. H. W. Jones, who served with distinction as Chief of this Division for over 20 years, retired from active service. Under his supervision important projects were carried out, one of the more recent being the charting of the complex tidal currents in the estuarial portion of the St. Lawrence River. The work of the Tidal and Current Survey embraces the Atlantic, Pacific, and Arctic Coasts of Canada, including Hudson Bay and Strait. Investigation of water-surface fluctuations in navigable fresh-water lakes and rivers was performed by the Precise Water Levels Division. During the year, the latter organization carried out its function of recording and periodically publishing the precise water-level elevations of the Great Lakes-St. Lawrence Waterway. A much-needed investigation of the levels of the Mackenzie River system is under way.

National and International Co-operation.—The policy of maintaining close cooperation with other services has been very successful. Hydrographic data were exchanged with the Admiralty, the United States Hydrographic Office, and with shipping interests generally. Consultations were held with, and navigational information for chart use was received from other Canadian Government departments. In return, hydrographic publications were supplied and special charting was performed on request.

Nautical research was necessary to answer questions referred to this Service. Inquiries dealt with such subjects as dangers to navigation; available depths in channels and anchorages; recommended ship-routes and distances between ports; harbour facilities; oceanic, estuarial, and river currents; descriptions of the Canadian continental shelf; ice-data; water-surface temperatures on comparative North Atlantic lanes; authorized nomenclature of coastal features, and many other navigational matters. Much information was supplied in regard to tidal phenomena and also as to rises and falls of the water-surface elevations of navigable lakes and rivers. To provide a ready-reference service to the sea-going public, a well-kept repository of nautical information is maintained. Much of the material is world-wide in scope and consists of hydrographic publications issued by this and other countries.

The work of the Hydrographic Service has important international aspects. Safety of foreign waterborne commerce in Canadian waters depends on accurate charting operations conducted by this Service. Canadian navigation charts conform to internationally recognized standards which are continually being developed and improved. In the organization known as the International Hydrographic Bureau, Monaco, a world affiliation of hydrographic offices has emerged. Standardization of chart features, development of efficient hydrographic instruments and methods, and the exchange of hydrographic information are a few of the main objects of the association in which Canada is interested, though this country has not yet become an active member.

Pilots and Sailing Directions.—Supplemental to the navigation charts are the volumes of Pilots and Sailing Directions issued by this Service. These compendiums of navigational information cover the Atlantic and Pacific sea approaches to Canada, the Hudson Bay Route, the Canadian portion of the Great Lakes-St. Lawrence Waterway, and the Mackenzie River. Supplements are produced and revised editions of the main volumes are issued when sufficient new information has accumulated. In the year under review, the following publications were made available: Supplement No. 1 to St. Lawrence River

Pilot (below Quebec), 1943 edition; Supplement No. 1 to St. Lawrence River Pilot (Montreal Harbour to Kingston), 1942 edition; St. Lawrence River Pilot (Quebec Harbour to Montreal Harbour), 4th edition; Mackenzie River Pilot (preliminary edition).

Urgent nautical information is promulgated through the medium of the official Notices to Mariners. Masters of vessels and shipping and engineering interests are supplied special data relating to harbour and channel depths, water-levels, recommended loading draughts, harbour facilities, ice conditions, and general navigational information. The Sailing Directions Section is also responsible for the preparation of chart place-name submissions to the Geographic Board of Canada.

Hydrography

The physical relief of the sea-floor is continually changing. In many places the shores are being worn away by the action of the elements: in other localities wind and wave build up dangerous shoals or erode existing obstructions. New channels are formed by natural and artificial means and these necessitate new buoyage and navigational lighting systems. Modern charts showing the actual conditions are required, and then constant vigilance is necessary to keep them up-to-date. In offshore waters and inaccessible areas, charting is conducted with the use of hydrographic vessels. On accessible coasts, surveys of inshore waters are carried on by small launch-equipped parties. All hydrographic surveys are based on rigid triangulation—generally on latitude and longitude values of one or more main stations of the Geodetic Service of Canada. In these surveys, air photography has superseded shore-traversing for the delineation of the coastline. Sounding is done almost entirely by means of echo-sounding.

In 1946, substantial progress was made in charting important sections of our seaboards and northern inland waters. Two major hydrographic vessels and five launch units were operated. The larger of the two ships conducted major projects off the Pacific Coast; the other, after a lapse of six years on naval duty, resumed the charting of the Gulf of St. Lawrence. Launch units continued the detailed survey of inshore waters of Nova Scotia and in Northumberland Strait. The recharting of the St. Lawrence River between Quebec and Montreal was advanced by a small, but well-equipped, hydrographic unit. Urgently needed surveys were carried on in the Mackenzie River and Great Slave Lake. The main charting projects were all integral parts of the established long-term program.

Concise reviews of the work of each undertaking follow:

Atlantic Coast and Inland Waters

Gulf of St. Lawrence.—After a lapse of six years, during which the ship was on loan to the Naval Service, the *Acadia* resumed charting operations in the Gulf of St. Lawrence. Due to the abnormal labour situation and unforseen delays in outfitting the ship for hydrographic duties, the season's work was delayed. While the vessel was in course of commissioning at Pictou, a small launch-equipped party carried on a survey of Northumberland Strait between Cape John and Caribou Harbour and between Logan Point and Merigomish Harbour. Charting of the latter place was also taken in hand. The *Acadia* commenced operations on July 24. The main undertaking was the sounding of areas in the Strait inaccessible to the small launches which, in recent years, have been engaged in charting the inshore areas of this important waterway. Other operations included a survey of Grand Entry Harbour (Magdalen Islands) and approaches for the Department of Public Works; the calibration of Belle Isle Direction Finding Station for the Department of Transport; and sounding work in the approaches to the Strait of Belle Isle. The season's work terminated on November 13.

Summary of Season's Work

Ship sounding	1258	linear miles
Boat sounding	47	" "
Coastline plotted	10	" "
Shoals examined	2	

Northumberland Strait.—Continuing the systematic charting of the southern portion of the Gulf of St. Lawrence, the survey launch *Henry Hudson* commenced operations on May 30. On completion of special surveys in Caribou Harbour and the Strait of Canso on July 17, the inshore areas between River John and Toney River, N.S., were sounded. Charting in the vicinity of Boughton Island, P.E.I., was then undertaken, but owing to the shortage of hydrographers this work was terminated on September 17 and the officer-in-charge joined the *Acadia*.

Summary of Season's Work

Boat sounding	395	linear miles
Coastline plotted	15	" "
Shoals examined	14	

Cape Breton.—Surveying operations of this unit commenced on June 7. The main work of the season was the charting of the southwestern portion of Great Bras d'Or and also St. Patrick Channel from Baddeck to Whycocomagh. In addition, examinations were made to complete the previous year's field sheet. A special survey was carried out to test the channel depths in the eastern entrance to Great Bras d'Or, and a comprehensive report dealing with existing and recommended aids to navigation was submitted. The season's work terminated on December 13.

Summary of Season's Work

Boat sounding	490	linear miles
Coastline plotted	66	" "
Shoals examined	55	

Atlantic Coast.—Objective of this survey was the completion of the charting of St. Margaret Bay, N.S., as well as the triangulation of Halifax Harbour and approaches, as a necessary preliminary to the publication of up-to-date charts of this national harbour. Equipped with the hydrographic launch *Dawson* and a small motor-boat, operations commenced on June 1. Several hitherto uncharted shoal areas were found. One of these, with a least depth of only 16 feet at low water, was discovered at a distance of 1½ cables northward of Black Rock, on the southwest side of the channel leading to West Dover. The St. Margaret Bay project was completed on October 10 and the triangulation of the Halifax area on November 14. As a result of the work a new chart covering St. Margaret Bay and approaches will be published.

Summary of Season's Work

Boat sounding	913	linear miles
Coastline plotted	89	" "
Shoals examined	102	

St. Lawrence River.—This unit, using the hydrographic launch *Boulton* and a small motor-boat, continued the charting of the St. Lawrence River between Sorel and Repentigny from May 29 to October 23. The party then undertook a reconnaissance survey of the Rideau Lakes Route from Kingston to Ottawa. On completion of the latter project the *Boulton* arrived at Prescott on November 7 for wintering. This was the 21st consecutive season in which this launch had been engaged in hydrographic work at various places from the Bay of Fundy to Lake Superior, but she has finally reached the stage where it is no longer economical to repair her for charting purposes.

Summary of Season's Work

Boat sounding	390 linear miles
Coastline plotted	40 " "
Shoals examined	6

Great Slave Lake—Mackenzie River.—A great increase in water-transportation in this area has resulted from the remarkable expansion in oil, mineral, water-power, and commercial-fishing developments. Nautical charts are urgently needed for navigation, channel, and harbour improvement, and also to meet the requirements of the new fishing industry. In this hitherto uncharted locality, the sequence of hydrographic procedure consists of a search for harbours of refuge along an extensive stretch of coast; the charting of main navigation routes; detailed examinations of principal harbours and anchorages; the suggesting of appropriate buoys, lights, and range beacons; the production of standard nautical charts, and the compilation and distribution of the official volume of Sailing Directions. The establishment of a standard low-water datum is an essential undertaking for navigation purposes as well as for municipal and industrial development schemes.

The season's hydrographic work commenced on June 9 and terminated on September 23. In the Mackenzie River, operations were conducted in the critical section extending from Fort Providence to Beaver Lake, a stretch of about 15 miles known at the Providence Rapids Section. Here the narrow, crooked channel, swift current, and shifting, bouldery bottom make navigation extremely difficult. A remarkable feature is the steep river gradient which averages about 2¼ feet per mile for twelve miles. A few miles above Fort Providence, a gradient of 5 feet per mile causes a swift current, the maximum being nearly 11 miles per hour. In order to determine this slope, a line of levels based on mean sea-level was run from Mill Lake to Beaver Lake, a distance of thirty miles.

In Great Slave Lake, the approach to Hay River was sounded and reconnaissance surveys were made of two harbours in the west shore of the lake.

As a result of operations, a new chart named "Beaver Lake to Fort Providence" will be published: large additions to the "Pointe Desmaraie to Fort Providence" chart were compiled; a revised edition of the "Plans of Harbours, Great Slave Lake" chart was prepared, and considerable extensive information required for dredging purposes was supplied to the Department of Public Works.

Summary of Season's Work

Boat sounding	540 linear miles
Coastlining	50 " "
Levelling	60

Pacific Coast District

Nowhere in Canada and, in fact, in few parts of the world are modern charts more urgently required than on the Pacific seaboard. The highly complicated submarine topography culminates in pinnacle rocks which, uncharted, would constitute a terrible menace to navigation. An outstanding feature of the marginal ocean bed off this coast is the proximity of the edge of the continental shelf to the land masses—Vancouver Island and the Queen Charlotte Islands. The location of the seaward perimeter of this submerged shelf, a bold and easily recognizable topographic feature, is of vital importance to ships making landfall from the Orient. Depths on the continental shelf are extremely irregular; the whole extent of coastal waters requires rigid charting.

During the year under review, owing to lack of sufficient floating equipment and technical staff to expand the work to offshore areas, activities were focused on the production of charts covering the inner navigable waters from Victoria and Vancouver to Prince Rupert and Alaskan waters. The hydrographic ship *Wm. J. Stewart* was engaged in this work.

The vessel cleared from Victoria on April 28 for her season's operations. The abnormal labour situation resulted in a heavy crew turnover which had the effect of hampering the work. Nevertheless, good progress was made, charting being conducted in the following localities: Goletas Channel and Gordon Channel area; North Passage area from Calvert Island south to Latitude 51°20′; from north end of Grenville Channel to Kennedy Island; Comox Bar; Drew Harbour; south entrance to Baynes Sound; Malibu Rapids, Jarvis inlet; sweeping was carried on in the vicinity of James Island and a wharf at Patricia Bay was surveyed. A correction to Esquimalt Harbour was made.

The ship returned to Victoria on October 28 and during the next few days hydrographic examinations were made in Esquimalt Harbour in order to bring the chart of that important place strictly up to date. The ship was decommissioned on October 31.

Summary of Season's Work

Ship sounding	852	linear miles
Boat sounding	2,701	" "
Coastline plotted	131	" "
Shoals examined	1,258	
Shoals swept	4	

Tides and Currents

The Tidal and Current Division continued the investigation and analysis of tides and tidal action, and the compilation of the resultant data for public use. The information is published in the form of the official tide-prediction tables, special tidal-current charts and comprehensive tidal reference data on the standard navigation charts. New information for the refinement or extension of existing tidal information is continually being studied and tabulated.

Preparation of the various editions of 1947 Tide Tables was completed in the early part of the fiscal year, and considerable progress was made on the 1948 issues. The Tide Tables are sold through the Department of Public Printing and Stationery; postmasters, customs officers in seaport towns, maritime newspapers, libraries, and tourist bureaus are supplied free single copies. Large quantities are required by the Department of Fisheries for distribution to the fishery trade.

Two complete editions of the Tide Tables are produced: one for the Atlantic Coast and one for the Pacific Coast are published for shipping interests generally. Six abridged pocket editions serve the needs of fishermen and others locally: four cover 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". Tide tables for Nelson, Manitoba, are supplied in mimeographed form.

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". Efforts are made to improve the tide tables each year: the 1948 tables will include complete current tables for Seymour Narrows. Additional current information for First Narrows and Active Pass, as well as "Tide Tables for Canoe Pass, Seymour Narrows", will be inserted for the first time: Sailing Directions, based on analysis of the recent current surveys, will be given for Second Narrows, Burrard Inlet.

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"; "Tides at the Head of the Bay of Fundy", and "Tides and Tidal Streams".

The principal tidal stations maintained in operation are:—

Atlantic Coast.—Quebec, Father Point, and Harrington, P.Q.; Charlottetown, P.E.I.; Saint John, N.B.; Halifax, N.S.; Churchill, Man. A station at Chicoutimi is maintained during the open season of navigation and a temporary station was operated at Grand River, P.Q.

Pacific Coast.—Vancouver, Point Atkinson, Victoria, Clayoquot, Seymour Narrows, and Prince Rupert, B.C.

Special Investigations of Tides and Tidal Streams.—A survey of the currents was carried out at the Second Narrows bridge in Burrard Inlet to determine velocities and directions for tides of different ranges. Accidents have occurred in this critical passage. For safe navigation, accurate tidal information is required. Additional observations of the directions and velocities of the current in Montreal Harbour were also obtained.

Information Service.—Much specialized tidal data were furnished to navigation interests, engineers, coast industries, and Government departments.

Precise Water Levels

The function of the Precise Water Levels Division is the systematic recording of precise water-level data pertaining to Federal waterways. The work is an integral part of the activities of the Hydrographic Service in charting the Great Lakes-St. Lawrence Waterway and the Great Slave Lake-Mackenzie River system. Special studies are carried on to provide authoritative reports respecting phenomena connected with lake and river elevations. Tabulated data are supplied in the form of graphs and bulletins. This information is the basis of regulatory measures for the maintenance of adequate water-levels for navigation, water power, and municipal purposes.

Gauging stations were maintained at 49 locations on the Great Lakes and the St. Lawrence and Ottawa Rivers. Well over 600,000 water-surface elevations were compiled into comprehensive tabulations. Over 10,500 sheets of bulletins, reports, profiles, and special data were issued, and 12 monthly, 5 annual, 6 general data, and 5 graphic bulletins were also published. The Canadian Press was given a concise synopsis of each monthly bulletin for publication in marine sections of many newspapers. A number of investigations in regard to lake and river levels were undertaken for special purposes during the year.

Chart Construction and Reproduction

The Chart Construction and Reproduction Division prepares charts from original hydrographic data submitted by the field charting units. It also has the responsibility for the revision of existing charts and for the production of new editions. An important part of the work is the hand-correction of chart stocks to keep them up to date with important changes affecting navigation.

Production of new standard charts, new editions, and reprints exceeded previous records, but, owing to shortage of staff and inadequate printing facilities, output was still not sufficient to meet all demands. In consequence, stocks of certain charts were depleted for varying periods.

In the twelve months under review, 92 charts and other navigational publications were printed as follows: 75 charts published in colours; 10 charts printed in black only; 6 index maps for catalogues and "Pilots"; and one catalogue.

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

Chart distribution receded from the abnormally high quantities supplied during the war years, but remained substantially larger than in 1939. Since the war the call for special charts, strategic charts, and instructional charts has terminated almost entirely, but the contraction of orders for charts for purely naval purposes was accompanied by a rapid expansion in chart demand for commercial uses. In consequence, the demand for standard charts has remained at or near peak levels. An interesting sidelight on chart requirements during the year was the insistent call for charts of Georgian Bay and other protected waters, for recreational purposes.

Following are the figures of annual chart distribution: 1939, 19,850; 1940, 33,136; 1941, 47,699; 1942, 50,968; 1943, 83,936; 1944, 106,042; 1945, 101,633, 1946, 50,129.

Hydrographic publications distributed during the year were as follows: Catalogue of Charts, Sailing Directions and Tidal Information with Index Maps, 1,606; Navigational Charts 50,129; Pilots and Sailing Directions, 2,674; Supplements to Pilots, 391; Tide Tables, 59,261; Water Level Bulletins and Graphs, exclusive of those distributed through Notices to Mariners, 10,582.

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 year 1946-47 was significant for the Legal Surveys and Map Service in as much as it demonstrated that the pattern of activities which took form during the war years now constitutes a solid basis for the fulfilment of peace-time needs.

The Legal Surveys Division, as the name implies, is concerned with surveys for title necessary in any part of the Canadian Crown Lands. These comprise the vast area of the Northwest Territories and Yukon, extending over one and one half million square miles, the 2,200 Indian reserves scattered throughout Canada, Crown Ordnance lands, and other miscellaneous parcels of Canadian Government property.

The Map Service is the largest single producer of maps in Canada, maintaining in current circulation over 1,500 separate map sheets of various types.

A year of re-adjustment has passed since the closing of the war. It is therefore opportune to pause and evaluate the considerable impact which the trends established by the necessities and developments of conflict have had upon the character of the work performed by this Service.

War acted as an immediate stimulus to the exploration and development of the Canadian Northwest. On the one hand it resulted in the institution of gigantic projects urgently requisite for purposes of defence—the Alaska High-

way, the Canol oil pipeline and road, the creation of great air bases, and the development of the multitude of diverse complementary facilities essential to the operation of aircraft. On the other hand, war intensified and expanded the age-old search for varied minerals in the Northwest Territories.

The effects of these events will be projected far into the future. The Legal Surveys Division will be fully occupied for a considerable period in overtaking the backlog of work created thereby. During the past year, four field parties were operating in the Territories in the official delimitation of 200 miles of the Alaska Highway, in setting up the boundaries for airfields at Fort Smith, Teslin, and Fort Providence, and in surveying townsites. New settlements must be controlled in their growth, and the important function of establishing properly laid out subdivisions was accomplished at Fort Smith, Hay River, Yellowknife, Aklavik and Rat River.

The correct determination of the limits of staked mineral claims is of primary importance, since claims not surveyed within a specified period revert to the Crown. The rate of mining development in the Northwest, accelerated as never before by the interacting forces of necessity, modern methods, and the superior facilities afforded by improved air transport, added largely, and will continue to add, to the responsibilities of the Legal Surveys. The Division issues the instructions relative to which the survey of each new mineral claim is carried out by surveyors in private practice, and the results of all such field work are checked and certified in the Surveyor General's office.

The emergence of air power as a dominant factor in warfare and the extension of the effects of its stepped-up evolution into civilian life has had an effect on the Map Service which may be described fairly as revolutionary.

In 1939, a groundwork for air map coverage of Canada was being laid on a very modest basis with the initiation of a series of air charts of the routes being flown by the Trans-Canada Air Lines. When hostilities commenced only six sheets had been completed, although much had been learned of the requirements of this new type of map. This work was, at that time, merely supplementary to the normal production of various topographic maps. Following the advent of war came the inauguration of the Commonwealth Air-Training Plan, a sudden shift in defence emphasis to the northern frontiers, and the pioneering of long-range flying of vital supplies and equipment to war theatres. The provision of satisfactory aeronautical charts in the shortest possible time became an absolute necessity.

The manner in which the Map Service met this challenge is an outstanding example of how a civilian organization, with an extensive background of experience, established plant facilities, and a nucleus of specialized personnel, possessing, in a word, what is called "know-how", can complement the needs of a military machine with a speed and efficiency impossible on any other basis. Today, Canada is covered by aeronautical charts at a scale of 8 miles to 1 inch from the 49th Parallel almost to the Pole. The series, comprising 221 sheets, was completed on a provisional basis during 1944, and revisions are carried out as fast as additional information is available. The magnitude of this task can be visualized when it is compared with the Map of Hispanic America, recently completed by the National Geographic Society of Washington, D.C. This latter map, totalling only 106 sheets on a scale of 16 miles to 1 inch, was recently the subject of a special brochure by the Society, which stated that the work on it engaged the services of an average of eight technicians for a period of twenty-five years.

In comparison with the irregular and very incomplete pattern of map coverage prior to 1939, the Air Navigation Series emerges as the first consolidation of existing Canadian cartographic knowledge, on a uniform and useful

scale, ever accomplished. In addition to its special value as the fundamental base for the ever expanding post-war civilian aviation industry, it serves in a dual capacity as a series of topographic maps, each containing all the data appropriate to its scale to the extent that such material is available. Constant revision is in progress so that up-to-date guidance is maintained for air traffic in the same way as hydrographic charts serve mariners. Twenty-six topographic and 160 air information revisions were made during the past year.

The production plant of the Map Service resembles an assembly line of interlocking units. A mass of heterogeneous material is drawn in at one end and the finished maps emerge ready for distribution at the other. To the traditional set-up of compilation, drafting, photography, lithography, and distribution units, has been added that of Air Photogrammetry. This section was established primarily to plot tri-camera (popularly known as trimetrogon) air photography with particular regard for the requirements of the air navigation charts. Many aspects of this work are of recent development, and a wide field for research in methodology and application, both of a highly technical nature, exists. Reference is made in the appropriate section of this report to some of the accomplishments of the Air Photogrammetry Section in this particular. Despite the work already done, a million and a half square miles of hinterland still await the advent of the air camera for a complete revelation of its topographic detail.

So rapid is the pace of progress in the air that there are now in service aircraft capable of such increased speeds and sustained flight periods that they tend to "fly off the map" too rapidly when using 8-mile charts, and maps of smaller scales with greater geographical coverage per sheet are required. The first sheet of a series on a scale of 1:1,000,000 has already been produced in response to this demand.

The pattern of chart aids to air travel is evolving along lines parallel to those existing for marine use. The small-scale chart for distance flying must be supplemented by large-scale maps of terminals, both land and water, by route charts, plotting charts, aeronautical planning charts, approach and landing charts, and by charts showing radio facilities. The approach and landing charts and the Airways Facilities charts are essentially parts of the Canada Air Pilot. This handbook had its genesis in several publications maintained during the war by the Royal Canadian Air Force for the purpose of keeping up to date the constantly changing data on aerodromes, airways, radio aids, and servicing facilities.

In 1946, as agent for the Department of Transport, the Map Service assumed responsibility for the preparation and distribution of such information, compacted into two volumes, revised and adapted to civilian needs, and named it the Canada Air Pilot. Distribution is on a subscription basis. Amendments are issued every two weeks. The Canada Air Pilot dovetails with the Air Navigation Charts, and serves the air navigator in much the same way as the Pilots and Sailing Directions serve the mariner.

Ground elevations are essential to safe air travel. Of the total area of Canada, only twelve per cent has been sufficiently surveyed to provide contours adequate for the air map; another twenty-eight per cent has a scattering of elevations, but of the remaining sixty per cent very little is known of ground heights. To gather the information needed over this enormous area by conventional methods would be a task of almost prohibitive proportions. The Map Service has in hand the development of a method of doing this work quickly and cheaply by the use of sensitive altimeters transported over the terrain by aeroplane. An experiment to devise the most satisfactory type of radar altimeter is now being carried out in conjunction with the National Research Council, with excellent prospects for success.

Correct information on the declination (variation) of the compass needle is a very important factor in air operations. The Map Service issues periodically a magnetic map of Canada, showing the declination of the compass needle with its annual rate of change, and this map is used as a basis for the magnetic data included in both aeronautical and hydrographic charts.

In this shrinking world, in which the spectacular trans-oceanic stunt flight of yesterday has become the airline schedule of today, international standards for air maps are a growing need. The Map Service is represented on the Map Division of the International Civil Aviation Organization, and implements in Canadian charts the decisions which are designed to standardize air chart specifications throughout the world. The international organization requires full coverage of the land masses of the world on a scale of 1:1,000,000, or about 16 miles to 1 inch. Canada has accepted responsibility for the production and maintenance of sixty-five sheets in the series embracing Canada and Newfoundland. The first sheet was completed during the past year, and it is expected that further sheets will be produced as rapidly as possible.

Although the production of air navigation charts, plotting charts, and work associated with Air Force map needs nearly monopolized the resources of the Map Service during the years of war, the experience of the past year, on a peace-time basis, has demonstrated that what may be regarded as the normal demand for this type of map can be met without preventing a resumption of publication of the ordinary topographic maps upon which the Service was engaged in former years. About fifty per cent of last year's output consisted of air maps. Since the cessation of hostilities, the demand for maps to accommodate the tourist, the banker, the school teacher, the engineer, in short, persons from almost every walk of life, has far exceeded anything previously experienced. While a sharp decline in total volume from the war-time peak resulted with the curtailment of military activities, it is noticeable that civilian demand, represented by individual requests, increased by fifty per cent over the preceding year. The total distribution of maps, plans, and publications was in round figures, 349,000, which is 130 per cent greater than that of any pre-war year. The total cash revenue from the sale of maps, plans, Air Pilots, and other publications was $39,391, an increase of sixty per cent over the previous year.

The Legal Surveys and Map Service had twelve parties conducting ground surveys during 1946-47. Of these, two were engaged in legal surveys in the Yukon, two on similar work in the Northwest Territories, three on surveys of Indian reserves, two in field revision of aeronautical charts, and three in making topographical plans required by the Canadian section of the International Columbia River Engineering Board.

The Map Service also engages in a considerable number of subsidiary activities. Information is supplied regarding official airline distances, such as those upon which air mail contracts are based. Measurements of the annual rates of magnetic change are tabulated. A publication entitled "Astronomical Field Tables" is produced each year for surveyors. Data on such unusual subjects as the amount of possible sunlight available at any point in Canada in a given period are calculated for organizations doing photographic work, and measurements of topographic features supplied for such publications as the Canada Year Book. These tasks and others of a similar nature formed, in varying proportions, a part of the duties of the specialized mathematicians attached to the staff.

One of the principal difficulties experienced in carrying out the yearly program was to secure an adequate number of trained personnel. A clue to this difficulty is to be found in the appended report of the Board of Examiners for Dominion Land Surveyors. It may be noted that of fifty-five candidates who sat for preliminary examination, only four were successful. In the Air

Photogrammetry Section, the staff turnover during the year amounted to 33 per cent. In a service such as this, engaged in work of an intricate character, with the age level of experienced personnel relatively high, and the normal replacement and training process interrupted for two-thirds of a decade, the failure to induce younger men of high calibre to undertake the probationary training essential to their assumption of higher responsibility, or the inability to hold those so trained, can become progressively more threatening to the maintenance of Canada's record of achievement in the mapping world.

Legal Surveys

FIELD-WORK

The program of field surveys undertaken was, of necessity, adapted to the limited number of qualified land surveyors available. Surveys executed were as follows:—

Northwest Territories.—The system of base line and block outline control surveys adopted for the Northwest Territories was extended from the northeast corner of Section 25, Township 145-16-6 to the northeast corner of Section 34, Township 150-24-6, a distance of 85 miles; the airfields at Fort Smith and at Fort Providence were surveyed, and additional settlement lots were laid out on the ground at Fort Smith, Hay River, Yellowknife, Aklavik, and Rat River. In addition, instructions were issued to Dominion Land Surveyors in private practice for the survey of 197 mineral claims.

Yukon Territory.—The survey of the Alaska Highway, which has been in progress since 1944, was extended from Whitehorse to a point about 25 miles northwest of Burwash Landing, a distance of 200 miles.

At Teslin Settlement, the survey of the airport commenced in 1946 was completed, and the survey of a cemetery and a few other minor surveys were carried out. Minor surveys were also executed at Bear Creek, at Burwash Landing, and at the southerly end of Kluane Lake.

British Columbia.—The St. John Indian Reserve in the vicinity of Fort St. John, comprising 18,136 acres, was subdivided into individual farm sites for war veterans, and a similar area in three separate tracts was laid out and subdivided for the benefit of the Indians. Miscellaneous surveys were carried out on Chekwelp Indian Reserve and a parcel containing 317 acres was surveyed as a new Indian reserve near the confluence of the Germanson and Omineca Rivers.

Alberta.—Six tracts of land involving the survey of over 100 miles of exterior boundaries were laid out as Indian reserves in the vicinity of Hay Lake; a survey was made of the R.C.M.P. property at Chipewyan Settlement and a traverse survey was made of the power transmission line of the Royal Canadian Corps of Signals near Fort Smith, and of the road adjacent thereto.

Saskatchewan.—A portion of Muskoday Indian Reserve containing 3,200 acres was subdivided into farm lots to be leased to white farmers for the benefit of the Indians.

Ontario.—Snake Island in Lake Simcoe, forming part of Georgina Islands Indian Reserve and containing 338 acres, was subdivided into summer residence sites to be leased for the benefit of the Indians, and levelling operations were carried out on Georgina Island for drainage purposes.

Extensive control surveys and other miscellaneous surveys were carried out on Manitoulin Island. Subdivision surveys were also made on Walpole Island and Tyendinaga Indian Reserves.

Quebec.—The boundaries of a 500-acre wood lot were surveyed for the Indians of Oka Indian Reserve in Deux Montagnes County.

New Brunswick.—At the request of the Lands, Parks and Forests Branch, a survey was made of the boundaries of Beaver Ordnance Land Reserve in Charlotte County.

OFFICE WORK

In addition to the preparation of the instructions for the above-listed surveys and the examination of plans, field notes, and other returns relative to them, the usual routine work of preparing descriptions, reports, plans, and sketches relating to surveys affecting many of the over 2,200 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 seventy-two descriptions for insertion in legal transfers were prepared; 48 new plans were drawn and 129 additional plans, including 27 plans of mineral claim surveys, were examined and checked; 3,017 blue prints or photostat copies from plans or field notes were requisitioned and sent out; additional information was added to 861 plans and maps, and 1,452 letters or memoranda relating to surveys were prepared for the Surveyor General's signature.

The boundaries of all Indian Agencies, Treaties, Hunting and Fur Preserves, and Indian populations (1944 census) were inserted on nine large-scale maps for use of the Parliamentary Committee inquiring into Indian affairs.

Approximately 90 per cent of all surveyed mineral claims in the Northwest Territories were accurately compiled on 31 sheets (scale 1,000 feet to an inch) for administrative purposes, and a similar compilation to consist of 33 base sheets showing all surveyed and unsurveyed claims in Yukon Territory was commenced.

AIR PHOTOGRAMMETRY

The Air Photogrammetry Division was primarily employed on plotting the planimetry from trimetrogon air photographs for aeronautical charts, published on a scale of 8 miles to 1 inch.

The square mileage output was increased by 33 per cent over the preceding year, from 134,198 to 177,339 square miles. This improvement in production is attributable to progress in staff efficiency, added experience, and new devices for improved technique which shortened several phases of the work.

The following table is a summary of the work performed:

Sheet No.	Name	Area Plotted
74 NW.	Lake Athabaska	9,486 sq. mi.
74 NE.	Black Lake	6,325 " "
74 SE.	Mudjatik-Geikie	9,489 " "
23 SE.	Ashuanipi	4,360 " "
13 SW.	North West River	23,000 " "
12 NE.	Harrington-Belle Isle	13,800 " "
23 NW.	Kaniapiskau	15,669 " "
22 NW.	Pletipi	23,220 " "
13 SE.	Battle Harbour-Cartwright	26,650 " "
23 SW.	Nichicun	22,200 " "
54 NW.	Churchill	10,500 " "
55 SW.	Eskimo Point	12,640 " "
	Total	177,339 " "

Eight operation maps covering a total area of 695,000 square miles were prepared for the 1947 tricamera (trimetrogon) photographic program; 5 were prepared for vertical photography.

Trimetrogon air photographs received, indexed, and filed numbered 27,231, and cover one-quarter million square miles.

Two thousand vertical air photographs were also received, indexed, and filed. These cover 13 Indian reserves.

A map of Caughnawaga Indian Reserve showing all detail was made from vertical air photographs for the Indian Affairs Branch of the Department.

A complete volume of indices, showing all trimetrogon air photography in Canada by the U.S.A.A.F. during the late war, was compiled.

Complete indices of all the Canadian 8-mile sheets were prepared and mounted. They total 221, and show all Canadian trimetrogon air photography to date.

General training and instruction of old and new personnel progressed favourably throughout the year. At its close, the staff totalled 22. Seven technicians resigned during the year, and 8 new ones were engaged.

No additional instrumental equipment was purchased during the year.

Research.—A nomographic device which reduces the time formerly spent on the scale-factoring phase of the work by 75 per cent, with attendant improved accuracy, was computed and drawn, as was a nomographic device whereby the adjustment of all triangulated and other resected secondary points can be speedily and accurately carried out. The saving in time in this phase of the work is 33 per cent. It is hoped to translate both these devices into metal machines. Further studies in print distortion resulted in the compilation of tables to simplify the corrections to photo measurements in the photo analysis phase of the work.

Forty-eight transverse mercator projections on linen were computed and drawn on the 1-mile scale. Each minute quadrangle was shown, together with a 10-second subdivision. These were for the purpose of plotting, on the lay down projection, astronomically observed control points and others of given latitude and longitude. The device saves 66 per cent in time and has a record of no errors to date. An error in plotting an astro control point has far-reaching complicated effects, difficult and laborious to rectify. Lengthy computations were made, resulting in 1,200 drawings on transparencies—an ingenious device for projecting horizontal images from an oblique photo so that the standard type of portable oblique sketchmaster is readily adapted to project a small-scale horizontal image from a large-scale oblique photograph, exposed at as low an altitude as 8,000 feet.

A nomographic drawing and accompanying table were set up whereby meridian flight lines may be drawn on a 16-mile operational map in the field or in the office expeditiously, so that flight spacing at all altitudes from 8,000 to 20,000 may be read off for all latitudes from 48° to 72° and laid down in accordance with the accepted limits of clear plotting.

A camera perspective sight was built about an old lens, and a table computed to be read in conjunction with the sight readings whereby the horizontal distance from the plumb point of the aircraft to any ground object the image of which appears on the ground glass of the sight can be determined in 10 seconds. This instrument was devised for the use of navigators of trimetrogon and vertical photographic aircraft. Two test flights were made with the rough mock-up with gratifying results. The invention has been passed to the Research Committee of the National Research Council for examination.

Mapping

Field Work

British Columbia.—During the field season of 1946, three parties were engaged in making surveys for topographic plans in the basin of the Columbia River. This work was undertaken for the International Columbia River Engineering Board, Canadian Section, in order to investigate the possibility of a more advantageous use of the water of the Columbia River system.

One party completed the survey of the Kootenay River between the International Boundary and Kootenay Lake. The requirements for this survey called for 20-foot contours from lake surface to the 1,800-foot level with 2-foot contours on those flat bottom lands considered to have a high present or potential agricultural value. Underwater contours were also obtained where the depth of water did not exceed five feet. Six maps on the scale of 1,000 feet to one inch will be issued covering this section, which covers an area of 65 square miles.

A second party was engaged on the survey of Kootenay Lake, including the West Arm, in order to obtain information sufficient for the preparation of six contoured plans on the scale of two inches to one mile showing 20-foot contours from the lake surface to the 1,800-foot level, with supplementary data to show 10-foot contours on the flatter areas where the scale of mapping would permit, and 5-foot contours between 1,740- and 1,770-foot levels around the West Arm from the main lake to Corra Linn Dam, the settled areas in vicinity of Kaslo, and the flats at the north end of the lake near Argenta. Underwater contours were also secured for the 1,740- and 1,745-foot contours. This party also made a survey of that portion of the Columbia River between Birchbank and Syringa Creek.

A third party was engaged along the Upper Kootenay River and tributaries, between the International Boundary and Elk River, on a reconnaissance survey for the preparation of plans showing 20-foot contours generally between the river and the 3,000-foot level.

This work is to be continued in 1947.

Manitoba.—Field revision of the 8-mile aeronautical sheet Indian Head-Brandon was carried out, and those areas which were considered inadequately mapped were examined and revised.

Quebec.—Field revision of the 8-mile aeronautical chart Parent-Three Rivers was put in hand and considerable new information was obtained and assembled for revision of the southeastern portion.

It is proposed to complete the examination and revision of this sheet during 1947.

Office Work

Aeronautical Charts.—The production of the aeronautical charts of the National Topographic Series continued to be the major activity of the Mapping Division. These 8-mile sheets incorporating all available information suitable to the scale, and covering the whole of Canada, have proven to be as serviceable to peace-time needs as they were essential during the war. Over 214,000 copies were printed during the fiscal year, an increase of 275 per cent over 1945-46.

The revision of these sheets keeps pace with the acquisition of additional information from new photography. There is thus a constant process of revision which is applied to those sheets of which the base stock shows signs of depletion.

The aeronautical editions have the air information shown by an overprint in magenta colour. The changes and developments in this information require new plates more often. In the case of the more active sheets, a revision every year is contemplated.

Four standard sheets showing hypsometric tints and 22 preliminary sheets in two and three colours were revised. In addition, limited corrections possible on the printing plates were made for 27 maps.

Revision of the air information by correcting the magneta overprints was made on 160 eight-mile charts.

Eight aeronautical charts along the Pacific Coast between latitudes 44° and 57°, drawn on the Mercator projection on the scale of 1:1,000,000 were especially prepared for the Royal Canadian Naval Service. These charts were designed for

use in contact flying by aircraft operating from an aircraft carrier. Each chart is 17 inches square and shows the topography in black, the air information in magenta, and the relief in graded tints of blue.

Using the 100-mile map as a base, and enlarging to 1:5,000,000, the staff prepared a chart showing the airways and air routes across Canada for the World Air Planning Chart series for Provisional International Civil Aviation Organization. This chart also shows the index to the aeronautical charts in green, and air information in red.

A map of the Canadian Arctic regions on a Modified Lambert Conformal Projection was drawn and printed for the Associate Committee on Aeronautical Research.

Two new aeronautical charts on the 1:1,000,000 scale, according to Provisional International Civil Aviation Organization specifications, were put in hand.

Using the eight-mile index to the National Topographic Series, the staff prepared a new index to the aeronautical editions. On this index, the new air editions are indicated by a narrow red band in the upper left hand corner of the sheet. This index is revised and issued every two months.

Recommendations and specifications for the construction of 1:1,000,000, 1:500,000, and approach and landing charts were prepared and submitted to the Inter-departmental Committee on Air Charting for submission to the Provisional International Civil Aviation Organization meeting at Montreal.

Canada Air Pilot.—This publication combines the publications previously issued by the R.C.A.F. listing data on aerodromes, airways, and radio aids to air navigation. Coverage extends over Canada, Newfoundland, Labrador, and adjacent areas of the United States and Alaska.

It now consists of two volumes: Volume One, Western Region, covering the area between the Pacific Coast and Winnipeg; Volume Two, covering the Eastern Region from Winnipeg to Newfoundland. The compilation, production, and distribution of these volumes are now undertaken by the Map Service under the authority of the Department of Transport.

Each volume consists of approximately 220 loose-leafs sheets in a soft leatherette binding, measuring about 10½ inches by 8 inches.

Included in the manual are Radio Facility Charts showing the airways and radio aids, locations of all land and water aerodromes together with photographs, sketches, and full details regarding the position, altitude, lighting, obstructions, weather service, ground facilities, mooring facilities, etc., of each.

The price of each volume is $5, which includes one year of amendment service; after the first year this amendment service is $3 per volume. This amendment service, which is performed by the Map Service, is designed to bring each volume up to date every two weeks.

Topographic Maps.—The following revisions of the National Topographic Series were made when current stocks were exhausted: One 1-mile map; four 2-mile maps; and eleven 4-mile maps. Two new 4-mile maps were compiled. These are designed to replace sectional sheets which are out of print.

Two 8-mile topographic editions were prepared as a commencement towards providing topographic editions for the 8-mile series wherever it is thought desirable.

The 3-mile Sectional Map Series which covers the prairie part of the three western provinces still retains a great deal of popularity. It is the policy to gradually eliminate this series, by replacing the marginal sheets with 4-mile sheets of the National Topographic Series, but in the meantime the more popular sheets must be kept in stock. During the year three sheets were revised.

Work was continued on the major task of producing a new map of Canada on a scale of 64 miles to 1 inch. This map will be published during 1947.

Maps of Canada's National Parks are published by this Service. The Jasper Park south sheet and the Banff Park map were revised. In addition, a new compilation was prepared from the 8-mile aeronautical sheets to replace the old Wood Buffalo Park map, the stock of which had become exhausted.

Work was resumed on a new map of southern Manitoba, scale 16 miles to 1 inch, which had been interrupted by the war. This sheet is designed to serve as a companion map to the Manitoba North map, on the same scale, which was produced in 1938.

Special Maps.—In order to record trappers' leases in Canada's northland, a number of special maps on the scale of three and four miles were prepared for the Bureau of Northwest Territories and Yukon Affairs.

For the purpose of registering mining claims, special maps of areas in the Northwest Territories and Yukon over which mining claims have been staked were prepared.

Electoral Maps.—In anticipation of and preparation for a Redistribution Bill, a quickened interest was shown in electoral maps, and the demand for copies increased. When the new Representation Act becomes law, new compilations will have to be made, and a great increase is expected in this work during the next few months.

Azimuthal Equidistant Projections.—A request from the Department of National Defence for an Azimuthal Equidistant Projection of the World, having a designated pole projection at Churchill, was handled. This Service computed the co-ordinates and the Hydrographic Service drew the projection.

General Activities.—Routine work of the office included the supplying of information regarding areas, and lineal measurements for the Canada Year Book, official air line distances for air mail contracts, latitude and longitude, magnetic declination, and elevations of designated points, as well as descriptions and values of miscellaneous survey monuments and cadastral control points.

The preparation of nomenclature for the maps issued by this Service and charts issued by the Hydrographic Service, and its presentation to the Geographic Board, constituted an operation of unusual importance during this year because of the work done on over 10,000 names for the new map of Canada which was compiled. In addition, all map names submitted by other organizations to the Geographic Board were checked and reviewed for the Executive Committee of the Board.

This Division also co-operates with other mapping organizations in exchanging information. During the year many requests were dealt with. About 500 maps and plans were received and indexed in the Map Library.

Owing to the variations in the areas, scales, and purposes of the maps dealt with, the determination of the projections best adapted to individual cases becomes most important. In this connection, investigations were carried out to decide the projection best suited to the extension of the 64-mile map of Canada to the North Pole. Certain characteristics of the Transverse Mercator Projection were carefully studied.

Investigation of the method of determining ground elevations from the air by means of radio altimeters, started in May, 1943, was continued. Interest in this subject is quite active and the project has been referred to the Associate Committee on Survey Research. Under the sponsorship of this Committee, the National Research Council has undertaken the development of a suitable instrument and is being assisted in every way possible by officers of this Service. Results to date are very encouraging.

Survey Records and Distribution

The Survey Records and Distribution 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, the staff keep records, compile indexes, lists, and catalogues, make inventories, estimates, and reports, receive, arrange, store, and ship maps, and handle the many thousands of official survey records.

In dealing with 32,055 letters and requests received during the year, the Division distributed 335,423 maps and aeronautical charts, 3,767 publications, and 9,583 official plans. Up to the end of the fiscal year, 22,465 books of survey notes and 40,334 plans were placed on record. In dealing with survey records, 881 technical requests were received.

The total distribution of maps, plans, and publications for 1946-47 was 348,773, which was 130 per cent greater than any previous distribution during a peace-time year.

From April 1, 1926, when records were first kept, up to March 31, 1947 (21 years) this Division has dealt with 432,721 requests and distributed 7,191,952 maps, aeronautical charts, plans, and publications.

The decline in volume of distribution from the peak of 1,861,963 in 1943-44 to the present level represents the diminished demands of the armed services.

During the past year, the number of requests averaged over 100 for each working day. The total number received showed an increase of 50 per cent over the previous year, and was the largest ever received in this Division in any one year.

In view of the absence of publicity, because press articles have not been issued since 1939, the increase shown is due solely to the needs of many thousands engaged in administrative, industrial, and recreational activities who have sought and utilized the service provided by this office.

The standard price of the maps and aeronautical charts is 25 cents per sheet. In a few cases, the prices are slightly more or less than the standard rate.

Agents who handle the maps on a resale basis are allowed 40 per cent discount off the list price. In the case of an educational institution under the control of a provincial department of education that requires quantities of maps for teaching geography it is the practice of the office to allow a 40 per cent discount off the list price.

As $27,995.06 was collected in the past year from the sale of maps and aeronautical charts, it will be seen that over one-third of the maps distributed were paid for and the remaining two-thirds were issued free of charge. The free issues went to Federal and provincial administrative offices and to educational institutions.

At present the stock of maps, charts, and official plans consists of nearly 11,000 items. As in the past, a constant inventory is kept, and requests for reprints and estimates for future requirements are made.

Various sheets of the National Topographic Series published by the Army Survey Establishment RCE (Geographic Section, General Staff) Department of National Defence, were distributed to the number of 44,463.

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 the index to aeronautical charts, issued bi-monthly, were distributed.

As the stocks of maps are always expanding and as the space available is limited, it is not possible to assemble the huge volume of maps in one place. At present the stocks are scattered in six rooms in three connected buildings. The dispersal of supplies is a major handicap in the work of the Division and a cause of delay in filling orders.

Draughting

In the Draughting Division during the fiscal year the finished drawings of 2 standard and 23 preliminary 8-mile aeronautical charts were revised for new editions, and 10 minute grids, according to the new plan of showing graticules, were drawn for overprinting on 8 charts of this series.

Eighteen drawings were corrected and revised for new editions of the 1-, 2-, 3-, and 4-mile scale topographic maps.

The projections were laid down and the drawings made for 8 Royal Canadian Navy air navigation charts, including air information overprinting plates.

A projection was drawn for the 64-mile Map of Canada, the draughting of which is nearing completion. Two maps of the Columbia River Project (Sheets 1 and 2) were completed, and projections made and draughting commenced on 3 other maps of this series. The drawings for the Athabaska River 1:1,000,000 aeronautical chart and the Northern Canada (West Part) chart at the 35-mile scale were completed.

Twenty-one new township plans were drawn, and 7 maps were compiled and drawn for the National Parks Bureau to be used in their publications.

One hundred and sixty drawings for the magenta overprints showing aeronautical information for air editions of the 8-mile series were revised and corrected.

Sixty-three tracings for indexing mining claims were drawn for the Bureau of the Northwest Territories and Yukon Affairs, and a large scale map (black and red) of the Canadian Arctic Regions was drawn.

Three draughtsmen and one compositor were employed revising and correcting the Canada Air Pilot.

Photo-Mechanical

The work performed in the Photo Mechanical Division included: wet plate negatives, 1,619; photolithographic plates, 774; photographic prints, 5,032; vandyke prints, 3,763; vandyke printing, 7,646 square feet; blue-printing, 207,525 square feet; photostat work 10,867 sheets. As usual, much of this work was done for other branches and for other departments.

Lithography

The endeavour to continue operating all printing equipment at sustained high pressure for another year resulted in several mechanical and power unit breakdowns. This office is indebted to the King's Printer for his co-operation in affording the services of his chief mechanic and staff when repairs were urgently required. Including many minor jobs, the transferring press was overhauled and reconstructed and a spare set of damping rollers was machined and fitted from old salvage stock. Throughout the war, the Department of Public Works was unable to give the services requested due to lack of materials and skilled labour. This condition no longer exists, and recently several long standing requisitions for necessary work have at last been efficiently taken care of. The hope that printing supplies would be back to normal this year was not fulfilled. Ink manufacturers still report difficulty in procuring certain pigments and warn that costs of all materials are climbing rapidly. Florida sponges were unobtainable owing

to disease in the sponge beds and an inferior Mediterranean type had to be accepted. Owing to certain farsighted action taken during the war years, the stock of zinc printing plates was adequate. However, there is difficulty in obtaining rolled aluminum plates used for mounting original drawings. As referred to in last year's report, this office is still contending with unsatisfactory conditions for control of stretch and ripple, especially in the cheaper grades of paper stock. The printing facilities available are insufficient to accomplish all the work required.

The total number of maps, charts, and miscellaneous jobs printed in this office during the fiscal year was 368, the number of copies printed being 441,035. These figures are about 22 per cent and 29 per cent higher respectively, than the corresponding figures for last year, and, although lower than those at the peak of production during the war years, are nearly 68 per cent higher than the average production figures for pre-war years.

Details of the printing done in 1946-47 are as follows:

	Maps published	Total Copies
New maps printed	37	10,230
Maps reproduced	2	500
Maps revised	62	105,035
Maps reprinted	150	229,165
Hydrographic charts	94	83,755
Miscellaneous	23	12,350
Total	368	441,035

In addition, 203 plates showing aeronautical data were overprinted in magenta colour on 97,690 copies of air edition bases, and 18 plates showing other information were overprinted on 25,405 copies of other maps. The total number of impressions required to produce the maps printed during the year was 1,643,335, an increase of more than 40 per cent over last year's figure.

An analysis of the year's work shows that of the 1-, 2-, 4-, and 8-mile maps of the National Topographic Series 51 were revised and 99 were reprinted; of these the great majority were aeronautical charts. Twenty-six other maps and 52 township or settlement plans were printed, of which about half were new; they include the Athabaska River sheet, the first of the World Aeronautical Chart series to be issued by this Service.

Board of Examiners for Dominion Land Surveyors

The Board of Examiners for Dominion Land Surveyors held one meeting during the year. This was the regular annual meeting called for by Section 9 of the Dominion Lands Surveys Act. It began on February 10, 1947, and lasted until March 31, 1947. During this meeting, examinations were held at Ottawa, Winnipeg, Saskatoon, and Edmonton. Fifty-seven candidates presented themselves at the examinations. Of these, 55 tried the preliminary examination, one tried the final examination, and one tried the examination for certificate of Dominion Topographical Surveyor.

Four candidates were successful in the preliminary examination and one in the final examination.

One commission was issued to a candidate 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 Lands Surveys Act.

Five 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

Conditions among Canadian Indians during the past year have been determined to a large extent by the diversity of employment opportunities and by the environment in which the numerous scattered groups found themselves. Indians engaged in agricultural, stock raising, and lumbering pursuits generally enjoyed satisfactory returns. There were some favourable reports from Indian commercial fishermen though in a few areas the runs of fish were lighter than for the previous year. Indians who trapped on fur conservation areas realized good returns, but those who carried on operations in unorganized trapping regions reported a serious scarcity of furs which, combined with greatly reduced market prices, resulted in a disappointing season. Indians living near large urban industrial centres were employed to the same extent as during war years.

A major step forward in improving the efficiency of Indian Affairs administration in the field was the production of an Indian Agent's manual covering all aspects of the responsibilities of a Canadian Indian agent. This is the first time in the long history of administration of Indian affairs in Canada that such a manual has been available for reference by the field staff.

A reorganization of field staff, designed to meet the increased responsibilities and obligations of Indian agents and their assistants, was commenced during the year under review.

Another important advancement during the year was the recognition of Indian school teachers as permanent civil servants for purposes of salaries, superannuation, and other benefits.

Housing programs, medical services, and general welfare training projects were commenced wherever materials and facilities could be secured. Reports continue to come in regarding the benefits resulting, particularly to Indian children, from the introduction of Family Allowances.

Generally, the economic, social, and cultural progress of Canadian Indians kept pace with that of others living in similar environments throughout the country.

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	12,441
British Columbia	25,515
Manitoba	15,933
New Brunswick	2,047
Northwest Territories	3,816
Nova Scotia	2,364
Ontario	32,421
Prince Edward Island	266
Quebec	15,194
Saskatchewan	14,158
Yukon	1,531
Total Indian population	125,686

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 231.

Progress During the Year

THE YUKON AND NORTHWEST TERRITORIES

Yukon.—An adverse event of considerable economic consequence attracted world-wide notoriety during the first quarter of 1947. A cold wave, beginning around the middle of January, blanketed the entire Yukon for almost four weeks, and at Snag the all-time North American minimum was shattered when a temperature of 84 degrees below zero was officially recorded. Game suffered considerably, a heavy toll being taken on rabbits and muskrats, while most predators holed up during the extreme weather. Reports reached the agency of entire dog teams succumbing to the unprecedented cold, leaving Indians without any means whatever of transportation. Trappers were unable to leave their cabins, while elderly indigent Indians were reduced to the lowest depths of sustenance.

Fort Simpson.—Fishing at Great Slave Lake was again successful this year, allowing the Indians to sell some commercially and keep adequate stocks for their own use. Meat was again very plentiful but fur-bearing animals of all kinds were scarce. Interest in gardening was kept up with the result that many Indians produced vegetables to last their families almost through the winter.

Fort Resolution.—The medical officer at this agency made numerous visits by plane throughout the region to Indians requiring emergency services. Constant clinic, hospital, and private home services were rendered Indians in accordance with a full and active schedule, organized to serve the Indians of this region.

Fort Norman.—Fishing at Aklavik and Great Bear Lake was reasonably successful, but disappointing at Fort Good Hope and Arctic Red River. The establishment of a day school at Fort McPherson has been welcomed and is operating at capacity. The campaign to X-ray Indians throughout the region has progressed well—approximately half the population of the Mackenzie Delta have been served, with interesting results to be reported upon more fully at a later date.

BRITISH COLUMBIA

The Indians of British Columbia have, on the whole, continued to improve their lot. Opportunities for employment at high wages prevailed throughout the Province. The returns from trapping and fishing were lower than for the previous year, owing to a decrease in fur prices and to light runs of fish, particularly in the northern districts. As in 1945, the spring was late and seeding was not completed in some areas until the end of May.

There was the usual seasonal movement of workers from the lower Fraser Valley, lower mainland coast, and the southern part of Vancouver Island to the berry fields of the United States.

Health.—The year under review was marked by a substantial extension of Indian Health Services. Hospitals were opened at Miller Bay in the Prince Rupert area and at Nanaimo on Vancouver Island, and three full-time nurses were added to the field staff. These nurses were stationed at New Westminster, Kamloops, and Lillooet. The opening of the Nanaimo Indian Hospital has relieved the Coqualeetza Indian Hospital of caring for a large number of Vancouver Island patients, and opened the way for the admission of an additional number of interior Indians at the Sardis institution. There are now three well-

equipped all-Indian hospitals in British Columbia, with a total patient capacity of 530. Although the emphasis is placed on the treatment of tuberculosis at these institutions, a limited number of general cases are accepted for hospitalization.

Education.—There is no phase of Indian affairs in which a healthier growth can be noticed than in education. This is indicated by the number of applications for assistance to enter high school, and the number of pupils taking the high school course without expense to the Department. Up until comparatively recent years, some influences were at work to prejudice Indians against having their children educated, but these appear to have been entirely overcome. The following day schools were open during the period April 1, 1946 to March 31, 1947: one-room schools, 5; two-room schools, 11; three-room schools, 1; total, 47.

At the Alert Bay Indian Residential School, Grades 1 to 4 attend for the whole day, as does Grade 8. Lack of classroom accommodation prevents the operation of all grades on a full-day basis. At Kamloops, the whole school operates on the half-time system; with four classrooms for an enrolment of 305 pupils.

Agriculture.—Apart from the increase in acreage under cultivation, which is placed at 3,277 acres, there were no outstanding developments reported during the year. High wages in the United States continued to divert Indians from a greater use of their agricultural resources.

Increasing interest in dairying is being taken by Indians of the Lower Fraser Valley; herds are being improved and increased, and dairy barns and equipment brought into line with the requirements of the Provincial Dairy Inspection Branch.

A considerable amount of new fencing and improvements to farm buildings was carried out on various reserves, mostly in the interior, during the year, as materials for such purposes were more readily available than in 1945-46.

Fishing.—The returns from the salmon fishing in some of the fishing districts compared favourably with those of the previous year, and in others the catch showed a marked decline.

It is estimated that approximately 50 per cent of the total salmon pack in this Province is caught by Indians.

Trapping.—Fur prices fell off considerably, but, notwithstanding this, the Indian trappers reported a fair return. As the industry is stabilized by sound conservation measures, better results may be expected to accrue to Indian trappers.

Trap-lines of white trappers have been purchased when opportunity offered and where it was in the best interests of the Indians.

Handicrafts.—The continued high demand for labour has resulted in further shortening the supply of handicraft articles, nevertheless, a considerable quantity, of such goods is being turned out for sale, particularly Cowichan sweaters and leather goods, for which there is a considerable demand at prices higher than during pre-war years.

Housing.—In spite of the shortage of building materials, assistance was extended, by way of new construction or repairs, to 354 Indian families.

Enfranchisement.—At the last Session of the Legislative Assembly of the Province the right to vote at provincial elections was extended to Indians of the Province residing outside Indian reserves.

Family Allowances.—This source of income is proving very beneficial to the Indian children of this Province and has brought about a great improvement in their general welfare.

ALBERTA

Health.—The health of the Indians in this Province was above normal and there were no serious epidemics. Preventive measures were taken where there were epidemics and where contagion was evident. The inoculation and vaccination of pupils in schools, homes, and at centres where Treaty and Annuity payments were being made are appreciated by the Indians more and more each year. There is now little opposition to these preventive measures.

Agriculture.—Harvesting was retarded by rain and, in the south, October snows stopped all harvesting; many parts experienced the worst winter in many years. In spite of these adverse conditions, a good average crop was harvested and, with good prices, the returns were encouraging.

Because of the severe winter, it was necessary in some instances to buy extra feed at a cost of over $4,000, and in order to avoid what probably would have been a complete loss at the Blood Reserve, an emergent sale was made to dispose of some 900 head yielding about $50,000. Altogether, 3,634 head of cattle were sold during the year and brought $379,524.46, an average of $104 per head. So long as prices remain at this figure, the cattle industry will continue to bring the most lucrative returns of all activities on the reserves.

The sale was recorded of 2,800 range horses for $29,000. The Sarcee Indians made a determined effort to round up slicks on their reserve and were moderately successful.

Fur and Game.—The fur industry experienced a year of declining prices. This industry brought returns estimated at about $107,000, confined mostly to the northern agencies and the Stony Agency, though the Bloods and Peigans earned considerable amounts from the sale of beaver and muskrat pelts.

Fishing is carried on mostly for the Indians own use and is not commercialized except in the Edmonton Agency, where sale of whitefish brought $2,800.

Lumbering.—It is estimated that about $11,600 worth of logs were milled and used for building houses on the reserves; about $5,500 worth were sold. Sales of rails, pickets, Christmas trees, and nursery stock continued to be one of the most lucrative part-time industries. Over $56,000 is estimated as the return from this source. Hobbema Indians continued to turn out large quantities of good willow pickets which found a ready sale to farmers through lumber yards.

Mining.—Coal mining is confined to the Blackfoot and Stony Reserves. The Blackfoot mine did not produce much coal during the year, as an effort was made to develop a new entry and this proved unsatisfactory. The coal mines on the Stony Reserve are under lease, and the output is limited.

Handicraft.—The Stony and Hobbema Indians netted an estimated $9,800 from the sale of bead work and other handicraft items. Some very fine work was on display at both the Calgary and Edmonton Exhibitions. As an industry, handicraft has been declining but the Indians still retain this craft for their own pleasure and use.

Employment and Earnings.—Only a rough estimate of income made by Indians in employment off the reserves can be made. There are plenty of opportunities for Indians in this field. It is felt that upwards of $200,000 was earned in this endeavour last year. Many Bloods and Peigans go to the United States for the autumn and winter months. Most of the young Indian men in the southern part of the Province are cow-boys, and spend much time following rodeos and fairs.

Education.—Practically all schools are filled to capacity. The one-day school in the Province, at Sarcee, was well-attended. Two provincial schools in British Columbia were also well attended by Indians from the Fort St. John

Agency. The pupils from these schools are progressing satisfactorily. A number of pupils from the various reserves were receiving higher education at high schools, colleges, and industrial institutes.

SASKATCHEWAN

Cattle.—The total cattle owned by Indians at the end of the fiscal year was 7,396 head. During the year, 1,493 head were disposed of by the Indians, and the total amount realized was $147,610.04.

Farming.—Farming acreages and production were as follows: 17,255 acres of wheat produced 241,107 bushels; 13,402 acres of oats produced 251,085 bushels; 3,361 acres of barley produced 48,379 bushels; 292 acres of flax and rye produced 1,422 bushels; 531 acres of garden produced 21,804 bushels of vegetables.

In addition, 11,421 acres were summer fallowed, and the Indians broke 5,925 acres. White people broke an additional 5,462 acres on Indian reserves. Of this amount, 1,640 acres were broken in Duck Lake Agency under a lease agreement to obtain revenue for the John Smith's Band. White people broke 3,822 acres on the Cote and Keeseekouse Reserves of the Pelly Agency on lease agreements for purposes of assisting new home owners on location tickets.

Total acreage under cultivation on all Indian reserves of the inspectorate is now 60,186 acres. Wheat averaged 14 bushels to the acre, oats 19 bushels, and barley 14 bushels.

The yield of garden produce was very disappointing, and many reserves had very few garden vegetables because of frosts throughout the summer.

Buildings.—A new residence was erected for the use of the farming instructor at the Meadow Lake Reserve of the Battleford Agency, and a new barn was erected for the use of the farming instructor at the Big River Reserve of the Carlton Agency.

New wells were sunk as follows: Battleford Agency, 8; Carlton Agency, 11; Duck Lake Agency, 3; Onion Lake Agency, 1; Touchwood Agency, 4.

Dug-outs for water purposes were constructed as follows: Battleford Agency, 5; File Hills Agency, 4; Touchwood Agency, 8.

New Indian homes were erected as follows: Battleford Agency, 8; Carlton Agency, 1; Duck Lake Agency, 2; File Hills Agency, 3; Onion Lake Agency, 7; Qu'Appelle Agency, 8; Touchwood Agency, 3. In addition to this, some repairing of Indian homes was done at each agency.

A new telephone line was built at the File Hills Agency.

Only a fraction of the amount authorized for new Indian homes and repairs to homes was used because of the difficulty of obtaining building material or the services of carpenters. On the Nut Lake Reserve of the Touchwood Agency timber was taken out by Indians to be sawn into lumber and about 300,000 feet of lumber resulted from this operation. This lumber is now being finished and will be available for building purposes for the fiscal year 1947-48.

The majority of Veterans' Land Act grants have now been approved and building material, wells, fencing, horses, farm machinery, and furniture are being purchased as fast as available. Many of the veterans have seeded crops this year and are breaking new land.

The twelve active Homemakers' Clubs are proving very satisfactory and beneficial on the reserves.

Education.—The Indian residential school at Lac la Ronge burned in February, 1947, thereby reducing the pupilage capacity of the inspectorate. All other residential schools were filled to capacity, and little was accomplished during the year in the erection of new day schools because of the scarcity of material.

MANITOBA

Agriculture.—The cultivated land was increased by 1,300 acres of new breaking. Most of this land was covered with scrub and trees and much labour was required in clearing the land and making it ready for breaking. The summerfallows were larger than usual and totalled 3,500 acres. The total grain crop harvested amounted to approximately 250,000 bushels.

The keen demand for beef makes it difficult to show much increase in the cattle, which now number 3,050 head. Hay was not plentiful, and in some districts it was necessary to obtain hay permits on Provincial Government land. A few Indians are interested in sheep, and there are now over 250 head. Poultry is kept by all the better farmers. A few Indians raise hogs, but most of these are butchered for their own use.

Fishing.—The Indians engaged in fishing had fair returns. Some fished with their own equipment and others worked for wages which ranged from $90 to $140 a month, plus maintenance.

Trapping.—Indian trappers found their income reduced. In some districts fur was scarce and in addition there was a sharp decline in price. Wild meat was scarce in certain areas, which created considerable hardship. The Indians who trapped on the fur conservation areas did well.

Housing.—A start was made on a five-year housing program, but, unfortunately, materials were scarce. However, in spite of this, many old buildings were repaired and enlarged and on most reserves one or two new houses have been built. In the Norway House Agency, 25 new log-houses were built on the Island Lake Reserve, and throughout the agency assistance was granted to repair and enlarge many of the older houses. In addition to these houses, six homes for old people were built on the Norway House Reserve and 8 on the Cross Lake Reserve.

The sawmill, operated at Norway House, sawed approximately 3,000 logs into lumber, and in addition, made 800 bundles of shingles. During the year, on the Norway House Reserve, the Indians manufactured 4,500 fish boxes. These were sold at a price of $100 a box. Another sawmill at Island Lake produced 22,500 feet board measure of rough lumber. A third sawmill, operated on the Fort Alexander Reserve, Clandeboye Agency, produced 30,000 feet of lumber. The Indians on this reserve had an unusually successful year in securing contracts for cordwood and pulpwood. Prices were excellent, resulting in favourable financial returns.

The women's clubs are doing excellent work. At present, some twenty clubs exist, although nearly all are inactive during the summer months. Reports received from five clubs show that some 800 garments were remade during the year from discarded army and police clothing.

Education.—All schools are filled to capacity, and additional accommodation will be supplied as materials become available. Six new schools were opened in the Norway House Agency. In the Portage Agency, a new day school was opened at Dauphin River on a share basis between the Provincial Government and the Department. This was operated under a board of three Indians and one half-breed with excellent results. School attendance greatly increased during the year. This was largely due to the regulations in connection with Family Allowances. Family Allowances have been most helpful to the Indian children, and they are better fed and clothed.

A number of returned men applied for grants under the Veterans' Land Act, and 29 were authorized during the year. These men have made a good start, and there is every reason to believe that their farming operations will be successful.

ONTARIO

The Indians in Ontario enjoyed excellent employment opportunities throughout the year and this condition was reflected most favourably in improved general health and a higher standard of living. There was also a marked advancement in home improvement. Indians found employment as skilled hands or general labourers in industry, contract workers cutting and peeling pulpwood in the bush, and seasonal workers in lumber camps. Others were employed in seasonal or full-time work on farms. Many central and northern Ontario Indians were employed as guides catering to the ever-expanding tourist trade. Their popularity with tourists is quite marked, and they seem particularly well suited to the duties involved. There was a marked increase in the number of Indians being given seasonal employment at attractive wages on tobacco-growing farms in southern Ontario.

Agricultural operations on Indian reserves throughout the central and southern part of the Province again showed an increase in the acreage planted and the number of live stock raised. Hog production, increased during the war years, was maintained, with many of the younger farmers showing a keen interest in the application of scientific methods in their care and feeding. A substantial increase in canning factory contracts was noted for such crops as corn, peas, tomatoes, beans, and pumpkins. A favourable growing season was experienced, and average yields for canning factory, grain, hay, and fodder crops were harvested in good condition.

The reforestation of submarginal lands on Indian reserves was generally increased, and was introduced on a number of reserves not previously interested. Approximately 120,000 conifers were planted, of which 75,000 were planted on Christian Island Reserve as part of a yearly plan to reforest entirely a large submarginal area. Considerable progress was made in increasing the numbers of home gardens for Indian families on the various reserves throughout the Province.

In view of the satisfactory economic situation, a marked increase in repairs and improvements made to individual homes was noticeable. Many additions were erected and extensive repairs completed, with a number of families installing electric lights.

Most of the 12,000 Indians engaged in trapping throughout the northern part of the Province experienced a satisfactory year, with revenues comparable to those of recent years. An exception to this was experienced at Attawapiscat, where, owing to an absence of fur-bearers, Indian trappers and their families were placed on relief. The 7,000 square-mile development known as the Kesagami Beaver and Fur Preserve, inaugurated in 1941, has progressed to a stage where the area was partially trapped during the year. Some 770 beaver pelts were sold, bringing a revenue in excess of $18,000 to the Indian trappers. The restocking of depleted trapping areas with live beaver was continued, with 60 beaver live-trapped in Algonquin Park being transferred to Albany Preserve and other areas.

The Indians engaged in commercial fishing in the Georgian Bay and other waters had a fairly prosperous year. The average market prices obtained, while somewhat less than that of the previous year, were offset by satisfactory catches.

QUEBEC

The Indians living in the south portion of the Province of Quebec were steadily employed at high wages. This was particularly true of the Caughnawaga Indians, who are noted steel-workers. In the thickly populated section of the Province, Indians who are qualified plasterers, brick-layers, carpenters, and

steamfitters were regularly employed at good wages, which was reflected in improvement in their general health and in their homes. These Indians live in well-furnished houses that equal those of their white neighbours. Many of the Indians in the Province are gainfully employed in lumbering and pulpwood operations. The Indians engaged in handicraft work were able to sell their wares, which are in great demand, at high prices. The Indians residing in the northern part of the Province, who are engaged in trapping and hunting, had poor catches during the year. The price of fur was low, and, therefore, their annual incomes were considerably reduced. With the exception of the Bersimis and Pointe Bleue Agencies, where many Indians are employed in the pulpwood and lumbering industries and in farming, there has been a serious falling-off in the amount of money earned by the Indians of the north, which will reflect in higher relief costs from welfare appropriation. Little fishing is done other than that for the Indians' own use. The Indians at Bersimis, who operated a commercial fishing licence, had a poor catch and, as a result, their earnings were very small.

Agriculture.—On most reserves where conditions are favourable, Indians raise their own vegetables. Indians engaged in farming at Pointe Bleue, Oka, Caughnawaga, St. Regis, and Restigouche had better than average crops and were able to earn substantial incomes because of the prevailing high prices. Many Indians were employed as guides, canoemen, and game wardens. On the whole the Indians in the southern part of the Province have had a good year. In the northern part, however, general conditions were not good.

Dwellings.—The Indians in the older settled areas, who were regularly employed, are living in well constructed houses of stone, brick, and frame. Most of these houses are tastefully furnished. These Indians, because of their high earnings, are making substantial improvements to their homes. In the more remote areas, the trapping and hunting Indians live in tents practically all year. In keeping with the Department's policy of assisting Indians to improve their houses, 400,000 feet of logs were cut, i.e. 100,000 at Doncaster Reserve and 300,000 at the Restigouche Reserve. A sawmill was established on the Restigouche Reserve and the Indians there will manufacture their own lumber from the logs cut.

Homemakers' Convention.—The annual convention of Indian women's Homemakers' Clubs in Eastern Canada was held at St. Regis Indian Reserve. Approximately forty delegates attended. Many topics were discussed, such as Family Allowances, medical services, welfare, sanitation, and home improvements. On returning to their home reserves these women did excellent work in organizing worthwhile projects by assisting and advising their Indian neighbours to work together in an effort to raise their standard of living. Moving pictures were taken of the work done at the convention so that educational films could be sent to other places in Canada to foster and promote the Homemakers' movement.

Medical Services.—In the last few years, the Indians of the Abitibi region have been fortunate in being the first large body of people in Canada to receive inoculations against tuberculosis with B.C.G. vaccine. Last year a team of doctors and nurses examined, tested, and inoculated Indians at the Mistassini, Obedjiwan, Manowan, Weymontaching and Waswanipi Reserves. There was 100 per cent co-operation and the visit was a real success. It is planned to duplicate this service in all the reserves in the Province.

Although a period of five years is needed to assess the results, it is already noted in the reserves where vaccination has taken place that tuberculosis is on the decline.

In hospitals at La Tuque and Roberval the vaccination of all new-born babies has become a regular practice.

NEW BRUNSWICK

Many Indians in the Province of New Brunswick are employed in the lumber camps in cutting pulpwood, pit props, and timber. A number are engaged each spring on the river drives. The harvesting of the potato crop in the State of Maine provides seasonal employment for a great number of Indian families each year. Many Indians earn a fairly good income from making axe and pick handles, and others are engaged in the making of potato baskets as well as fancy baskets. They excel in this work, and as a result obtain top prices

Agriculture.—The St. John River Valley Indians, with the exception of the Kingsclear group who put in small vegetable gardens, do not engage in farming of any kind, and do not raise live stock. A few Indians on reserves on the east side of the Province farm in a small way, raise vegetables, and grow some grain. They cut enough hay for some thirty horses and cattle. A farm was purchased last year adjoining the Kingsclear Reserve to encourage Indians in the raising of live stock and also to make it possible for Indian soldiers to qualify for the Veterans' Land Act grant. A herd of goats was moved from the Golden Lake farm in Ontario to the Kingsclear Reserve, for distribution to needy Indians in the Province.

Dwellings.—The Indian houses in the St. John River Valley, with the exception of a number on the Woodstock and Oromocto Reserves, are better than average. During the year, the more progressive Indians made worthwhile improvements to their houses. Some of them are neatly furnished. Fourteen new houses were built during the year under Veterans' Land Act grants to Indian soldiers. These are very good units, with cement foundations and brick chimneys. One hundred and fifty thousand feet of timber, mostly cedar, was cut on the Kingsclear Reserve during the year and a shingle mill established. This project is being carried on in conjunction with the building program for Indians undertaken by the Department.

NOVA SCOTIA

The Indians of Nova Scotia, owing to employment conditions in the Province, were unable to obtain steady employment. However, a number were employed for short periods cutting pulp and loading boats with pulpwood, pit props, and lumber. Those engaged in handicraft, in making axe, peavey and pick handles, and potato and fancy baskets, earned a considerable amount of money. There is a good market for these products at high prices.

Agriculture.—Apart from growing vegetables for their own use, the Indians do little farming. Most of their efforts consist in growing feed for their live stock. Goat herds were established at the two large reserves, Eskasoni and Shubenacadie. The goats were sent from the Golden Lake farm in Ontario. The Eskasoni Indians have approximately 40 head of cattle, which together with the goats, provide a generous supply of milk for the whole reserve. There is only one cow at the Shubenacadie Reserve and these Indians as yet have shown no interest in the raising of goats. Twenty-four hundred day-old chicks were distributed as part of a welfare program. The Indians gave them excellent care, which resulted in a good supply of eggs and meat being provided. Three hundred apple trees were set out.

Dwellings.—On the Eskasoni Reserve, twenty-five new houses were constructed, and twenty houses were built at the Shubenacadie Reserve in conjunction with the centralization program. To date, 90 houses have been constructed at Eskasoni and 80 at Shubenacadie. The Indians of Nova Scotia are co-operating with the centralization scheme to such an extent that at both places requests for houses exceed the number that can be built each year. One million feet of logs (500,000 on each reserve) were cut last year, all of which will be

manufactured into lumber by Indian labour at their own sawmills. This work has provided employment at a time when it was just about impossible for Indians to obtain work at outside places.

Agency Buildings.—At the Eskasoni Agency, a large six-room school was completed. Other buildings completed during the year were: a nursing station, an Agent's office, a store, houses for the storekeeper, clerk, and principal, and a teachers' residence. These buildings are provided with an adequate up-to-date water system as well as electricity. They are complete in every detail, and comparable to any buildings of a similar size constructed in Canada. At the Shubenacadie Reserve work was started on the construction of houses for the Agent, and the principal, a teachers' residence, an Agent's office, and a warehouse. The construction of a water supply system for these buildings was also commenced during the year.

PRINCE EDWARD ISLAND

The small number of the Prince Edward Island Indians, located at Lennox Island, farm in a limited way. The majority of them grow their own vegetables, including potatoes, turnips, beets, carrots, and cabbages. They have about thirty-five milch cows. Chickens and pigs were distributed as part of a welfare program. The Indians scattered over Prince Edward Island are engaged in the making of axe and pick handles, as well as potato and fancy baskets. There is very little steady work, but seasonal employment is available harvesting potato and other crops. A number of Indians are experienced and fully-equipped fishermen, and earn considerable money fishing lobsters and oysters.

Dwellings.—In connection with the centralization of the Prince Edward Island Indians at the Lennox Island Reserve, a quantity of lumber sufficient to construct ten houses was manufactured by the Indians at the Shubenacadie Reserve in Nova Scotia. Under the supervision of a foreman, the Indians did all the carpentry work, and nine houses, complete with cement foundations and brick chimneys, were built last year. The cost of this work was paid from welfare appropriation, and has provided employment at a time when Indians could not obtain work outside the reserve.

WELFARE AND TRAINING SERVICE

WELFARE

The standard of living of Indians engaged in agriculture, ranching, commercial fishing, timber operations, and industrial pursuits remained for the most part at the high level enjoyed throughout the war years. Living conditions among Indians residing in some northern areas, however, reverted to pre-war levels owing to a scarcity of fur and a decline in fur prices. A cyclic scarcity of game food and a tightening of the game conservation regulations in the Northwest Territories also affected the natives' food supply. However, Departmental representatives in the control area have been authorized to issue such relief as may be necessary to alleviate distress.

The housing program on Indian reserves throughout Canada is being carried forward as quickly as staff, funds, and availability of materials will permit. Portable sawmills have been set up on a number of reserves where timber resources warrant.

The unusually severe winter of 1946-47 and feed shortages resulted in a slight decrease in Indian-owned live stock, but basic breeding herds were maintained and production in this field was not seriously curtailed. Cattle sales at the Blood Indian Reserve in Alberta exceeded $100,000.

Farming operations and crop returns for the most part showed an encouraging increase over the previous year, as indicted by the following table:

—		1945-46	1946-47
New breaking	Acres	3,906	8,008
Summer fallow	Acres	33,600	32,287
Wild hay	Tons	47,345	54,331
Wheat	Acres	27,510	37,605
Wheat	Bushels	388,245	552,730
Oats	Acres	26,805	26,401
Oats	Bushels	533,634	593,016
Barley	Acres	7,971	7,366
Barley	Bushels	148,339	143,814
Corn, flax, rye, etc.	Acres	1,235	2,193
Corn, flax, rye, etc.	Bushels	14,461	23,799
Roots, potatoes, and gardens	Acres	1,272	1,085
Roots, potatoes, and gardens	Bushels	58,736	53,755
Green feed and tame hay	Acres	7,043	8,393
Green feed and tame hay	Tons	7,537	7,346
Total acres under cultivation	.....	108,375	123,514

The Griswold Agency in the Province of Manitoba, with a total of 2,814 acres under cultivation—of which 757 was summer fallow—showed the following returns: wild hay, 240 tons; wheat, 16,301 bushels; oats, 20,425 bushels; barley, 10,200 bushels; corn, flax, and rye, 1,525 bushels; roots, potatoes, and gardens, 1,650 bushels; green feed and tame hay, 39 tons. Two community farms in this agency, one on the Oak Lake Reserve and one on the Oak River Reserve, contributed substantially to the returns recorded.

The Indian Affairs Branch continues to encourage the Indian Homemakers' Clubs in an effort to promote a better standard of living and to provide guidance in the attainment of finer family life. The members receive instruction in sewing, cooking, and good housekeeping practices. A Homemakers' convention was held on the St. Regis Reserve, to which delegates from all organized clubs in Eastern Canada were invited. The senior officials of the Branch attended and addressed the convention on the various subjects under their supervision.

Higher commodity prices have resulted in a substantial increase in relief costs. Increased earnings have not kept pace with living costs, and, furthermore, the majority of those receiving relief assistance are not in the employable class.

Welfare Expenditure by Provinces 1946-47 and 1945-46

Province	1946-47	1945-46	Province	1946-47	1945-46
	$ cts.	$ cts.		$ cts.	$ cts.
Nova Scotia	194,539 86	125,938 72	British Columbia	132,253 52	98,340 23
Prince Edward Island	14,306 17	11,143 10	Northwest Territories	22,047 79	17,579 18
New Brunswick	56,109 09	30,262 71	Yukon	10,668 31	10,790 68
Quebec	175,716 27	130,926 53	Headquarters Salaries	29,050 82	19,622 99
Ontario	197,667 92	124,658 09	Triennial Clothing	3,985 83	224 66
Manitoba	153,602 31	140,635 00	Miscellaneous	11,852 02	8,704 11
Saskatchewan	121,710 82	87,815 55	Handicraft	1,944 92	1,133 81
Alberta	105,412 40	69,832 39		1,230,868 05	877,607 75

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
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
1946-47	9,304	8,192	10,181	7,344	19,622	15,641	79·71

The distribution of vitamin biscuits was continued to Indian day schools in northern Ontario, Manitoba, Saskatchewan, Alberta, and the Northwest Territories. Twenty-five tons of these biscuits were distributed during the academic year.

The four-room day school at Eskasoni, Nova Scotia, is near completion, and a four-room day school at Muncey, Ontario, is under construction. A two-room school at Sarnia will be ready for use by September, and a one-room day school was completed at Little Grand Rapids, Manitoba. A growing school population necessitated the use of improvised classroom accommodation in many places. At Brantford, former Army camp buildings were moved and modified for use as schools.

The Lac la Ronge Residential School was destroyed by fire.

A teachers' magazine, the Indian School Bulletin, is now being sent to teachers every two months. Problems of school administration and teaching techniques are dealt with, and many principals and teachers have written in appreciation of the benefits received from this publication.

A salary schedule for day and hospital school teachers was approved by the Treasury Board and will become effective on September 1, 1947.

High school classes are now in operation in several day and residential schools. In addition to the pupils shown above as attending Grades IX and X, the Branch is also providing tuition grants for Indian children attending universities, normal schools, technical schools, and other institutions of advanced learning.

Handicraft and Home Industries

Canadian Indians are noted for their skill in many types of employment, and not the least of these skills is the ability to create useful and beautiful articles from whatever materials are at hand. For instance, in some districts many styles of basketry are made from black ash splints, woven with sweet grass. These baskets range from bushel baskets used for picking potatoes and fruits, to finely made work baskets, thimble holders, and needle books. In wooden work, articles produced and marketed range from axe handles, pick handles, paddles, oars, and rustic furniture to tiny souvenir axes, paddles, canoes, and tomahawks. Drinking cups are carved from the knots of trees, and each is fitted with a thong loop to hang from the belt; food bowls are carved from larger knots, and fitted with legs to make them stand evenly;

from heavy birch bark, storage boxes and carrying baskets are made, sewn with strong roots; and in still other areas, thinner birch bark forms the foundation of various useful articles, which are decorated in fine designs with porcupine quills. Many western Indians are noted for the colourful costumes, saddle trappings, bags, gauntlets, head bands, and moccasins which in these days are seen only on special occasions. The workmanship and design are amazing —fine needlework, using tiny seed beads of many colours, or embroidering the design with fine silkwork. The preparing of the skins used for this work is an art in itself.

Various tribes in British Columbia are noted for the exceptionally high standard of craft work produced: the miniature baskets and boxes made from fine roots and seaweed, with woven designs depicting actual occurrences; the large containers made from heavier roots and embrocaded in geometric designs using cedar and cherry bark; the hand-carved totems of wood and slate; the hand-wrought silver bracelets; the Cowichan sweaters with designs so unusual they are being copied all over the world; the handwoven Chilcot rugs and blankets—these and many other fine hand arts are part of the heritage of Canadian Indians.

GRANTS PAID TO AGRICULTURAL EXHIBITIONS AND INDIAN FAIRS

	1946-47
Ontario	
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
Manitoba	
Manitoba Provincial Exhibition	250.00
Rossburn Agricultural Society	25.00
Saskatchewan	
Prince Albert Agricultural Society	400.00
Regina Agricultural and Industrial Exhibition Association, Ltd.	400.00
Alberta	
Calgary Exhibition	500.00
Edmonton Exhibition Association, Ltd	400.00
British Columbia	
North and South Saanich Agricultural Society, Cowichan	50.00
Windermere and District Fall Fair, Kootenay	175.00
Chilliwack Fair, New Westminster	150.00
Armstrong Fall Fair, Okanagan	250.00
Bulkley Valley Agricultural and Industrial Association	100.00
General	
The Canadian Handicrafts Guild	50.00
Garden Prizes, Standing Crop Competitions	905.69
Home Improvement Competitions	454.47
	$5,085.16

Very little has been attempted in the way of promoting the marketing of the finest Indian hand arts and crafts, but in many sections of the country a local market is available and the workers themselves are able to sell directly to the consumer. There are still many districts, however, where for various reasons this is not possible, and in a few such areas help has been given through the Indian Welfare and Training Service by way of securing necessary materials and assisting in marketing goods produced through industry on reserves. Difficulty is encountered in keeping the goods up to standard, and arranging for continuous delivery to merchants. For this reason, very careful supervision is

essential, particularly in the initial stages of any project. It is necessary to concentrate on training one or two reliable Indian workers to handle checking and paying for goods on the reserve concerned—under the supervision of the Indian Agent—and it has also been found necessary to have the goods shipped to a central warehouse in order to build up a stock from which to fill orders. The main production is during the winter months, and shipping is heaviest during the summer months.

The Indian goods produced and marketed under the supervision of the Welfare and Training Service form a very small percentage of the goods produced by the Indians throughout the Dominion; but that small percentage has a widespread effect in steadying the prices paid to workers and preventing exploitation by the occasional unscrupulous dealer.

Re-Establishment of Indian Veterans

The re-establishment of Indian veterans on the reserves belonging to the bands of which they are members has been given special consideration since the cessation of hostilities.

Applications for benefits under section 35A of the Veterans' Land Act continue to be made in increasing numbers from all sections of the Dominion. Three hundred and ninety grants were approved during the fiscal year 1946-47, bringing the total to four hundred and twenty-nine.

These grants are being obtained for the purpose of re-establishing Indian veterans in full-time farming, part-time agricultural operations in conjunction with other employment, commercial fishing, fur farming and trapping, and forestry operations.

Indian Agents were advised, by circular letters, of the provisions of the Veterans' Land Act and regulations thereunder. Conferences of Indian Agents were held in Toronto, Winnipeg, Regina, Calgary, and Vancouver, and visits were made to several Indian agencies and reserves. At these meetings the benefits available to veterans were discussed with Agents and Indian veterans collectively and individually. Articles have also been published in several Indian periodicals explaining the Veterans' Land Act and other re-establishment schemes for which Indian veterans are eligible, and the conditions under which they may be obtained.

The following is a summary of the amounts granted for the various purposes for which these grants may be made:

	1945-46	1946-47	Total
Grants	39	390	429
Land and buildings	$ 4,454.90	$ 69,984.03	$ 74,438.93
Building materials	18,943.88	220,606.41	239,550.29
Clearing land	1,812.04	21,910.96	23,723.00
Stock and equipment	36,673.48	338,422.50	375,095.98
Forestry equipment	—	3,690.00	3,690.00
Commercial fishing equipment	9,712.60	64,607.79	74,320.39
Fur farming equipment	—	16,286.25	16,286 25
Household equipment	4,384.30	36,272.17	40,656.47
	$ 75,981.20	$771,780.11	$847,761.31

RESERVES AND TRUSTS SERVICE

RESERVES DIVISION

Land Sales and Leases.—During the fiscal year, 141 sales of Indian lands were made. One hundred of these sales were for cash, amounting to $101,338.44, and 41 were time sales, amounting to $147,662.75, a total for the year of $249,001.19. This figure represents an increase of $183,763.31 over sales made

in the previous year, and is explained by the greatly increased demand for farm lands in Western Canada and by the fact that the Department made available for purchase surrendered lands which previously had not been readily saleable at their appraised values.

The sum of $239,875.51 was received during the year on land sale agreements, and was made up of $200,464.81 on account of principal and $39,410.70 on account of interest. In addition to this, $12,902.35 was received and held in suspense pending completion of sale agreements.

During the year, 98 land sale contracts were paid in full, no contracts were cancelled for non-fulfilment of the conditions of sale, and one reduction was made by consolidation by order of the Board of Review under the Farmers' Creditors Arrangement Act. Two consolidations were reversed by order of the Court, with the result that the total number of current time sale contracts as at March 31, 1947, stood at 280, a net decrease of 56.

One hundred and fifty-eight patents to Indian lands were issued to purchasers.

Rentals collected under leases, permits, etc., for the fiscal year amounted to $330,672.20, an increase of $107,549.74 over the previous fiscal year. This substantial increase has as its basis both the demand for agricultural land throughout Canada and the realization by many Indian bands of the opportunity to acquire revenue from reserve lands which are not for the time being required by the Indians.

Adjustments under Farmers' Creditors Arrangement Act.—Eight land sale contracts were adjusted under the Farmers' Creditors Arrangement Act, resulting in a gross reduction of $7,078.31, of which $2,704.71 was on account of principal and $4,373.60 on account of interest.

Timber.—Forty timber licences were in force at the beginning of the year. Sixteen new licences were issued, six were completed, and two were forfeited during the year, leaving 48 licences current. More than 900 timber permits were issued to Indians. Revenue from dues, interest, and ground rent under licences was $151,442.40, and from dues under permits $47,041.34, making a total credit to band funds of $198,483.74.

Forest Protection.—Seventy forest fires were reported, in connection with which $13,190.21 was spent in suppression.

Petroleum and Natural Gas.—Revenue from oil permits and leases during the fiscal year amounted to $25,041.71. Wells were drilled on the Blackfoot, Ermineskin, and Stony No. 142B Reserves, but no oil was produced.

Mining.—There was no production of minerals on Indian reserves during the fiscal year. One mining lease was recorded, covering 110 acres in Kenora Reserve No. 38B, and 40 claims were recorded in Abitibi Reserve No. 70, Township of Kehoe, Province of Ontario.

Revenue from mining rentals and sales of sand and gravel amounted to $11,057.62.

Indian Enfranchisement.—There were 169 enfranchisements under the Act carried out during the fiscal year, involving the enfranchisement of 460 Indians.

Estates.—During the year, there was a decided increase both in the number of estates referred to the Department for administration and the number in which administration was completed and the assets were distributed among the heirs.

The special emphasis placed on this phase of the work during the past year enabled the Department to complete administration of many old estates,

and it is anticipated that the majority of the old estates will be cleared up within the next year, thus enabling current estates to be dealt with more expeditiously.

Fur Conservation.—During the past year, substantial progress has been made in the rehabilitation of fur-bearers as the means of providing a better standard of livelihood for almost half the Indians of Canada, who still depend on this traditional occupation for their subsistence. This work, which is carried on in co-operation with the provincial administrations, includes muskrat development by water control methods and the restocking and management of beaver-producing areas.

In the Province of British Columbia, where almost half the traplines in the province are registered by Indians, several new traplines have been acquired by purchase from their white owners. A small experimental area on the Parsnip River, consisting of one trapline purchased in 1942, has now increased to where it will support a crop, and an initial take of 113 beaver was authorized during the year.

In the Province of Alberta, a full-time supervisor is employed in the organization of Indian traplines and in the restoration of their trapping grounds by transplanting beaver and, to a lesser extent, marten. Indian traplines registered number 868, and these are being placed on a sustained-yield basis. In addition, a detailed examination of the Athabaska Delta as a muskrat development is under way. When the report of this examination is available, it will be used as a basis for planning future development in co-operation with the province.

In the Province of Saskatchewan, an agreement was reached with the provincial administration for the development of that part of the Province which lies north of Latitude 53. The territory has been divided into 64 community blocks which are organized on the traditional family system of trapping, and as a means of accelerating the recovery of the area, 498 beaver were successfully transplanted. The Onion Lake Project in Saskatchewan which was developed by this Branch, produced 11,801 muskrats with an estimated market value of $20,000. Work was continued on the Sipanok Fur Project, which is still in a partial stage of production. The present crop from this development consists of 4,257 muskrats and 191 beaver.

In the Province of Manitoba, the organization of family and individual trap-lines under the joint agreement concluded with the province in 1945 was continued, and marked success was achieved. Several community districts have reached the stage where a crop of beaver is being taken. Transplanting of beaver to depleted districts was continued. Indian participation in the proceeds of the provincially operated muskrat rehabilitation blocks continued, and proceeds to them from this year's take amounted to $49,175.27.

In the Province of Ontario, the Kesagami Preserve, which was established in 1942, reached a stage of partial production. Beaver trapped and sold under Departmental auspices numbered 772, from which the amount accruing to the trappers was $18,598. The Albany Preserve showed marked increases in the number of beaver lodges counted, and is nearing production stage. In Ontario, 52 beaver were moved from Algonquin Park to the Albany and Kesagami Preserves and, in addition, 8 beaver were placed on Indian-registered traplines in the Cochrane district.

In the Province of Quebec, the area leased to the Department for development on behalf of the Indians was increased by approximately 17,000 square miles by an addition to the Old Factory Beaver Preserve, and increases in the

number of beaver on all managed areas were up to expectations. The Nottaway and Abitibi Preserves continued in production, and the number of beaver taken from these two areas amounted to 1,810, which netted the Indians concerned $58,190.50.

The year has been marked by increased co-operation and better understanding between the Indians and this Branch on the one side and the provincial administrations on the other. The stage has now been reached where the entire trapping areas of various provinces are being established as conservation areas, and are being developed along lines previously adopted for restricted areas.

TRUSTS DIVISION

The balance in the Indian Trust Fund as at March 31, 1947, amounted to $17,577,364.57. Of this, one band alone, the Blackfoot Band in Alberta, owns $2,788,059.26, and over 400 other bands own respective varying amounts down to, in some cases, less than $100. A great number of Indian bands in the Dominion have no band funds.

The largest single source of revenue to the Trust Fund is interest paid by the Government of Canada, which amounted to $865,563.10 during the fiscal year under review. Other sources of income were land sales, land leases, mining licences, timber royalties, oil land leases and permits, repayments on band loans, and fines. Expenditures comprised: capital and interest distribution, relief expenditures, house construction and repair, band loans, agricultural assistance, road improvements, enfranchisements, and commutations. The net increase in the amount to the credit of the Fund for the year is $480,874.89. It is not thought that the increase will continue, as commitments for considerable sums have been made for housing construction and improvement, although because of shortage of supplies the actual expenditures have not as yet reached the anticipated rate. The purchase of heavy farm machinery by bands who wish to expand farming operations on their reserves has already begun, and will entail very considerable expenditures both in initial outlays for equipment and in operating costs.

It is a source of satisfaction to the administration that the Indians generally are showing increasing co-operation in putting their unearned incomes to constructive uses such as the foregoing. This is at least partly attributable to the fact that the band councils are learning to interpret the statements of their respective band fund accounts, made available to them annually, with the result that they plan a budget of expenditures for the ensuing year based on anticipated revenue for such year. This is a gratifying and noteworthy step in the development of their ability to participate in and take some responsibility for the management of their affairs.

Annuities.—During the fiscal year, annuity moneys were distributed in accordance with the various treaties as follows:

168 Chiefs paid at	$25.00	$ 4,200.00
363 Headmen paid at	15.00	5,445.00
50,031 Indians paid at	5.00	250,155.00
161 Indians paid at	4.00	644.00
Commutations of annuity paid at	50.00	4,100.00
Enfranchised Indians paid $100 in lieu of annuity		16,700.00
Amount paid on account of arrears for previous years		3,912.00
General advance re Robinson Treaty to be added		10,700.00

Personal Savings Accounts.—The following summary indicates the activity as regards individual Indians' savings accounts, approximately 2,300 in number, during the year:

April 1, 1946. Balance	$ 383,893.88		
Government interest	19,194.69		
Deposits during year	106,380 70		
Withdrawals during year		$ 98,956.75	
March 31, 1947. Balance			$ 410,512.52

Band Loans.—During the fiscal year, applications for loans from band funds were received from 151 Indians. One hundred and eleven applications were approved for a total of $26,843, the average loan being $241.83. The main purposes for which the money loaned was used were for live stock and equipment, land, building and wells.

One hundred and eleven loans previously granted were fully retired during the fiscal year for a total of $20,886.22.

Loan funds were set up from the capital funds of three additional bands during the fiscal year, bringing to 46 the number of Indian bands in the Dominion who make this one of the uses of their band funds.

INDIAN HEALTH SERVICES

Prior to November, 1945, Indian Health Services were under the jurisdiction of the Indian Affairs Branch of the Department of Mines and Resources. Since 1945, responsibility for these services has been assumed by the Department of National Health and Welfare. The mutual interest of the Indian Affairs Branch and the Department of National Health and Welfare in the health of the Indian population has resulted in the maintenance of a very close working relationship between the two departments.

The latest national census indicates that there were some 125,000 Indians and 7,700 Eskimos in 1944. The annual increment is in the order of 1,500. For these people the Indian Health Services organize the medical care, financed largely by public funds, and by contributions from those bands that have resources.

The aim of Indian Health Services is to provide complete health service. For this purpose, hospitals, nursing stations, professional medical and nursing personnel and auxiliary services have been provided.

Not only is attention directed to the treatment aspect of general medical and surgical conditions, with emphasis on the treatment of tuberculosis and venereal disease, but a serious effort is made to promote preventive medicine by the organization of surveys which will detect diseases in their early stages while there is hope of efficient eradication, and by active immunization programs for all preventable diseases.

Owing to the fact that Indians and Eskimos are scattered throughout many outlying areas difficult of access the service has been far from perfect in some regions. This state can be materially improved only when modern aircraft facilities are integrated into health services.

Indian and Eskimo Health Services revolve about a network of departmental hospitals, nursing stations, and medical outposts. Departmental hospitals and numbers of beds in each are as follows: Miller Bay, near Prince Rupert, 150; Nanaimo, B.C., 210; Sardis, B.C. (Coqualeetza), 200; Morley, Alta. (Stoney), 13; Cardston, Alta. (Blood), 45; Brocket, Alta. (Peigan), 10; Gleichen, Alta. (Blackfoot), 40; Edmonton, Alta. (Charles Camsell), 350; Fort Qu'Appelle, Sask., 68; Hodgson, Man. (Fisher River), 30; Pine Falls, Man. (Fort Alexander), 20; Selkirk, Man. (Dynevor), 50; The Pas, Man. (Clearwater Lake), 78; Norway House, Man., 22; Squaw Bay, near Prince Arthur, 22; Manitowaning, Ont., 13; Ohsweken, Ont. (Lady Willingdon), 40; Tobique, N.S., 4.

The institutions at Selkirk and The Pas are departmental hospitals operated for Indian Health Services by the Sanatorium Board of Manitoba. The institutions at Miller Bay and Nanaimo were former military hospitals which were taken over and operated during the year 1946-47.

Departmental nursing stations are established at Eskasoni, N.S.; Fort George, Que.; Gypsumville, Man.; Sandy Bay, Man.; Broadview, Sask.; Lac la Ronge, Sask.; Hobbema, Alta.; Wabasca, Alta.; Port Simpson, B.C.

Departmental medical stations staffed by field nurses are maintained at: Vancouver, B.C.; New Westminster, B.C.; Kamloops, B.C.; Lillooet, B.C.; Duncan, B.C.; Edmonton, Alta.; Gleichen-Brocket-Morley, Alta.; Driftpile, Alta.; Fort Norman, N.W.T.; Whitehorse, Yukon Territory; Prince Albert, Sask.; Birtle, Man.; Port Arthur, Ont.; Tyendinaga, Ont.; Caradoc, Ont., James Bay, Ont. (2); Abitibi, Que. (2); Caughnawaga, Que.; Bersimis, Que.; Shubenacadie, N.S.

In addition to departmental institutions, the Services make use of every hospital adjacent to concentrations of natives, and actually a large proportion of hospitalization is provided by other than departmental hospitals, these institutions being reimbursed from funds voted for that purpose.

At the end of the year, the Indian Health Services employed full-time some 37 physicians, 92 nurses, and 27 field nurses and matrons. Vacancies still existed because of the scarcity of professional personnel and the Services are being expanded as skilled personnel become available. There were a considerable number of physicians employed on a part-time basis, but as with hospitalization, medical attention was provided by a very large number of physicians who accepted Indian patients in the same manner as their private patients, and were reimbursed through Indian Health Services.

Sanatoria.—The large departmental hospitals are principally sanatoria for the treatment of tuberculosis, although they have wards for general medical and surgical care. There were some 1,000 patients under treatment. Extensive use was made of sanatoria in every province, and about an equal number of patients were treated in sanatoria and departmental institutions.

Preventive Medicine.—Great emphasis was placed on preventive medicine and efforts were made during the year to immunize all children not already protected. In the more remote areas and among nomadic bands, this was accomplished at the time treaty moneys were paid. So far as possible every treaty party was accompanied by a physician, either a member of Indian Health Services or a doctor employed temporarily for the purpose. In addition to the usual protective inoculations against smallpox, diphtheria, whooping cough, and typhoid, the attack against tuberculosis was further extended by the use of the Bacillus-Calmette-Guerin in selected groups in Quebec and Saskatchewan. The success of immunization was reflected in the absence of any serious epidemics during the year, except a limited epidemic of measles at Brochet, Manitoba.

Within the limits imposed by the scarcity of trained personnel and special equipment, surveys for tuberculosis were conducted across the country and into the Arctic. Some 1,500 Eskimos were X-rayed on the 1946 trip of the *Nascopie.*

Venereal Disease.—This community problem has been attacked through the mutual co-operation of the Department and provincial authorities. In one instance, with marked success, a camp was established in conjunction with the provincial department for the intensive treatment of Indians and non-Indians.

Transportation.—Much of the work carried on by the Indian Health Services was in a terrain inaccessible except by aircraft. Extensive use was made of commercial planes, and in areas not serviced by commercial lines excellent co-operation has been provided by the R.C.A.F. and by the U.S.A.A.F., which frequently carried Eskimos down the east coast.

Hospitals.—The work of the Indian Health Services has been curtailed by the general scarcity of hospital beds. The number of beds controlled by the Services has been inadequate to meet the needs, and accommodation in other institutions, wherever available, was accepted. Although surveys for tuberculosis among the Indians and Eskimos were continuously in progress, these were geared to the amount of accommodation which could be found. Surveys are extended farther afield as each institution is opened, there being a perpetual waiting list.

FAMILY ALLOWANCES

Registration.—Indian families registered under the Family Allowances Act as at February 28, 1947, totalled 17,682, representing 49,301 children.

These figures include only those Indians registered through an Indian Agent on the special registration form. A number of Indians, while retaining membership rights, are living permanently away from their reserves and are presumed to have registered for the Allowances through facilities available to the white population.

It is estimated that there are approximately 3,000 eligible Indian children who do not as yet receive the benefits of Family Allowances owing to a reluctance on the part of their parents to register. Clandeboye, Six Nations, St. Regis, and Caughnawaga are the agencies principally concerned.

Method of Payment.—Payments to Indian families are being made as follows:

			Per cent
(*a*) Cheque direct to Indian.....	10,803		
(*b*) Cheque direct to Indian, but mailed c/o Agent.....	2,521		
Total		13,324	75·4
(*c*) Administered through agency trust accounts		508	2·8
(d) Allowances in kind.....		3,850	21·8

The following shows registration and method of payment by province:

Province	Families Reg.	Children Reg.	Payment			
			(a)	(b)	(c)	(d)
British Columbia.....	4,066	10,978	3,420	337	225	84
Alberta.....	1,939	5,762	902	422	18	597
Saskatchewan.....	2,285	6,578	1,278	660	54	293
Manitoba.....	2,360	6,849	1,596	741	23	.....
Ontario.....	3,775	10,657	2,392	200	94	1,089
Quebec.....	1,709	4,577	498	142	58	1,011
Prince Edward Island.....	34	103	34	.....	.....	.....
Nova Scotia.....	365	1,010	359	.....	6	.....
New Brunswick.....	372	813	323	19	30	.....
Northwest Territories and Yukon.....	777	1,974	1	.....	.....	776
	17,682	49,301	10,803	2,521	508	3,850

Administration.—There have been abuses and special cases requiring administration. Some parents have proved unreliable, wasting or misusing the money intended for their children. Then, there are orphans, abandoned children and children from broken homes, many of whom move from family to family with several different guardians in as many years. To take care of all such Indian children, and to make sure that they get full benefit from Family Allowances, payment is made to the Agency Trust Account, and the spending of the money is supervised by the Indian Agent.

Fortunately, such cases are exceptional. The Indian people, by their ready co-operation and careful use of this money, have done at least as much as any other single group of people toward making this experiment a success.

There are 508 such accounts at present. Not all of these, however, represent orphaned, abandoned, or neglected children. Occasionally, because of difficult postal arrangements, or to the mode of living of the parents, payment through Agency Trust Account has proved the most convenient method for the Indian parent. This factor applies to Indian families who hunt and trap for a living in agencies where the majority live settled lives and are paid by cheque direct. Rather than institute a complete system of bookkeeping for a few scattered families, payment is made to the Indian Agency Trust Account and is re-issued at every suitable opportunity by the Indian Agent. Bersimis and Chapleau are examples of agencies where such accounts are so handled.

Allowances in Kind.—Although entailing many administrative difficulties, the payment of Allowances in kind is proceeding along orderly lines and should obtain maximum benefits for the children of Indian trapping families in the northern part of the Dominion.

The Branch, through its insistence on the supply of only foods and clothing which will be of real benefit to the Indian children, is able to ensure that such goods are stocked regardless of the profit margin, which in some cases would militate against their supply by a trader in an isolated spot free of competition.

School Attendance.—The betterment in school attendance noted during the previous year has been maintained. By means of the monthly day school attendance reports, the attendance of each pupil at Indian day schools is closely followed. Where necessary, Section 4 (2A) of the Family Allowances Act is invoked and Family Allowances are suspended until the child concerned returns to regular attendance.

Teachers generally have reported on the improvement in the clothing of the Indian children in their care, and that the children's lunch boxes and personal appearance reflect an improvement in diet.

Children in attendance at residential schools do not qualify for payment of Family Allowances during the school term. Those who return home to the care of the parents for the holiday months are placed in pay and receive Family Allowances for the months of July and August.

General.—Provincial conferences of Indian Agents were held again this year in Winnipeg, Manitoba, August 12 and 13, 1946; Regina, Saskatchewan, August 14 and 15, 1946; Calgary, Alberta, August 16 and 17, 1946; Vancouver, British Columbia, August 21 to 23, 1946; and at Toronto, Ontario, December 19 to 21, 1946.

These conferences proved to be of great value in providing an opportunity for a discussion of problems arising from the administration of Family Allowances. They were attended in each case by the Supervisor of Family Allowances, Indian Affairs Branch, and by the Regional Director of Family Allowances for the province concerned. It was therefore possible to clarify points raised by the Agents at the time.

An opportunity was afforded of speaking directly to delegates from the Indian Homemaker's Clubs of Eastern Canada on June 20, 1946, during their annual convention held at the St. Regis Agency. The purpose of Family Allowances, along with progress to date, was outlined to this advanced group of Indian women with the request that the message be carried back to their individual reserves.

Visits were made during the course of the year to Sioux Lookout, St. Regis, Abitibi, Cowichan, New Westminster, Lytton, Nicola, Kamloops, and Restigouche Agencies. The purpose of these visits was to observe at first hand the operation of Family Allowances in the individual Indian home and to assist Indian Agents with special problems. As many homes as possible were visited and band meetings held at which the purpose and function of Family Allowances were discussed and special problems peculiar to the particular area clarified.

There has been no widespread evidence during the past year to indicate that the payment of Family Allowances has had a derogatory effect on the initiative or will to work of the individual Indian. There have been reports from Indian Agents of isolated cases in which the breadwinner has slackened his efforts to accommodate the added income from Family Allowances, but such reports have not been sufficiently numerous to have any general significance.

Indian families who must be absent for many months on the trapline find, on their return to the trading post, a large accumulation of Family Allowances to their credit. The spending of these credits has been supervised as carefully as possible in view of the unusually large amount of money involved in many cases. Experience over the past year has not revealed any evidence to suggest that such money has been improperly used or wasted. No change in the method of distribution of credits for this category is therefore contemplated at present, although the situation is being closely observed in case corrective action should prove necessary.

CONSTRUCTION AND ENGINEERING WORK

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 of these will be found in the report of that Branch. In some cases, however, materials were purchased by this Branch and buildings and other works constructed without reference to the aforementioned Branch. Among these were the following:

Prince Edward Island.—A wharf was constructed at Lennox Island in co-operation with the Department of Public Works. A telephone cable was laid to Lennox Island.

Nova Scotia.—A large garage and an addition to the warehouse on the Eskasoni Reserve to provide a community store and living quarters for the storekeeper were constructed. A residence for the Agency clerk was provided by moving and remodelling a house formerly used by the school principal.

Ontario.—The building of an implement shed on the Tyendinaga Reserve was commenced. A bridge was constructed on the Oneida Reserve, Caradoc Agency. A telephone line was completed from Manitowaning to Wikwemikong, work having been commenced in the previous year, and the bridge over the Chemitogen River, Walpole Island, was also completed. A protection wall to prevent erosion of part of the Walpole Island Reserve was built.

Manitoba.—A warehouse was built at Garden Hill, Island Lake, in the Norway House Agency, and two small buildings were constructed on the Sandy Bay and Swan Lake Reserves, Portage la Prairie Agency. Warehouses were constructed or partially built at Split Lake, Grand Rapids, Pelican Narrows, Nelson House, Pukitawagan, and Pine Bluff Reserves in The Pas Agency, and on the Roseau River Reserve in the Clandeboye Agency.

Saskatchewan.—A residence was built for the farming instructor on the Meadow Lake Reserve, Battleford Agency, and three residences in the Duck Lake Agency were insulated.

Alberta.—A new granary was constructed at Farm 4, Blood Agency, and a small warehouse was built at Jackfish River in the Athabaska Agency. Three residences at the Hobbema Agency were insulated.

British Columbia.—A landing float was built at the Kwawkewlth Agency for the Indians of Alert Bay and a float was constructed for the mooring of Indian boats at the Massett Indian Reserve, Queen Charlotte Agency.

Northwest Territories.—Small warehouses were erected at Hay River and Fort Rae.

Yukon.—A building was taken over from the Army and remodelled for agency residence and office purposes, at Whitehorse, headquarters of the new agency in the Yukon.

LAND AND BUILDINGS

Land was purchased to widen the road through the Department's property at Oka, Quebec, and to enlarge the agency property at the Caradoc Agency, Muncey, Ontario. A building was purchased from the Roman Catholic Mission at Lac du Brochet for use as a ration house at The Pas Agency, Manitoba. A building to be used as a ration house and a medical clinic was purchased in the town of Glenevis, Edmonton Indian Agency, Alberta, and property was acquired at Telegraph Creek, for an Agency residence for the Indian Agent, Stikine Indian Agency, British Columbia.

ROADS

Roads were repaired on Indian reserves throughout Canada. Some of the more important works undertaken were as follows: A road was built through the Cornwall Island Indian Reserve, Ontario, in the St. Regis Indian Agency, Quebec; the road through the Oka property in Quebec was widened and improved; a road was constructed to the New Caradoc Indian Day School, Caradoc Agency, Ontario; the road between the Missisauga Reserve and the County of Haldimand, Six Nations Indian Agency, Ontario, was improved in co-operation with the county; a road was constructed to the nursing station at the Eskasoni Indian Reserve, Nova Scotia; the road from Pine Falls to the Fort Alexander Reserve, Clandeboye Agency, Manitoba, was gravelled; and a road to open up the Industrial School Reserve in Kwawkewlth Indian Agency, British Columbia, was constructed.

WATER SUPPLY SYSTEMS

Quebec.—A well was drilled at the St. Regis Agency and at the Obedjiwan Reserve, Abitibi Agency. Extensive improvements were made, including the drilling of a well and the installation of a pump, at Lorette Reserve.

Manitoba.—Wells were drilled at the Portage la Prairie Agency.

Saskatchewan.—A well was provided at the Sandy Lake Reserve, Carlton Agency; dugouts were provided on the Poorman's Reserve, Touchwood Agency, and the Red Pheasant Reserve, Battleford Agency; and wells were sunk at the Duck Lake Agency.

Alberta.—A well was drilled at the Peigan Agency, and two wells were sunk at the Edmonton Agency.

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 various reserves in the Province of British Columbia by this Branch.

MISCELLANEOUS

Nova Scotia.—An electric pump and a 1,000-gallon tank were purchased for the water supply system on the Shubenacadie Reserve.

Quebec.—Purchases included a pneumatic storage tank for the St. Regis Agency buildings, an electric refrigerator for the R.C.M.P. quarters at Caughnawaga, and water systems for the Pointe Bleue and Temiskaming Indian Agency residences. Four pumps for Abitibi Agency were acquired.

Ontario.—Materials for wiring the farm house on the Manitou Reserve, Fort Frances Agency, and oil-burning equipment for the James Bay office were purchased.

Saskatchewan.—A water system and plumbing were installed at the clerk's residence, and furnaces were purchased for the agency office and Agent's residence, Duck Lake Agency. A new furnace was purchased for File Hills Agency, and electric refrigerators for the Touchwood Agency residence, being remodelled for the use of the Agent and doctor, were acquired.

Alberta.—Batteries for the lighting plant and oil-burning equipment were acquired for the Agency buildings at Fort Chipewyan, Athabaska Agency.

Wells were cleaned out and fencing, telephone and electric power-lines, furnaces, pumping equipment, lighting plants, and water systems, at all agencies were repaired and improved as required.

SUMMARY OF INDIAN AGENCIES BY PROVINCES AND TERRITORIES

The local administration of Indian lands, on the reserves scattered throughout the Dominion, is conducted through the Department's 98 agencies. The number of bands included in an agency varies from one to more than thirty. In addition to the agent, the staff of an agency may include various officers, such as: clerk, farm instructor, constable, and stockman, according to the special requirements of the particular agency. Medical staff is provided for agencies as required by the Department of National Health and Welfare. The work of the agencies is supervised by the Department's provincial inspectors. There is an Indian Commissioner at Vancouver, acting in a supervisory capacity for British Columbia.

LOCATIONS OF INDIAN AGENCIES IN CANADA

Prince Edward Island.—The only agency in the Province is 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 Fork.

Nova Scotia.—There are two Indian agencies in Nova Scotia, one in Hants County (Shubenacadie) and the other in Cape Breton County (Eskasoni).

Quebec.—The 18 Indian agency offices in Quebec are located as follows: Amos (Abitibi), Bersimis, Cacouna (Viger), Caughnawaga, Gaspe, 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).

Ontario.—The Indian agency offices in Ontario, 24 in number, are located as follows: Alert Bay (Kwawkewlth), Bella Coola, Cranbrook (Kootenay), 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 Chemong Lakes), Port Arthur, Sarnia, Sault Ste. Marie, Scugog, Sioux Lookout, Sturgeon Falls, Virginia (Georgina and Snake Islands), Wallaceburg (Walpole Island), Wiarton (Cape Croker).

Manitoba.—There are nine agencies 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).

Saskatchewan.—The following are the nine agencies in this Province: Balcarres (File Hills), Battleford, Broadview (Crooked Lake), Duck Lake, Kamsack (Pelly), Leask (Carlton), Muscow (Qu'Appelle), Onion Lake, Punnichy (Touchwood).

Alberta.—Locations of Alberta's ten agencies are: Brocket (Peigan), Calgary (Sarcee), Cardston (Blood), Driftpile (Lesser Slave Lake), Fort Chipewyan (Athabaska), Gleichen (Blackfoot), Hobbema, Morley (Stony), Saddle Lake, Winterburn (Edmonton).

British Columbia.—In British Columbia there are eighteen agencies located 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.

Northwest Territories.—The three agencies are at Fort Simpson, Fort Resolution, and Fort Norman.

Yukon Territory.—The one agency in Yukon Territory is at Whitehorse.

SUMMARY OF TRIBAL ORIGINS OF CANADIAN INDIANS

Prince Edward Island.—Micmac tribe, of Algonkian stock.

Nova Scotia.—Like the Indians of Prince Edward Island, those of Nova Scotia also bear the distinctive name of Micmac, and are of Algonkian stock.

New Brunswick.—Mostly Micmacs, though there are some bands of Maliseets, also of Algonkian stock.

Quebec.—The principal tribes found in Quebec are: Iroquois at Caughnawaga, Lake of Two Mountains, and St. Regis; the Hurons of Lorette are 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.

Ontario.—Most of the Indians of Ontario are Ojibwas, Chippewas, and Missisauga tribes, which are all of Algonquin 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 Algonkian stock, are found in northern and northwestern Ontario.

Manitoba.—Manitoba Indians are mostly Ojibwas and Crees of Algonkian stock. Bands of Swamp Crees found at the Norway House and Fisher River Agencies and in the York Factory district 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.

Saskatchewan.—The most numerous tribes among the Saskatchewan Indians are Objibwas, Swamp Crees, and Plains Crees, which all belong to the Algonkian stock. In addition to these, Sioux Indians are found at 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.

Alberta.—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.

British Columbia.—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.

Northwest Territories.—The principal tribes found in the Far North are the Slaves, Hares, Loucheaux, 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.

Yukon Territory.—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 the 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.

TABLE No. 1

Census of Indians: Arranged Under Provinces and Territories, 1947

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	10,494	1,281	5,925	307	10,338	1,147	2,929	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	93	94	1,319	1,360	1,750	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	125,686	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

Land, Property and Live Stock, Fiscal Year Ended March 31, 1947

Bands	Land				Property				Live Stock						
									Horses			Cattle			
	Total Area of Reserve (Acres)	Acres Under Wood	Acres Cleared but Not Cultivated	Acres Under Cultivation	Private Houses	Churches	Council Houses	Saw Mills	Stallions	Geldings and Mares	Foals	Bulls	Steers	Milch Cows	Young Stock
Prince Edward Island	1,667	800	200	200	28	1	1	0	0	6	1	1	8	9	12
Nova Scotia	19,787	12,741	527	1,066	281	5	1	2	0	41	1	2	0	56	13
New Brunswick	38,253	33,440	1,250	310	372	6	4	0	0	19	0	0	0	8	5
Quebec	183,375	124,014	29,130	9,515	1,933	26	12	1	2	569	77	51	70	1,595	821
Ontario	1,303,485	1,075,617	101,704	31,410	5,099	128	47	19	25	2,376	173	84	513	2,598	1,632
Manitoba	484,764	225,664	162,181	16,312	3,214	71	12	10	159	2,182	367	28	483	1,552	861
Saskatchewan	1,193,452	423,562	614,165	60,186	2,498	50	22	3	20	6,741	194	114	1,623	3,315	2,476
Alberta	1,412,766	261,116	787,281	56,744	2,499	32	8	4	168	10,207	1,700	268	3,347	7,682	4,243
British Columbia	832,565	438,501	248,414	41,205	6,596	169	82	11	100	6,860	1,053	224	8,344	4,530	4,707
Northwest Territories and Yukon	5,918	3,577	33	32	441	3	2	.....	3	17	1	.....	.....	.....	.....
	5,476,032	2,599,032	1,944,885	216,980	22,961	491	191	50	477	29,018	3,567	772	14,388	21,345	14,770

Statement of Ordinary Expenditure Year 1946-47

—	Branch Administration	Indian Agencies	Reserves and Trusts Admin.	Welfare	Education	Grants to Residential Schools	Grants to Exhibitions	Total
	$	$	$	$	$	$	$	$
Nova Scotia	.....	62,139	.....	194,540	123,277	30,595	119	410,670
Prince Edward Island	.....	9,264	.....	14,306	1,234	.....	.....	24,804
New Brunswick	.....	14,579	13,040	56,109	20,698	.....	60	104,486
Quebec	.....	92,849	10,698	175,716	76,578	11,229	75	367,145
Ontario	2,016	196,614	4,049	197,668	215,748	255,776	1,213	873,084
Manitoba	35	118,844	280	153,602	120,200	176,309	599	569,869
Saskatchewan	93	169,737	1,193	121,711	88,464	319,861	1,000	702,059
Alberta	.....	153,994	239,171	105,412	34,403	375,147	1,063	909,190
British Columbia	255	191,948	351,403	132,254	130,124	356,238	956	1,163,178
Northwest Territories	.....	21,413	.....	22,048	16,295	44,962	.....	104,718
Yukon	.....	4,112	.....	10,668	5,614	15,677	.....	36,071
Headquarters and Miscellaneous	59,135	39,192	43,580	46,834	120,291	.....	.....	309,032
British Columbia Special	.....	22,617	.....	46,426	9,138	.....	.....	78,181
	61,534	1,097,302	663,414	1,277,294	962,064	1,585,794	5,085	5,652,487
Pensions and Gratuities	.....	.....	.....	.....	.....	.....	.....	1,019
Statutory—Indian Annuities	.....	.....	.....	.....	.....	.....	.....	295,847
Statutory—Pensions	.....	.....	.....	.....	.....	.....	.....	600
Total Ordinary Expenditure	.....	.....	.....	.....	.....	.....	.....	5,949,953

Statement of Special Expenditure Year 1946-47

FUR CONSERVATION

Quebec	$ 21,794
Ontario	14,982
Manitoba	33,633
Saskatchewan	57,048
Alberta	23,100
British Columbia	884
Northwest Territories	47
Head Office	9,625
Total Special Expenditure	161,113
Total Ordinary Expenditure	5,949,953
Grand Total Ordinary and Special Expenditure	6,111,066

Open Account—Advances for Assistance to Indians 1946-47

EXPENDITURE

Nova Scotia	$ 2,000.00	
Manitoba	268.00	
Saskatchewan	13,301.50	
British Columbia	500.00	
		$ 16,069.50

REPAYMENTS

Saskatchewan	2,593.45	
Alberta	596.25	
British Columbia	216.08	
		$ 3,405.78
Expenditure over repayments		$ 12,663.72

Indian Trust Fund

Showing transactions in connection with the fund during the fiscal year ended March 31, 1947.

—	Debit		Credit	
	$	cts.	$	cts.
Balance April 1, 1946			17,096,489	68
Collections on land sales, timber and stone dues, rents, fines, fees, etc.			1,368,195	02
Interest for the year ended March 31, 1947			865,563	10
Credit transfers during the year			21,502	55
Expenditure during the year	1,756,011	26		
Transfers by Warrant, etc.	18,374	52		
Balance March 31, 1947	17,577,364	57		
	19,351,750	35	19,351,750	35

Annuities Paid and Interest on Indian Trust Funds 1946-47

Alberta	$ 281,697.93
British Columbia	84,870.64
Manitoba	123,742.04
New Brunswick	2,733.49
Northwest Territories	22,055.00
Nova Scotia	3,016.06
Ontario	286,483.01
Prince Edward Island	.19
Quebec	22,781.45
Saskatchewan	196,769.66
Yukon Territory	28.15
	$1,024,177.62

Indian Education Ordinary Expenditure 1946-47

—	Day Schools	Residential Schools	General	Total
	$ cts.	$ cts.	$ cts.	$ cts.
Nova Scotia	120,279 67	33,592 90	.....	153,872 57
Prince Edward Island	1,233 65	.....	.....	1,233 65
New Brunswick	20,698 41	.....	.....	20,698 41
Quebec	76,578 18	11,229 21	.....	87,807 39
Ontario	177,595 50	293,928 39	.....	471,523 89
Manitoba	84,190 21	212,318 42	.....	296,508 63
Saskatchewan	51,331 65	356,993 49	.....	408,325 14
Alberta	4,700 08	404,850 42	.....	409,550 50
British Columbia	95,425 69	390,936 18	.....	486,361 87
British Columbia Vocational Instruction	.....	.....	9,137 51	9,137 51
Northwest Territories	15,722 40	45,535 16	.....	61,257 56
Yukon Territory	4,165 27	17,124 86	.....	21,290 13
Assistance to Ex-pupils	.....	.....	42,771 66	42,771 66
Freight and Express	.....	.....	131 80	131 80
Salaries and Travel	.....	.....	20,150 32	20,150 32
Stationery	.....	.....	55,601 17	55,601 17
Miscellaneous	.....	.....	1,636 06	1,636 06
	651,920 71	1,766,509 03	129,428 52	2,547,858 26

SCHOOL STATEMENT

Statement Showing Enrolment by Provinces in the Different Classes of Schools for the Fiscal Year Ended March 31, 1947

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	X
Nova Scotia	1	.....	.....	1	.....	80	85	165	155	93·93	41	21	30	25	18	14	10	5	1	....
Quebec	2	1	.....	1	.....	21	39	60	52	86·66	18	13	10	10	3	.....	.....	.....	6	....
Ontario	13	5	1	6	1	799	869	1,668	1,458	87·41	459	300	186	208	208	115	96	79	17	....
Manitoba	9	1	1	4	3	498	629	1,127	1,007	89·44	303	156	165	148	138	106	62	25	24	....
Saskatchewan	14	3	.....	9	2	846	1,011	1,857	1,676	90·25	521	309	247	244	231	133	101	57	14	....
Alberta	19	5	.....	12	2	954	1,084	2,038	1,759	86·32	681	315	263	274	200	157	81	66	1	....
Northwest Territories	4	1	.....	3	.....	89	121	210	164	78·10	85	55	27	18	8	8	5	4	.....	....
British Columbia	13	2	.....	9	2	986	1,123	2,109	1,868	88·56	523	344	331	264	245	188	111	73	30	....
Yukon	1	1	.....	.....	.....	39	31	70	53	75·71	26	17	16	7	4	.....	.....	.....	.....	....
Total—Residential Schools	76	19	2	45	10	4,312	4,992	9,304	8,192	88·05	2,657	1,530	1,275	1,198	1,055	721	466	309	93	....

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	X
Prince Edward Island	1	15	13	28	20	71·42	14	3	1	6	1	.....	3	.....	.....	.....
Nova Scotia	9	193	217	410	300	73·17	177	63	56	45	35	21	11	2	.....	.....
New Brunswick	10	174	199	373	305	81·77	110	61	63	30	41	30	27	10	1	.....
Quebec	30	735	838	1,573	1,196	76·03	510	258	220	211	160	104	29	58	23	.....
Ontario	76	1,406	1,577	2,983	2,408	80·72	983	527	353	319	288	211	167	119	12	4
Manitoba	42	782	779	1,561	936	59·96	822	301	197	111	72	28	22	7	1	.....
Saskatchewan	31	442	443	885	622	70·29	412	167	135	87	50	22	7	3	2	.....
Alberta	2	78	102	180	135	75·00	41	31	21	24	36	18	4	4	1	.....
Northwest Territories	3	23	25	48	36	75·00	19	8	5	7	4	.....	4	1	.....	.....
British Columbia	54	998	1,012	2,010	1,311	65·23	931	334	243	174	154	88	43	41	2	.....
Yukon	7	54	76	130	75	57·69	96	19	8	4	2	1	.....	.....	.....	.....
Total—Day Schools	265	4,900	5,281	10,181	7,344	72·13	4,115	1,772	1,302	1,018	843	523	317	245	42	4

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	X
Quebec	1	5	10	15	12	80·00	3	5	1	6	.....	.....	.....	.....	.....	.....
Ontario	3	37	31	68	53	77·94	21	6	13	6	6	5	3	7	1	.....
Manitoba	2	23	31	54	40	74·25	40	7	4	2	1	.....	.....	.....	.....	.....
Total—Combined White and Indian Schools	6	65	72	137	105	76·64	64	18	18	14	7	5	3	7	1	.....

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	X
Prince Edward Island	1	.....	.....	1	15	13	28	20	71·42	14	3	1	6	1	.....	3	.....	.....	.....
Nova Scotia	9	1	.....	10	273	302	575	455	79·11	218	84	86	70	53	35	21	7	1	.....
New Brunswick	10	.....	.....	10	174	199	373	305	81·77	110	61	63	30	41	30	27	10	1	.....
Quebec	30	2	1	33	761	887	1,648	1,260	76·46	531	276	231	227	163	104	29	58	29	.....
Ontario	76	13	3	92	2,242	2,477	4,719	3,919	83·05	1,463	833	552	533	502	331	266	205	30	4
Manitoba	42	9	2	53	1,303	1,439	2,742	1,983	72·32	1,165	464	366	261	211	134	84	32	25	.....
Saskatchewan	31	14	.....	45	1,288	1,454	2,742	2,298	83·81	933	476	382	331	281	155	108	60	16	.....
Alberta	2	19	.....	21	1,032	1,186	2,218	1,894	85·38	722	346	284	298	236	175	85	70	2	.....
Northwest Territories	3	4	.....	7	112	146	258	200	77·51	104	63	32	25	12	8	9	5	.....	.....
British Columbia	54	13	.....	67	1,984	2,135	4,119	3,179	77·18	1,454	678	574	438	399	276	154	114	32	.....
Yukon	7	1	.....	8	93	107	200	128	64·00	122	36	24	11	6	1	.....	.....	.....	.....
Totals	265	76	6	347	9,277	10,345	19,622	15,641	79·71	6,836	3,320	2,595	2,230	1,905	1,249	786	561	136	4

IMMIGRATION BRANCH

A. L. JOLLIFFE, DIRECTOR

The total number of immigrants admitted to Canada during the fiscal year ended March 31, 1947 was 66,990, as compared with 31,081 in the previous fiscal year. This represents an increase of 116 per cent over the year 1945-46. This increase is due largely to the admission to Canada from the British Isles of 39,092 dependants of members of the Canadian Armed Forces and of about 10,000 United States citizens. Immigrants arriving at ocean ports numbered 55,580 and from the United States, 11,410. Their racial origins were: British 54,843; French, 3,035; the remaining 9,112 representing 45 other racial groups. Classified by nationality, 55,807 were British subjects; 9,592 United States citizens; the remaining 1,591 comprising 37 nationalities. Classified by sex, 19,782 were males and 47,208 females. Non-immigrants entering Canada from abroad numbered 34,693,241, an increase of 20 per cent over the previous fiscal year.

Tourist Movement

During the year ended March 31, 1947, a total of 34,769,219 persons applied for entry to Canada and were individually examined at border and ocean ports. Of this number, 34,693,241 appeared as non-immigrants, an increase of approximately 20 per cent over the previous year, and 8,988 were refused admission. The figure of 34,693,241 represents the actual number of persons examined at ports of entry, and not the actual number of different individuals who entered Canada. Out of the total of 34,693,241 persons permitted to enter Canada, a substantial proportion represented tourists.

The tables appearing below show the comparative figures of non-immigrant entries for the last ten years:—

Non-Immigrants Entering Canada from Abroad

—	Via Ocean Ports	From U.S.A.	Totals
Fiscal year ended March 31, 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
" " 1947	40,807	34,652,434	34,693,241

Residents of Canada Returning After Visits Abroad

—	Via Ocean Ports	From U.S.A.	Totals
Fiscal year ended March 31, 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
" " 1947	16,919	14,047,603	14,064,522

The following table shows, by immigration districts, the number of persons examined upon application for entry to Canada and their disposition:—

Admissions and Rejections by Districts, Fiscal Year ended March 31, 1947

—	Admitted as Immigrants	Admitted as Non-immigrants	Rejected
Atlantic	50,316	8,515,210	1,460
Eastern	5,014	22,032,121	6,416
Western	1,587	2,125,252	223
Pacific	2,020	2,020,658	791
Through U.S.A. Ocean Ports	7,776	.....	80
Not shown	277	.....	18
Totals	66,990	34,693,241	8,988

Returning Canadians

A significant increase has been recorded in 1946-47 in the number of Canadians returning from abroad to make their homes in Canada. Figures covering the years 1924 to 1934 will be found on page 181 of the report for the year ended March, 1944. Figures for subsequent years are shown in the following table:—

—	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	4,910	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
Fiscal year 1946-47	5,448	756	111	6,315
Totals	50,659	4,568	3,037	58,264

Students

The number of students admitted to Canada in 1946-47 to attend preparatory schools, to obtain degrees, or to take post-graduate courses in Canadian Universities was 5,310, as compared to 3,803 during the previous year, an increase of 40 per cent. Of this number, 568 were British subjects, 3,574 United States citizens, 333 from Central and South America, and 835 from other countries.

Legislation and Regulations

Regulations relating to immigration, enacted or amended during the fiscal year 1945-46, are recorded on page 236 of the Annual Report for the year ended March 31, 1946. The following enactments and amendments became effective in the year 1946-47:

1. By Chapter 54, 10 George VI, assented to on August 31, 1946, the Immigration Act was brought into conformity with the Canadian Citizenship Act of June 27, 1946, in respect of the qualifications for and definition of Canadian citizenship and Canadian domicile. In the latter case, rules were established regarding the acquisition and loss of Canadian domicile. A further amendment concerned charity immigrants, who may not be permitted to enter Canada unless under specific authority of the Deputy Minister, the Director of Immigration, or the Superintendent of European Emigration in London, and provided such authority has been acted upon within sixty days thereafter. Another amendment to the Immigration Act provided for the validity of dismissals of appeals by the Minister, irrespective of any lapse of time between their issuance and execution.
2. P.C. 1272, dated April 2, 1946 revoked P.C. 1841 providing for exit permits for women and children under 16 years of age proceeding to destinations outside the Western Hemisphere.
3. P.C. 1373, dated April 9, 1946, revoked P.C. 2653 passed under the authority of the War Measures' Act. P.C. 2653, as amended, prohibited the entry to or landing in Canada of enemy aliens, with certain exceptions. Under P.C. 1373 the admission of enemy aliens remains prohibited, with the exception of enemy aliens who can satisfy the Minister that they were opposed to an enemy government.
4. P.C. 2071, dated May 28, 1946, further amended P.C. 695 to provide for the admission of the father or mother, the unmarried son or daughter, 18 years of age or over, the unmarried brother or sister, the orphan nephew or niece under 16 years of age, of any person legally admitted to and resident in Canada who is in a position to receive and care for such relatives.
5. P.C. 2070, dated May 28, 1946, amended P.C. 3016 governing passport requirements to provide that a travel document establishing the identity of the holder may be accepted in lieu of a passport from an immigrant who has been displaced from his country of origin as a result of the recent war.
6. P.C. 3112, dated July 23, 1946, provided for the admission to Canada, from the United Kingdom and Italy, of 4,000 single ex-members of the Polish Armed Forces, qualified for and willing to undertake agricultural employment in Canada.
7. P.C. 4044, Dependants Transportation Regulations, 1946, dated September 26, 1946, transferred, as of December 1, 1946, the responsibility for the administration of the movement of servicemen's dependants from the Department of National Defence to the Department of Mines and Resources, Immigration Branch.
8. P.C. 4216, dated October 11, 1946, amended P.C. 858 in order to limit the provisions of the later Order in Council with respect to immigration status and free medical inspection, to conform with the provisions of P.C. 4044.
9. P.C. 5103, dated December 12, 1946, amended P.C. 4044 to include dependants who married after October 15, 1946, and children born after that date, and to give discretional powers to the Minister of National Defence in respect of dependants who had failed to file application before October 15, 1946.
10. P.C. 371, dated January 30, 1947, widened the base for the admission of close relatives by further amending P.C. 695 to include in the admissible classes the widowed daughter or sister of a legal resident

of Canada, with her unmarried children under 18 years of age, and by raising the age limit from 16 to 18 years of age in the case of orphaned nephews and nieces. P.C. 371 also provided for the admission of agriculturists entering Canada to farm, when destined to a father, father-in-law, son, son-in-law, brother, brother-in-law, uncle or nephew, himself engaged in agriculture as his principal occupation and in a position to receive such an immigrant and establish him on a farm. Also included in the admissible classes by P.C. 371 were farm labourers, as well as persons experienced in mining, lumbering or logging, entering Canada to engage in assured employment.

Administration and Inspectional Work

Field and Inspectional Service, Canada

The resumption of near normal pre-war traffic between Canada and the United States, the substantial increase in the number of admissions at ocean ports, and a considerably expanded air traffic between Canada and the United States, as well as overseas countries, have taxed the facilities of the Immigration Branch to the limit. Although a total increase in staff of 184 was authorized during the year under review, immigration personnel, both at headquarters and in the field, have been hard pressed to cope with a volume of work which is increasing faster than it has been possible to obtain additional trained staff.

The most significant expansion was in the volume of air traffic. During the year, 19,460 planes landed 186,199 passengers at Canadian airports, an increase of 32 per cent over the year 1945-46 which had already marked a 51 per cent increase over the previous year. Similarly, the number of admissions at Atlantic ports more than doubled in the course of the year. An illustration of the increase of the tourist movement into Canada from the United States may be found in figures for the ports of Fort Erie and Niagara Falls where an increase of over one million admissions over the previous year was registered at each port. There has also been a large increase in the number of investigations conducted in conjunction with applications for admission to Canada. The additional investigational work was due largely to the conclusion of outstanding applications for dependants of members of the Armed Forces in the early part of the year, and the subsequent rush of applications following the amendment of P.C. 695 to provide for the admission of aliens coming within certain degrees of relationship to legal residents of Canada, particularly from Continental Europe. The number of Boards of Inquiry held in connection with appeals also has been substantially greater than in the previous year. With the gradual return to normal travel conditions between the West Coast and the Far East a perceptible increase in the volume of investigational work has been noted in the Pacific Immigration District.

Deportations

Of 334 persons deported subsequent to entering Canada, 178 had effected illegal entry; 123 were returned to their country of origin on completion of sentences for criminal offences; 17 were deported on grounds of mental disability, the remainder as the result of becoming public charges, for infraction of the Opium and Narcotic Drug Act, and for other causes.

During the year 13,680 ships' manifests recording the arrival and disposition of 295,153 seamen, comprising the crews of 6,577 vessels, were filed at ocean ports and checked by immigration officers.

Repatriation of Dependants of Canadian Service Personnel

On December 1, 1946, the Immigration Branch assumed responsibility for the movement of dependants which had formerly come under the jurisdiction of the Department of National Defence.

The number of applications for admission and free passage to Canada under existing Dependants Regulations was noticeably smaller during the fiscal year under review. The total number of such applications filed in 1946-47 was 5,906 bringing the total number of such applications received since the beginning of the movement, up to March 31, 1947, to 43,328 family units. At April 1, 1946, upwards of 20,000 dependants were awaiting sailing in the United Kingdom. As the repatriation movement neared completion, additional shipping space became available which permitted the movement of a total of 39,092 dependants during the year. This brings the total number of dependants of Canadian servicemen brought to Canada since the commencement of the movement to 63,110, made up of 42,728 wives and 20,382 children.

British Evacuee Children

As of March 31, 1947, there remained in Canada 70 British children under supervision from the 1,532 admitted under the evacuation scheme jointly sponsored by the British and Canadian Governments at the outbreak of World War II. In addition, a significant number of older boys and girls have complied with Immigration Regulations and have been granted permanent admission to Canada. The 70 children remaining are awaiting the arrival of their parents to establish residence in Canada, or are completing their education. It is expected that while some may later return to the United Kingdom, the majority will remain permanently in this country.

New Ports of Entry

The following additional points were designated by the Minister during the year as authorized ports of entry:

Nova Scotia:—Dingwall.

Quebec:—Jamiesons Lines.

British Columbia:—Flathead, Tulsequah.

Yukon Territory:—Snag Creek.

Field and Inspectional Service, Overseas

United Kingdom.—The interest in immigration to Canada continued unabated. Broadly speaking, applicants making inquiries were of a desirable type. A substantial number were skilled technicians, professional men, and individuals with capital, many of whom have served in the Forces during the last war. The main hindrance to a larger movement from the United Kingdom has been the lack of shipping, although some improvement became discernible toward the end of the year. The number of inquiries received at the immigration office in London was 72,682, about double the number received in 1945-46.

The Canadian Passage Priority Committee was dissolved on July 1, 1946, but transportation companies agreed to, and did, honour priorities issued before that date.

The Canadian Wives Bureau ceased its activities on January 15, 1947, after having made a determined effort to move the wives and dependants of servicemen eligible for free transportation, before the end of December, 1946.

On the closing of the Bureau, the Atlantic Passenger Conference proferred assistance in arranging for shipping space for repatriate dependants of servicemen from Europe and the Far East.

With the continuation of the increase of work, the lack of adequate office accommodation and the difficulties encountered in obtaining competent staff have been a serious handicap. The necessity of securing larger premises for the London office was acutely felt during the year, and steps were taken to lease suitable office quarters.

Continental Europe.—In anticipation of the resumption of normal immigration functions on the continent of Europe, and in order to cope with the movement of fiancées and dependants of Canadian servicemen, an immediate problem, regular inspectional offices were reopened at Paris, Brussels, and The Hague, at the end of November, 1946. A large number of inquiries concerning the possibility of migrating to Canada have been received in continental offices, but the larger percentage of inquirers or applicants are not admissible under existing regulations.

Displaced Persons.—With the intention of making a contribution towards the immediate resettlement of some of the large numbers of refugees and displaced persons in camps in Europe, the Prime Minister, on November 7, 1946, announced that the Government had approved emergency measures to bring to Canada some of these persons who were admissible under existing Immigration Regulations.

Under P.C. 2071, dated May 28, 1946, permission to enter Canada was granted to certain categories of relatives of residents in Canada (see *Legislation and Regulations*) who apply for the admission of these persons.

Arrangements have been completed with the Inter-Governmental Committee on Refugees by which it is expected that some of the refugees and displaced persons will be enabled to proceed to Canada. Lists of persons on whose behalf application is made will be forwarded to the I.G.C.R. These persons will be located, identified, and gathered into convenient centres in occupied territories by the I.G.C.R., and they will be subsequently inspected by itinerant teams of immigration officials, assisted by medical officers of the Department of National Health and Welfare and officials of the Department of Labour. Special arrangements have also been made for security screening.

The procedure outlined above applies to refugees and displaced persons in the British, American, and French zones of occupied territories.

In January, 1947, an immigration officer proceeded to Germany to make preliminary arrangements with the I.G.C.R. and the military authorities of occupation to get the movement under way. In March, 1947, two inspectional teams were in operation. It is expected that the first group of displaced persons will sail from Europe for Canada at the beginning of the next fiscal year.

Chinese Immigration

During the fiscal year 1946-47 two Chinese were granted permanent admission to Canada, as merchants. In addition, 7 Chinese persons were admitted as dependants of Canadian service personnel, under the provisions of P.C. 858 passed under the authority of the War Measures Act.

One hundred and thirty-one persons were temporarily admitted under Minister's Permit, issued under the authority of Section 9 of the Immigration Act. Of this number, 26 were students, and 37 were technicians who came to Canada for practical training for short periods.

Nineteen hundred and eighty-seven Chinese persons left Canada in the course of the fiscal year under review, with the declared intention of returning thereto, and 125 registered as seamen, operating in international waters. At the

close of the fiscal year there were 3,000 Chinese on visit in China, who were entitled under the regulations to resume their legal domicile in Canada. A large number of these had been unable to return to Canada during the war.

For purposes of comparison the following table shows figures applicable to Chinese immigration at the close of the fiscal year 1946-47:—

—	Exemptions	Paying Tax	Percentage of Total Arrivals Admitted Exempt	Registered for Leave	Total Revenue
					$
1923-24	49	625	7·27	5,661	334,039 00
1924-25	.....	.....	.....	5,992	308,659 00
1925-26	.....	.....	.....	3,947	25,969 00
1926-27	.....	.....	.....	5,987	14,844 00
1927-28	1	2	33·33	5,087	25,679 00
1928-29	1	.....	100·00	5,480	30,795 00
1929-30	.....	.....	.....	5,582	30,799 00
1930-31	.....	.....	.....	5,788	28,846 00
1931-32	.....	.....	.....	4,387	11,584 00
1932-33	1	.....	100·00	3,626	9,152 00
1933-34	2	.....	100·00	2,156	7,237 00
1934-35	.....	.....	.....	2,103	6,506 00
1935-36	.....	.....	.....	2,138	6,501 00
1936-37	1	.....	100·00	2,059	9,893 00
1937-38	.....	.....	.....	792	2,359 00
1938-39	.....	.....	.....	817	2,959 00
1939-40	.....	.....	.....	933	4,066 00
1940-41	.....	.....	.....	637	5,633 85
1941-42	.....	.....	.....	265	9,655 00
1942-43	.....	.....	.....	194	4,488 00
1943-44	.....	.....	.....	191	1,107 00
1944-45	.....	.....	.....	210	1,620 00
1945-46	2	.....	100·00	635	1,945 00
1946-47	2	.....	100·00	2,112	6,024 00
Totals	59	627	8·60	66,779	890,359 85

TABLE 1

Immigration to Canada from 1900 to 1947

		Via Ocean Ports			From U.S.A.				Grand Totals
		British Nationals	Others	Totals	U.S.A. Citizens	British Nationals	Others	Totals	
Six months ended June 30,	1900	5,141	10,211	15,352	.....	.....	.....	8,543	23,895
Fiscal year ended June 30,	1901	11,813	19,349	31,162	.....	.....	.....	17,987	49,149
" "	1902	17,270	23,721	40,991	.....	.....	.....	26,388	67,379
" "	1903	42,200	36,691	78,891	.....	.....	.....	49,473	128,364
" "	1904	51,050	34,110	85,160	12,648	4,145	23,946	40,739	125,899
" "	1905	65,967	36,756	102,723	15,477	2,263	22,190	39,930	142,653
" "	1906	88,174	43,094	131,268	33,013	2,108	17,675	52,796	184,064
Nine months ended March 31,	1907	59,272	30,736	90,008	20,479	1,309	10,369	32,157	122,165
Fiscal year ended March 31,	1908	126,783	77,374	204,157	31,411	2,674	19,067	53,152	257,309
" "	1909	55,463	31,613	87,076	33,474	2,894	17,926	54,294	141,370
" "	1910	63,757	41,239	104,996	65,190	3,662	22,196	91,048	196,044
" "	1911	126,170	63,463	189,633	77,353	5,007	22,524	104,884	294,517
" "	1912	141,504	79,023	220,527	91,840	6,236	16,250	114,326	334,853
" "	1913	152,373	111,050	263,423	92,061	7,398	19,959	119,418	382,841
" "	1914	144,513	132,835	277,348	74,745	6,374	8,773	89,892	367,240
" "	1915	44,117	40,893	85,010	34,745	3,541	3,482	41,768	126,778
" "	1916	9,032	2,568	11,600	21,370	2,796	1,687	25,853	37,453
" "	1917	9,980	4,005	13,985	43,261	3,324	4,558	51,143	65,128
" "	1918	4,879	2,881	7,760	47,818	3,444	6,923	58,185	65,945
" "	1919	10,701	6,286	16,987	28,280	1,725	1,950	31,955	48,942
" "	1920	60,659	7,021	67,680	36,628	2,250	1,850	40,728	108,408
" "	1921	75,783	24,635	100,418	33,891	2,768	1,651	38,310	138,728
" "	1922	39,606	21,048	60,654	18,782	1,825	1,063	21,670	82,324
" "	1923	36,360	14,520	50,880	14,095	1,641	830	16,566	67,446
" "	1924	78,740	49,299	128,039	14,928	1,478	805	17,211	145,250
" "	1925	54,943	40,601	95,544	13,171	1,794	853	15,818	111,362
" "	1926	37,569	39,717	77,286	15,442	2,251	1,085	18,778	96,064
" "	1927	50,378	72,586	122,964	17,820	2,239	966	21,025	143,989
" "	1928	51,552	75,041	126,593	21,260	2,696	1,051	25,007	151,600
" "	1929	59,497	77,666	137,163	26,539	3,061	960	30,560	167,723
" "	1930	64,962	67,599	132,561	26,751	3,121	855	30,727	163,288
" "	1931	28,144	35,799	63,943	20,723	2,938	619	24,280	88,223
" "	1932	7,332	4,123	11,455	12,277	1,815	205	14,297	25,752
" "	1933	3,283	3,303	6,586	11,172	1,806	218	13,196	19,782
" "	1934	2,454	3,709	6,163	6,545	1,032	163	7,740	13,903
" "	1935	2,408	3,768	6,176	5,104	769	87	5,960	12,136
" "	1936	2,264	3,718	5,982	4,322	709	90	5,121	11,103
" "	1937	2,521	4,389	6,910	4,301	742	70	5,113	12,023
" "	1938	3,351	6,651	10,002	4,727	852	64	5,643	15,645
" "	1939	3,831	7,634	11,465	4,685	917	61	5,663	17,128
" "	1940	3,962	6,495	10,457	4,383	1,234	131	5,748	16,205
" "	1941	3,428	625	4,053	5,295	2,064	84	7,443	11,496
" "	1942	2,353	201	2,554	5,075	1,180	56	6,311	8,865
" "	1943	2,524	94	2,618	3,457	1,344	26	4,827	7,445
" "	1944	4,519	80	4,599	3,302	1,101	38	4,441	9,040
" "	1945	10,564	118	10,682	3,687	907	30	4,624	15,306
" "	1946	21,463	2,164	23,627	6,051	1,354	49	7,454	31,081
" "	1947	54,036	1,544	55,580	9,546	1,771	93	11,410	66,990

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
Scottish	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	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	1,053	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	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	34,062
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 3

Immigration to Canada for the Period April 1, 1910, to March 31, 1920

	Fiscal Years										Totals
	1910-1911	1911-1912	1912-1913	1913-1914	1914-1915	1915-1916	1916-1917	1917-1918	1918-1919	1919-1920	
English	84,707	95,107	108,082	102,122	30,807	5,857	5,174	2,477	7,954	45,173	487,460
Irish	6,877	8,327	9,706	9,585	3,525	818	958	174	336	2,751	43,057
Scottish	29,924	32,988	30,735	29,128	8,346	1,887	2,062	473	1,518	10,997	148,058
Welsh	1,505	1,699	2,019	1,787	598	102	88	54	106	682	8,640
Totals	123,013	138,121	150,542	142,622	43,276	8,664	8,282	3,178	9,914	59,603	687,215
African, South	86	144	22	56	23	11	1	4	.....	23	370
Albanian	.....	.....	.....	3	4	.....	.....	.....	.....	.....	7
Arabian	3	2	10	16	.....	.....	.....	.....	.....	.....	31
Argentinian	.....	.....	.....	2	5	.....	.....	.....	.....	2	9
Armenian	20	60	100	139	36	.....	3	2	.....	10	370
Australian	266	184	106	106	51	32	18	34	35	88	920
Austro-Hungarian	16,285	21,651	21,875	28,323	7,150	15	1	.....	2	8	95,310
Belgian	1,563	1,601	1,826	2,651	1,149	172	126	19	48	1,532	10,687
Brazilian	13	.....	.....	5	.....	2	.....	.....	.....	.....	20
Bulgarian	1,068	3,295	4,616	1,727	4,048	1	.....	.....	.....	1	14,756
Chinese	5,278	6,247	7,445	5,512	1,258	88	393	769	4,333	544	31,867
Cuban	.....	.....	.....	10	1	1	3	1	.....	2	18
Doukhobor	41	24	108	4	.....	.....	.....	.....	.....	.....	177
Dutch	931	1,077	1,524	1,506	605	186	151	94	59	154	6,287
East Indian	5	3	5	88	.....	1	.....	.....	.....	.....	102
Egyptian	3	.....	7	5	.....	.....	.....	.....	.....	.....	15
Finnish	2,132	1,646	2,391	3,183	459	139	249	113	2	44	10,358
French	2,041	2,094	2,755	2,683	1,206	180	199	114	222	1,584	13,078
German	2,533	4,664	4,953	5,537	2,472	27	9	1	1	12	20,209
Greek	777	693	1,390	1,102	1,147	145	258	45	4	39	5,600
Hebrew	5,146	5,322	7,387	11,252	3,107	65	136	32	22	116	32,585
Italian	8,359	7,590	16,601	24,722	6,228	388	758	189	49	1,165	66,049
Japanese	437	765	724	856	592	401	648	883	1,178	711	7,195
Macedonian	.....	.....	.....	17	132	.....	.....	.....	.....	.....	149
Maltese	.....	.....	128	402	19	4	109	144	2	405	1,213
Mexican	.....	3	9	9	.....	.....	.....	1	3	.....	25
Montenegrin	.....	.....	36	13	9	.....	1	.....	.....	.....	59
Negro	12	138	211	266	202	34	98	35	22	61	1,079
Newfoundland	2,229	2,598	1,036	496	338	255	1,243	1,199	512	443	10,349
New Zealand	116	61	39	24	21	18	12	13	15	31	350
Persian	19	19	20	19	7	3	.....	2	2	.....	91
Polish	2,177	5,060	9,945	9,793	1,976	8	12	.....	4	76	29,051
Portuguese	13	6	9	58	8	.....	1	1	.....	3	99
Roumanian	511	793	1,116	1,504	361	4	4	.....	.....	21	4,314
Russian	6,621	9,805	18,623	24,485	5,201	40	25	42	42	51	64,935
Scandinavian—											
Danish	535	628	798	871	326	167	145	74	44	233	3,821
Icelandic	250	205	231	292	145	15	9	3	12	11	1,173
Norwegian	2,169	1,692	1,832	1,647	788	232	303	235	91	179	9,168
Swedish	3,213	2,394	2,477	2,435	916	177	332	156	101	241	12,442
Serbian	50	209	366	193	220	6	1	.....	1	12	1,058
Spanish	197	191	296	1,138	755	11	76	28	12	15	2,719
Swiss	270	230	246	269	209	42	30	12	11	100	1,419
Syrian	124	144	232	278	79	3	9	2	.....	18	889
Turkish	469	632	770	187	33	.....	5	.....	.....	1	2,097
U.S.A. citizens, via ocean ports	203	143	121	121	41	15	20	28	21	55	768
West Indian	455	393	495	719	389	47	315	307	223	66	3,409
Others	.....	.....	.....	2	18	1	.....	.....	.....	20	41
Total, Continental, etc.	66,620	82,406	112,881	134,726	41,734	2,936	5,703	4,582	7,073	8,077	466,738
From the United States	104,884	114,326	119,418	89,892	41,768	25,853	51,143	58,185	31,955	40,728	678,152
Total immigration	294,517	334,853	382,841	367,240	126,778	37,453	65,128	65,945	48,942	108,408	1,832,105

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	25,057	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	62	32	41	60	87	283
Albanian	6	6	1	7	2	22
Arabian	8	5	2	.....	.....	15
Argentinian	4	.....	4	.....	.....	8
Armenian	85	70	59	486	304	1,004
Australian	90	76	67	112	162	507
Austrian	26	14	23	62	75	220
Belgian	1,645	503	316	1,662	1,300	5,426
Bermudian	8	2	7	4	4	25
Brazilian	.....	.....	.....	.....	1	1
Bulgarian	4	27	19	267	69	386
Chilean	.....	.....	.....	.....	3	3
Chinese	2,435	1,746	711	674	.....	5,566
Cuban	.....	.....	.....	1	.....	1
Czechoslovakian	308	152	101	2,757	2,084	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
Esthonian	.....	.....	12	51	49	112
Finnish	1,401	274	1,171	7,640	4,261	14,747
French	861	332	281	370	326	2,170
German	137	178	216	1,769	2,215	4,515
Greek	357	209	177	292	237	1,272
Hebrew	2,763	8,404	2,793	4,255	4,459	22,674
Hungarian	23	48	23	364	1,052	1,510
Italian	3,880	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
Jugoslavian	89	180	136	1,306	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	1,830	4,619
Icelandic	50	31	21	27	49	178
Norwegian	429	480	507	2,424	2,550	6,390
Swedish	715	442	948	3,536	2,138	7,779
Spanish	202	6	15	39	3	265
Swiss	235	187	152	1,585	680	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

Statement of Immigration to Canada, by Origins, via Ocean Ports and

Racial Origin	1925-26			1926-27			1927-28			1928-29		
	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals
English	19,689	5,923	25,612	24,890	6,045	30,935	25,991	7,291	33,282	30,355	9,181	39,536
Irish	5,993	2,125	8,118	9,187	2,366	11,553	8,756	2,966	11,722	9,199	3,767	12,966
Scottish	10,295	2,139	12,434	14,296	2,432	16,728	14,341	2,856	17,197	16,137	3,453	19,590
Welsh	1,053	210	1,263	1,411	226	1,637	1,784	289	2,073	3,189	300	3,489
Totals	37,030	10,397	47,427	49,784	11,069	60,853	50,872	13,402	64,274	58,880	16,701	75,581
Belgian	1,063	78	1,141	2,080	69	2,149	2,171	78	2,249	1,222	79	1,301
Danish	1,112	299	1,411	2,030	225	2,255	3,835	284	4,119	3,311	351	3,662
Dutch	1,180	541	1,721	1,674	568	2,242	1,928	537	2,465	1,599	741	2,340
Finnish	1,617	63	1,680	5,180	88	5,268	4,765	112	4,877	3,651	100	3,751
French	498	1,821	2,319	548	2,499	3,047	868	3,138	4,006	745	3,934	4,679
German	7,356	2,318	9,674	12,540	2,681	15,221	12,032	3,190	15,222	12,806	3,803	16,609
Icelandic	53	22	75	30	32	62	28	18	46	24	23	47
Norwegian	1,072	800	1,872	3,384	1,255	4,639	4,327	1,330	5,657	2,434	1,419	3,853
Swedish	1,335	620	1,955	2,628	693	3,321	3,134	757	3,891	3,297	874	4,171
Swiss	320	98	418	568	101	669	614	134	748	490	156	646
Totals	15,606	6,660	22,266	30,662	8,211	38,873	33,702	9,578	43,280	29,579	11,480	41,059
Albanian	14	.....	14	17	.....	17	30	3	33	28	7	35
Arabian	10	.....	10	4	.....	4	6	1	7	1	1	2
Armenian	85	17	102	65	13	78	44	9	53	17	10	27
Austrian	75	79	154	401	129	530	606	153	759	409	100	509
Bohemian	8	63	71	22	85	107	7	67	74	8	86	94
Bulgarian	47	4	51	126	2	128	249	2	251	282	2	284
Chinese	.....	.....	.....	.....	.....	.....	3	.....	3	1	.....	1
Croatian	1,006	2	1,008	1,085	2	1,087	902	5	907	990	24	1,014
Czech	805	33	838	721	7	728	714	13	727	846	5	851
Dalmatian	1	.....	1	.....	.....	.....	.....	.....	.....	1	.....	1
East Indian	62	1	63	60	2	62	56	.....	56	52	1	53
Esthonian	28	2	30	92	.....	92	110	2	112	92	.....	92
Greek	217	41	258	340	45	385	583	72	655	736	70	806
Hebrew	3,587	427	4,014	4,471	392	4,863	4,296	470	4,766	3,301	547	3,848
Herzegovinian	.....	.....	.....	3	.....	3	4	.....	4	.....	.....	.....
Italian	1,638	138	1,776	3,301	165	3,466	3,593	190	3,783	792	272	1,064
Japanese	421	.....	421	475	.....	475	478	.....	478	445	1	446
Jugo-Slavian	1,604	23	1,627	2,084	18	2,102	1,450	19	1,469	2,824	32	2,856
Korean	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....
Lettish	24	3	27	60	4	64	77	8	85	74	3	77
Lithuanian	165	23	188	842	6	848	1,037	15	1,052	1,608	18	1,626
Magyar	4,112	75	4,187	4,863	77	4,940	5,318	103	5,421	6,242	106	6,348
Maltese	21	.....	21	33	1	34	39	1	40	18	1	19
Mexican	.....	4	4	1	2	3	.....	1	1	.....	.....	.....
Montenegrin	.....	.....	.....	5	.....	5	.....	.....	.....	.....	.....	.....
Moravian	6	.....	6	36	.....	36	33	2	35	4	1	5
Negro	53	269	322	51	241	292	88	237	325	96	280	376
North American Indian	.....	7	7	.....	13	13	.....	28	28	.....	23	23
Persian	11	.....	11	6	.....	6	4	.....	4	1	.....	1
Polish	2,535	190	2,725	6,505	199	6,704	6,733	254	6,987	8,269	246	8,515
Portuguese	3	3	6	14	4	18	7	4	11	12	10	22
Roumanian	265	26	291	292	38	330	237	38	275	284	48	332
Russian	925	167	1,092	1,127	169	1,296	948	184	1,132	908	285	1,193
Ruthenian	4,259	58	4,317	9,995	66	10,061	10,128	61	10,189	15,571	39	15,610
Serbian	454	4	458	885	8	893	411	15	426	390	20	410
Slovak	2,046	23	2,069	4,274	10	4,284	3,714	20	3,734	4,303	40	4,343
Spanish	12	17	29	29	20	49	28	17	45	18	49	67
Spanish American	.....	.....	.....	6	2	8	.....	.....	.....	3	4	7
Syrian	134	22	156	218	23	241	82	31	113	75	44	119
Turkish	17	.....	17	8	2	10	4	2	6	3	4	7
Totals	24,650	1,721	26,371	42,518	1,745	44,263	42,019	2,027	44,046	48,704	2,379	51,083
Grand totals	77,286	18,778	96,064	122,964	21,025	143,989	126,593	25,007	151,600	137,163	30,560	167,723

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from the United States, for the period April 1, 1925, to March 31, 1935

1929-30			1930-31			1931-32			1932-33			1933-34			1934-35		
Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals
32,278	9,379	41,657	14,662	7,498	22,160	4,275	4,525	8,800	1,940	4,153	6,093	1,375	2,623	3,998	1,380	2,053	3,433
10,159	3,762	13,921	4,233	2,904	7,137	791	1,716	2,507	323	1,512	1,835	283	905	1,188	291	727	1,018
18,640	3,638	22,278	7,872	2,917	10,789	1,843	1,732	3,575	764	1,747	2,511	547	1,038	1,585	472	734	1,206
3,005	332	3,337	817	231	1,048	179	147	326	70	92	162	55	77	132	55	55	110
64,082	17,111	81,193	27,584	13,550	41,134	7,088	8,120	15,208	3,097	7,504	10,601	2,260	4,643	6,903	2,198	3,569	5,767
696	92	788	255	105	360	47	31	78	37	42	79	41	23	64	61	18	79
2,685	319	3,004	820	184	1,004	53	87	140	55	53	108	43	47	90	21	28	49
1,755	703	2,458	344	444	788	33	236	269	33	226	259	27	137	164	44	104	148
4,565	82	4,647	2,297	57	2,354	92	38	130	30	29	59	51	16	67	59	21	80
697	4,419	5,116	347	4,391	4,738	87	2,734	2,821	88	2,702	2,790	74	1,130	1,204	86	809	895
14,281	3,733	18,014	7,724	2,673	10,397	727	1,532	2,259	518	1,180	1,698	401	755	1,156	301	656	957
6	28	34	25	17	42	.....	10	10	1	6	7	.....	10	10	1	12	13
2,256	1,149	3,405	740	645	1,385	70	171	241	44	218	262	31	108	139	37	93	130
2,918	736	3,654	730	366	1,096	79	195	274	17	165	182	19	110	129	10	83	93
473	117	590	211	83	294	24	28	52	17	41	58	19	30	49	22	21	43
30,332	11,378	41,710	13,493	8,965	22,458	1,212	5,062	6,274	840	4,662	5,502	706	2,366	3,072	642	1,845	2,487
26	1	27	25	1	26	5	.....	5	.....	.....	.....	1	.....	1	3	.....	3
7	2	9	2	.....	2	.....	.....	.....	2	.....	2	.....	.....	.....	1	.....	1
14	16	30	21	1	22	4	1	5	1	4	5	7	3	10	1	4	5
437	75	512	116	68	184	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	81	101	11	57	68	.....	21	21	7	16	23	.....	10	10	.....	9	9
296	10	306	295	.....	295	15	3	18	3	5	8	12	2	14	5	.....	5
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	2	.....	2	.....	.....	.....
771	11	782	482	2	484	106	5	111	96	4	100	108	6	114	155	.....	155
434	14	448	225	8	233	69	9	78	65	7	72	52	7	59	77	4	81
7	.....	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
58	.....	58	80	.....	80	47	.....	47	62	1	63	33	.....	33	33	.....	33
117	2	119	63	2	65	6	1	7	.....	1	1	2	2	4	2	.....	2
634	48	682	388	48	436	20	43	63	37	32	69	34	26	60	35	17	52
3,544	620	4,164	2,908	513	3,421	202	447	649	346	426	772	599	344	943	335	289	624
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1,277	236	1,513	1,007	228	1,235	414	166	580	255	142	397	267	109	376	325	56	381
194	.....	194	204	1	205	195	.....	195	115	.....	115	104	1	105	93	.....	93
921	35	956	364	27	391	57	9	66	56	11	67	63	3	66	120	2	122
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	8	78	28	1	29	4	2	6	.....	4	4	4	.....	4	.....	.....	.....
964	22	986	466	11	477	45	5	50	57	6	63	37	2	39	37	5	42
5,688	99	5,787	2,401	71	2,472	397	41	438	364	20	384	509	18	527	362	20	382
40	1	41	13	6	19	5	.....	5	2	4	6	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	2	2	3	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
23	.....	23	2	.....	2	.....	1	1	3	.....	3	.....	.....	.....	.....	.....	.....
195	251	446	120	158	278	15	83	98	9	60	69	19	57	76	5	16	21
.....	22	22	.....	8	8	.....	34	34	.....	20	20	.....	8	8	.....	6	6
1	.....	1	2	.....	2	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....
6,610	227	6,837	3,997	226	4,223	554	103	657	360	99	459	374	50	424	406	40	446
13	11	24	5	10	15	2	2	4	1	6	7	2	4	6	2	3	5
383	62	445	179	44	223	22	15	37	26	11	37	27	7	34	52	5	57
765	173	938	879	97	976	74	32	106	62	35	97	61	16	77	60	25	85
11,291	41	11,332	6,413	78	6,491	502	38	540	414	47	461	421	8	429	586	15	601
375	29	404	140	18	158	31	16	47	26	18	44	37	10	47	26	3	29
2,879	46	2,925	1,957	32	1,989	337	9	346	252	8	260	395	6	401	595	12	607
26	37	63	8	26	34	9	11	20	7	16	23	7	6	13	7	7	14
.....	4	4	1	1	2	2	.....	2	.....	1	1	4	.....	4	.....	.....	.....
61	51	112	54	22	76	15	16	31	19	26	45	14	26	40	13	7	20
6	1	7	7	.....	7	1	1	2	.....	.....	.....	2	.....	2	.....	1	1
38,147	2,238	40,385	22,866	1,765	24,631	3,155	1,115	4,270	2,649	1,030	3,679	3,197	731	3,928	3,336	546	3,882
132,561	30,727	163,288	63,943	24,280	88,223	11,455	14,297	25,752	6,586	13,196	19,782	6,163	7,740	13,903	6,176	5,960	12,136

TABLE

Immigration to Canada, by Origins, via Ocean Ports and from the

Racial Origin	1935-36			1936-37			1937-38			1938-39			1939-40		
	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A	Totals
English	1,286	1,744	3,030	1,445	1,738	3,183	1,949	1,870	3,819	2,247	1,824	4,071	2,489	1,878	4,367
Irish	249	626	875	262	617	879	364	686	1,050	387	726	1,113	375	710	1,085
Scottish	484	677	1,161	519	639	1,158	604	737	1,341	665	707	1,372	643	702	1,345
Welsh	30	56	86	38	69	107	55	48	103	74	60	134	59	75	134
Totals	2,049	3,103	5,152	2,264	3,063	5,327	2,972	3,341	6,313	3,373	3,317	6,690	3,566	3,365	6,931
Belgian	72	9	81	93	13	106	123	22	145	187	15	202	100	23	123
Danish	21	33	54	22	44	66	40	43	83	49	34	83	71	39	110
Dutch	111	97	208	90	102	192	119	113	232	237	139	376	264	147	411
Finnish	43	24	67	49	16	65	79	14	93	58	14	72	57	20	77
French	95	724	819	135	711	846	134	774	908	138	860	998	152	794	946
German	209	471	680	367	529	896	523	571	1,094	586	507	1,093	1,021	510	1,531
Icelandic	6	6	12	.....	2	2	3	5	8	.....	8	8	.....	4	4
Norwegian	31	94	125	25	74	99	27	91	118	21	84	105	40	89	129
Swedish	26	89	115	16	73	89	47	95	142	15	90	105	13	80	93
Swiss	32	18	50	49	16	65	87	18	105	75	22	97	49	32	81
Totals	646	1,565	2,211	846	1,580	2,426	1,182	1,746	2,928	1,366	1,773	3,139	1,767	1,738	3,505
Albanian	1	.....	1	4	.....	4	8	1	9	10	.....	10	4	.....	4
Arabian	.....	2	2	.....	.....	.....	4	.....	4	4	2	6	.....	.....	.....
Armenian	4	1	5	3	1	4	4	3	7	5	1	6	2	1	3
Bohemian	1	6	7	1	13	14	5	6	11	2	10	12	332	9	341
Bulgarian	22	2	24	18	1	19	28	2	30	29	.....	29	15	.....	15
Chinese	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Croatian	157	.....	157	240	.....	240	277	4	281	265	3	268	106	2	108
Czech	106	1	107	134	4	138	188	3	191	169	4	173	290	3	293
Dalmatian	.....	.....	.....	1	.....	1	.....	.....	.....	1	.....	1	.....	.....	.....
East Indian	20	1	21	13	.....	13	14	.....	14	14	.....	14	11	.....	11
Esthonian	2	.....	2	5	.....	5	2	1	3	12	.....	12	3	1	4
Greek	53	19	72	75	20	95	115	11	126	127	10	137	115	10	125
Hebrew	655	225	880	391	228	619	317	267	584	621	269	890	1,321	302	1,623
Italian	341	49	390	299	58	357	408	69	477	365	58	423	186	64	250
Japanese	83	.....	83	103	.....	103	139	.....	139	46	.....	46	36	.....	36
Jugo-Slavian	106	3	109	106	3	109	116	9	125	250	3	253	55	6	61
Lettish	3	.....	3	2	3	5	11	.....	11	4	.....	4	3	2	5
Lithuanian	22	3	25	42	10	52	37	6	43	39	6	45	49	5	54
Magyar	314	22	336	328	11	339	622	24	646	532	22	554	329	37	366
Maltese	.....	.....	.....	4	1	5	2	.....	2	1	5	6	.....	.....	.....
Mexican	.....	1	1	6	.....	6	1	.....	1	2	.....	2	.....	.....	.....
Montenegrin	.....	.....	.....	.....	.....	.....	2	.....	2	8	.....	8	.....	.....	.....
Moravian	.....	.....	.....	.....	.....	.....	3	.....	3	9	.....	9	52	.....	52
Negro	3	20	23	5	17	22	9	17	26	7	24	31	7	22	29
North American Indian	.....	2	2	.....	2	2	.....	11	11	.....	13	13	.....	4	4
Persian	.....	.....	.....	1	.....	1	2	1	3	.....	.....	.....	1	.....	1
Polish	362	42	404	432	35	467	615	46	661	586	68	654	297	51	348
Portuguese	4	3	7	2	.....	2	1	2	3	1	2	3	1	3	4
Roumanian	33	4	37	65	2	67	77	11	88	102	2	104	20	8	28
Russian	84	13	97	79	19	98	120	22	142	134	14	148	134	47	181
Ruthenian	418	8	426	855	15	870	1,356	13	1,369	1,837	19	1,856	1,509	16	1,525
Serbian	29	.....	29	35	3	38	83	4	87	70	5	75	17	4	21
Slovak	432	11	443	520	7	527	1,249	13	1,262	1,450	19	1,469	206	22	228
Spanish	6	5	11	10	11	21	14	2	16	6	4	10	9	10	19
Spanish American	.....	.....	.....	.....	1	1	3	.....	3	.....	.....	.....	.....	1	1
Syrian	26	10	36	19	5	24	15	8	23	18	10	28	14	15	29
Turkish	.....	.....	.....	1	.....	1	1	.....	1	.....	.....	.....	.....	.....	.....
Totals	3,287	453	3,740	3,800	470	4,270	5,848	556	6,404	6,726	573	7,299	5,124	645	5,769
Grand Totals	5,982	5,121	11,103	6,910	5,113	12,023	10,002	5,643	15,645	11,465	5,663	17,128	10,457	5,748	16,205

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United States, for the Period April 1, 1935, to March 31, 1945

1940-41			1941-42			1942-43			1943-44			1944-45		
Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals	Via Ocean ports	From U.S.A.	Totals
2,408	2,841	5,249	1,852	2,234	4,086	1,992	1,703	3,695	3,470	1,491	4,961	8,178	1,574	9,752
235	953	1,188	122	926	1,048	170	592	762	352	610	962	652	540	1,192
406	1,013	1,419	179	888	1,067	230	718	948	411	580	991	989	549	1,538
55	91	146	29	88	117	26	62	88	45	43	88	124	48	172
3,104	4,898	8,002	2,182	4,136	6,318	2,418	3,075	5,493	4,278	2,724	7,002	9,943	2,711	12,654
30	20	50	10	17	27	.....	11	11	6	9	15	13	8	21
22	63	85	4	42	46	3	22	25	9	28	37	12	36	48
51	187	238	11	192	203	10	136	146	8	123	131	28	131	159
2	30	32	1	18	19	.....	22	22	.....	15	15	2	10	12
129	849	978	104	632	736	69	580	649	149	586	735	305	653	958
39	359	398	23	371	394	15	256	271	11	302	313	55	312	367
.....	4	4	.....	5	5	1	4	5	1	4	5	1	6	7
21	79	100	14	96	110	19	84	103	12	51	63	13	55	68
6	117	123	1	72	73	6	53	59	3	53	56	6	91	97
12	42	54	15	36	51	3	18	21	4	10	14	9	13	22
312	1,750	2,062	183	1,481	1,664	126	1,186	1,312	203	1,181	1,384	444	1,315	1,759
.....	.....	.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2	3	5	.....	.....	.....	1	4	5	.....	2	2	1	2	3
3	12	15	.....	11	11	.....	6	6	.....	7	7	1	3	4
1	1	2	.....	.....	.....	.....	.....	.....	.....	2	2	.....	2	2
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	6	13	.....	3	3	1	2	3	2	3	5	.....	1	1
49	18	67	17	10	27	6	2	8	8	4	12	18	9	27
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	.....	6	3	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....
1	.....	1	1	.....	1	1	.....	1	2	.....	2	2	.....	2
26	20	46	3	27	30	1	14	15	1	11	12	3	15	18
284	342	626	111	277	388	31	239	270	56	182	238	93	237	330
43	85	128	1	66	67	.....	43	43	3	81	84	26	51	77
44	1	45	1	.....	1	.....	1	1	.....	.....	.....	.....	.....	.....
1	6	7	.....	5	5	.....	3	3	.....	6	6	1	10	11
1	6	7	.....	2	2	1	2	3	1	.....	1	1	1	2
6	8	14	.....	4	4	1	4	5	4	5	9	3	7	10
35	21	56	4	29	33	.....	27	27	3	26	29	19	24	43
.....	4	4	1	.....	1	.....	1	1	1	.....	1	1	.....	1
.....	.....	.....	.....	2	2	.....	1	1	1	.....	1	1	.....	1
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2	.....	2	.....	.....	.....	.....	.....	.....	1	.....	1	.....	.....	.....
45	30	75	13	31	44	5	53	58	5	24	29	23	42	65
.....	16	16	.....	15	15	.....	6	6	.....	16	16	2	21	23
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	.....	.....
25	100	125	5	102	107	5	71	76	7	63	70	43	76	119
4	2	6	5	4	9	3	2	5	3	.....	3	6	2	8
6	4	10	2	5	7	.....	3	3	3	8	11	2	4	6
9	31	40	11	35	46	6	22	28	4	19	23	9	42	51
3	19	22	.....	19	19	.....	15	15	.....	30	30	14	17	31
7	5	12	.....	9	9	.....	5	5	.....	4	4	1	3	4
5	23	28	2	20	22	4	19	23	1	21	22	.....	7	7
19	14	33	5	7	12	2	5	7	8	2	10	12	3	15
2	2	4	2	4	6	5	2	7	2	1	3	6	4	10
1	16	17	2	7	9	.....	13	13	1	19	20	7	15	22
.....	.....	.....	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....
637	795	1,432	189	694	883	74	566	640	118	536	654	295	598	893
4,053	7,443	11,496	2,554	6,311	8,865	2,618	4,827	7,445	4,599	4,441	9,040	10,682	4,624	15,306

TABLE 7

Immigration to Canada, by Origins, via Ocean Ports and from the United States for the Period April 1, 1945, to March 31, 1947

Racial Origin	1945-46			1946-47		
	Via Ocean Ports	From U.S.A.	Totals	Via Ocean Ports	From U.S.A.	Totals
English	15,781	2,416	18,197	35,596	3,767	39,363
Irish	1,410	936	2,346	3,073	1,441	4,514
Scottish	2,642	934	3,576	8,166	1,556	9,722
Welsh	329	102	431	1,141	103	1,244
Totals	20,162	4,388	24,550	47,976	6,867	54,843
Belgian	33	28	61	766	31	797
Danish	34	57	91	83	80	163
Dutch	97	235	332	2,365	298	2,663
Finnish	6	20	26	31	50	81
French	571	936	1,507	1,615	1,420	3,035
German	234	580	814	338	861	1,199
Icelandic	3	12	15	14	7	21
Norwegian	125	124	249	235	176	411
Swedish	27	110	137	88	154	242
Swiss	18	37	55	70	40	110
Totals	1,148	2,139	3,287	5,605	3,117	8,722
Albanian	.....	.....	.....	.....	4	4
Armenian	3	3	6	13	1	14
Bohemian	10	10	20	11	17	28
Bulgarian	.....	1	1	1	3	4
Chinese	1	.....	1	7	.....	7
Corsican	.....	.....	.....	1	.....	1
Croatian	1	2	3	5	6	11
Czech	43	12	55	176	20	196
Dalmatian	.....	.....	.....	1	.....	1
East Indian	1	.....	1	7	1	8
Esthonian	8	1	9	9	1	10
Greek	32	23	55	60	49	109
Hebrew	1,345	368	1,713	605	600	1,205
Italian	58	125	183	142	159	301
Japanese	.....	.....	.....	1	2	3
Jugo-Slavian	10	18	28	17	19	36
Lettish	1	.....	1	8	2	10
Lithuanian	4	5	9	23	12	35
Magyar	38	49	87	64	74	138
Maltese	5	1	6	16	.....	16
Mexican	3	2	5	2	.....	2
Moravian	.....	3	3	1	.....	1
Negro	75	52	127	110	43	153
North American Indian	.....	20	20	11	26	37
Persian	1	.....	1	4	1	5
Polish	528	95	623	336	163	499
Portuguese	12	4	16	34	10	44

TABLE 7—*Conc.*

Immigration to Canada, by Origins, via Ocean Ports and from the United States for the Period April 1, 1945, to March 31, 1947—Conc.

Racial Origin	1945-46			1946-47		
	Via Ocean Ports	From U.S.A.	Totals	Via Ocean Ports	From U.S.A.	Totals
Roumanian	5	15	20	21	26	47
Russian	59	53	112	145	64	209
Ruthenian	18	30	48	103	49	152
Serbian	1	4	5	5	14	19
Slovakian	4	13	17	5	15	20
Spanish	28	3	31	37	6	43
Spanish American	5	3	8	7	12	19
Syrian	14	11	25	9	26	35
Turkish	4	1	5	2	1	3
Totals	2,317	927	3,244	1,999	1,426	3,425
Grand Totals	23,627	7,454	31,081	55,580	11,410	66,990

TABLE

Immigration via Ocean Ports, Showing Country of

Country of Birth	Totals	Armenian	Belgian	Bohemian	Bulgarian	English	Irish	Scottish	Welsh	Chinese	Corsican	Croatian	Czech	Dalmatian	Danish	Dutch
Africa (British)	115					74	5	17								5
Africa (Not British)	15		2			9										
Albania	1															
Arabia	1					1										
Argentina	30					16	8	3	1							
Asia	2															
Atlantic Ocean Islands (British)	15					6		4								2
Atlantic Ocean Islands (Not British)	4					2		1								
At Sea	5					5										
Australia	260	1				176	23	42	7	2						2
Austria	85					1							5			
Bahamas	22					16	1	2								
Barbados	64					30		3	1							
Belgium	831		703			42	7	9								8
Bermuda	48					39	2	1								1
Brazil	20					11		1								2
Bulgaria	1				1											
Canada	54		3			29	6	7								
Chili	14					5		6								
China	117					73	11	16							1	4
Cuba	16					6	1	1								
Czecho-Slovakia	182			6									149			
Dansig	1															
Denmark	47														44	
Dutch East Indies	29															29
Ecuador	3					3										
Egypt	27					16		3								
Eire	896					74	786	19								1
England	35,524	4	27	4		31,063	834	1,275	209	4		2	14		28	108
Esthonia	7															
Fijian Islands	1					1										
Finland	19															
France	275		15			36	1	4								1
Germany	191					19	1	1					1			15
Gibraltar	9					8		1								
Greece	39					1										
Guatemala	13						3									1
Guiana (British)	23					12	1	1								
Haiti	2															
Hawaiian Islands	1							1								
Holland	2,407		5	1		153	22	25	1				1			2,111
Honduras (British)	3					2										
Hong Kong	21					13	1	4							1	
Hungary	54					1										
Iceland	2														2	
India	326	2				250	17	33	4							4
Iraq	1					1										
Ireland, Northern	758					76	645	23	3							
Italy	64					2		1								

8

Birth by Racial Origin, for the Fiscal Year, 1946-1947

East Indian	Esthonian	Finnish	French	German	Greek	Hebrew	Icelandic	Italian	Japanese	Jugoslav	Lettish	Lithuanian	Magyar	Maltese	Mexican	Moravian	Negro	North American Indian	Norwegian	Persian	Polish	Portuguese	Roumanian	Russian	Ruthenian	Serbian	Slovak	Spanish	Spanish American	Swedish	Swiss	Syrian	Turkish
....	....	....	7	2	....	3	....	....	..	..	..	..	..	..	..	..	....	....	1	....	....	..	..	....	....	..	..	1	....	..	..	..	....
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....	....	....	9	2	....	1	....	....	..	..	..	1	..	..	..	..	....	....	....	....	....	2	..	1	....	..	..	....	....	..	..	..	....
....	1	9	952	132	12	288	12	56	1	2	1	8	17	5	1	..	12	5	70	....	115	3	7	80	75	2	..	13	....	42	29	2	....
....	6	....	.....	....	....	.....	....	....	..	..	..	..	..	..	..	..	....	....	....	....	....	....	..	..	1	....	..	..	....	....	..	..	..	....
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....	....	....	208	....	....	2	....	2	..	..	..	..	..	..	..	..	....	....	....	....	2	..	..	1	....	..	..	....	....	..	3	..	....
....	....	....	.....	81	....	66	....	....	..	..	..	..	1	..	..	..	....	....	....	....	3	..	..	....	1	..	..	....	....	1	1	..	....
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TABLE

Immigration via Ocean Ports, Showing Country of

Country of Birth	Totals	Armenian	Belgian	Bohemian	Bulgarian	English	Irish	Scottish	Welsh	Chinese	Corsican	Croatian	Czech	Dalmatian	Danish	Dutch
Jamaica	141					79	5	19								
Japan	21					13		1							3	
Java	5					2										3
Jugoslavia	18											3		1		
Korea	3						3									
Latvia	10															
Lesser British Isles	83					64		4								1
Lithuania	5															
Luxemburg	4		2													
Malta	19					8		2								
Mexico	24					6		2								9
Newfoundland	2,397					1,892	316	72	13						1	1
New Zealand	108					76	10	19	2							
Norway	129					1										
Palestine	9					4										
Persia	1	1														
Peru	16					9	4	2								
Poland	251					1							1			1
Porto Rico	2					2										
Portugal	4					3										
Roumania	20															
Russia	55					3		1								3
Scotland	7,774		5			621	297	6,437	20				4		3	25
Siam	1					1										
South America (N.E.S.)	7					6	1									
Spain	12					6		3								
St. Pierre et Miquelon	12					2										
Straits Settlements	13					7	1	2								3
Sumatra	3					1	1									1
Sweden	31					4	3									
Switzerland	45		1			5	1									
Syria	6					1										
Trinidad	49					19	4	4			1					
Turkey	18	5				5		1								
Ukraine	6															2
United States	185		2			108	14	33	2							4
Uruguay	1					1										
Venezuela	5					2	2									
Wales	1,360		1			354	33	49	877				1			7
West Indies (British) N.E.S.	67					18	3	8	1	1						1
West Indies (Not British) N.E.S.	15							3								10
	55,580	13	766	11	1	35,596	3,073	8,166	1,141	7	1	5	176	1	83	2,365

8—*Conc.*

Birth by Racial Origin, for the Fiscal Year, 1946-1947

East Indian	Esthonian	Finnish	French	German	Greek	Hebrew	Icelandic	Italian	Japanese	Jugoslav	Lettish	Lithuanian	Magyar	Maltese	Mexican	Moravian	Negro	North American Indian	Norwegian	Persian	Polish	Portuguese	Roumanian	Russian	Ruthenian	Serbian	Slovak	Spanish	Spanish American	Swedish	Swiss	Syrian	Turkish
....	....	....	2	....	....	1	....	1	..	..	..	..	..	..	..	..	27	....	....	....	....	1	..	....	....	..	..	3	....	....	2	1	....
....	....	....	.....	....	....	.....	....	.....	..	..	..	..	..	..	..	..	.....	....	1	3	....	..	..	....	....	..	..	.....	....	....	..	..	....
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....	....	....	82	1	....	5	....	1	..	..	..	..	..	..	..	..	.....	1	4	....	1	3	..	1	1	..	..	1	....	....	..	1	....
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....	....	....	.....	2	....	1	....	.....	..	..	..	..	..	..	..	..	.....	....	125	....	....	..	..	....	....	..	..	.....	....	....	..	..	....
....	....	....	.....	....	....	5	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	..	....	....	..	..	.....	....	....	..	..	....
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....	....	....	.....	....	1	12	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	7	....	....	..	..	.....	....	....	..	..	....
....	1	....	.....	....	....	19	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	4	..	..	23	1	..	..	.....	....	....	..	..	....
....	....	6	177	31	....	14	1	15	..	..	..	10	3	1	..	..	....	1	19	....	25	..	3	15	20	..	..	1	....	13	7	..	....
....	....	....	.....	....	....	.....	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	..	....	....	..	..	.....	....	....	..	..	....
....	....	....	.....	....	....	.....	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	..	....	....	..	..	.....	....	....	..	..	....
....	....	....	.....	....	....	.....	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	..	....	....	..	..	3	....	....	..	..	....
....	....	....	9	....	....	.....	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	..	....	....	..	..	1	....	....	..	..	....
....	....	....	.....	....	....	.....	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	..	....	....	..	..	.....	....	....	..	..	....
....	....	....	.....	....	....	.....	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	..	....	....	..	..	.....	....	....	..	..	....
....	....	....	.....	....	....	1	....	.....	..	..	..	..	..	..	..	..	.....	....	1	....	....	..	..	....	....	..	..	.....	....	22	..	..	....
....	....	....	.....	9	....	.....	....	.....	..	..	..	..	1	..	..	..	.....	....	....	....	1	..	..	2	....	..	..	.....	....	..	25	..	....
....	....	....	.....	....	....	1	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	..	....	....	..	..	.....	....	....	..	4	....
....	....	....	2	....	....	.....	....	.....	..	..	..	..	..	..	..	..	10	....	....	....	....	7	..	....	....	..	..	2	....	....	..	..	....
....	....	....	.....	....	4	.....	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	..	....	....	..	..	.....	....	....	..	1	2
....	1	....	.....	....	....	.....	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	1	..	..	2	....	..	..	.....	....	....	..	..	....
....	....	....	5	2	....	5	....	1	..	1	..	..	..	..	..	..	.....	....	3	....	2	1	..	....	....	..	..	.....	....	1	1	..	....
....	....	....	.....	....	....	.....	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	..	....	....	..	..	.....	....	....	..	..	....
....	....	....	.....	....	....	.....	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	..	....	....	..	..	1	....	....	..	..	....
....	....	....	21	3	1	....	1	2	..	..	..	..	..	..	..	..	1	....	1	....	4	..	..	2	1	..	..	.....	....	1	..	..	....
....	....	....	3	....	....	1	....	.....	..	..	..	..	..	..	..	..	24	1	....	....	....	5	..	....	....	..	..	1	....	....	..	..	....
....	....	....	1	....	....	.....	....	.....	..	..	..	..	..	..	..	..	.....	....	....	....	....	..	..	....	....	..	..	1	....	....	..	..	....
7	9	31	1,615	338	60	605	14	142	1	17	8	23	64	16	2	1	110	11	235	4	336	34	21	145	103	5	5	37	7	88	70	9	2

TABLE 9

Immigration from the United States, Showing Country of Birth by Racial Origin for the Fiscal Year 1946-1947

Country of Birth	Totals	Albanian	Armenian	Belgian	Bohemian	English	Irish	Scottish	Welsh	Bulgarian	Croatian	Czech	Danish	Dutch	East Indian	Esthonian	Finnish	French	German	Greek	Hebrew	Icelandic	Italian	Japanese	Jugoslav	Lettish	Lithuanian	Magyar	Negro	North Am. Indian	Norwegian	Persian	Polish	Portuguese	Roumanian	Russian	Ruthenian	Serbian	Slovak	Spanish	Spanish American	Swedish	Swiss	Syrian	Turkish
Africa (British)	10					6	1	1											1								1																	
Africa (Not British)	1					1																																						
Albania	1	1																																										
Argentina	6																		5								1																	
Atlantic Ocean Islands (Br.)	1					1																																						
Atlantic Ocean Islands (Not British)	1					1																																						
At Sea	1						1																																					
Australia	15					14		1																																				
Austria	23				2	1					1								10		5															1	3							
Barbados	1					1																																						
Belgium	17			13		2												2																										
Bermuda	4					2								1														1															
Brazil	5					2		1																									1	1										
Bulgaria	1									1																																		
Canada	1,305					423	203	229	12			2	23		1	261	52	3	50	1	7						2	1	9		3		2		9					6	3	3	
Chili	6					2	1									3																											
China	13					1	2					1				1	1		5																						1			
Cuba	1							1																																				
Czecho-Slovakia	11			1	1							3							1					1			1											3					
Danzig	1													1																														
Denmark	14												14																															
Eire	27					1	26																																					
England	473					430	7	10	3					1					3		4	12												2			1							
Finland	9																9																											
France	23			1												21							1																					
French Indo-China	1					1																																						
Germany	58					1						1		1					39		13		1												1									1
Gibraltar	1															1																											
Greece	15									1										13	1																						
Guatemala	2																		2																									
Guiana (British)	1															1																											
Hawaiian Islands	1																																										
Holland	16													16																													
Hungary	33																		2		3				1			25							2								
India	12					7		5																																			
Ireland (Northern)	38					1	37																																				

Italy	28					1																	27																						
Jamaica	14					5		4					1																4																
Japan	1																																	1											
Java	2					1								1																															
Jugo-Slavia	13										2								4	1					3										1			1	1						
Labrador	1					1																																							
Latvia	1																									1																			
Lesser British Isles	3					3																																							
Lithuania	1																				1																								
Mexico	1							1																																					
Newfoundland	42					35	4	3																																					
New Zealand	6					6																																							
Norway	27																				1										26														
Persia	1																															1													
Peru	2					1																																		1					
Philippine Islands	7					4		1																																2					
Poland	78																		2		46												27				3								
Porto Rico	2																												1												1				
Portugal	1																																	1											
Roumania	14																		3		8														3										
Russia	82					1								6			2		4		58				1								1			9									
Scotland	205					7	1	193					1					1			1		1																						
South America (N.E.S.)	1							1																																					
Spain	2								2																																				
Sweden	14																																									14			
Switzerland	9																																										9		
Syria	3																	1																										2	
Trinidad	4						1											1																1						1					
Turkey	3					1		1												1																									
Ukraine	2																																			1	1								
United States	8,667	3	1	16	14	2,793	1,157	1,102	74	1	3	16	61	248	1	1	38	1,124	736	27	395	6	122	2	13	1	12	46	34	25	138		130	5	18	53	33	13	11	1	11	134	27	21	
Wales	19					7			12																																				
West Indies (British)	5					2		2																					1																
West Indies (Not British)	1					1																																							
Totals	11,410	4	1	31	17	3,767	1,441	1,556	103	3	6	20	80	298	1	1	50	1,420	861	49	600	7	159	2	19	2	12	74	43	26	176	1	163	10	26	64	49	14	15	6	12	154	40	26	1

TABLE

Origin, Sex, Occupation, and Destination of Immigrant Arrivals

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	3	4	4	2	13	.....	.....	.....	.....	.....	.....	.....	.....	.....
Belgian	17	676	39	34	766	2	4	2	2	1	.....	4	2	.....
Bohemian	4	3	3	1	11	.....	.....	.....	.....	.....	.....	1	.....	.....
British—														
English	4,073	21,937	4,812	4,774	35,596	421	204	181	524	230	137	1,529	553	426
Irish	413	1,690	497	473	3,073	34	10	7	98	33	14	145	54	31
Scottish	776	5,104	1,147	1,139	8,166	76	43	34	88	47	31	305	130	80
Welsh	172	805	85	79	1,141	17	6	6	22	9	5	74	17	12
Bulgarian	1	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....
Chinese	.....	3	1	3	7	.....	.....	.....	.....	.....	.....	.....	.....	.....
Corsican	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1	.....	.....
Croatian	2	2	.....	1	5	.....	.....	.....	.....	.....	.....	2	.....	.....
Czech	72	53	16	35	176	.....	.....	.....	3	3	2	20	12	7
Dalmatian	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1	.....	.....
Dutch	51	2,017	125	172	2,365	10	3	3	5	1	.....	9	2	.....
East Indian	1	3	3	.....	7	.....	.....	.....	.....	.....	.....	1	1	.....
Esthonian	3	5	.....	1	9	.....	.....	.....	1	.....	.....	2	.....	.....
Finnish	5	7	9	10	31	.....	.....	.....	1	.....	.....	3	2	2
French	76	254	661	624	1,615	10	4	9	17	1	2	12	4	1
German	51	111	76	100	338	8	4	3	6	2	1	11	3	3
Greek	31	13	6	10	60	1	.....	.....	9	.....	.....	3	.....	.....
Hebrew	177	298	63	67	605	2	1	1	6	4	3	46	25	12
Italian	20	74	19	29	142	.....	1	.....	3	.....	.....	9	2	.....
Japanese	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Jugo-Slavian	5	8	1	3	17	.....	.....	.....	1	.....	.....	3	2	2
Lettish	1	5	2	.....	8	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lithuanian	3	15	2	3	23	1	.....	.....	.....	.....	.....	2	1	1
Magyar	11	29	10	14	64	3	.....	.....	1	.....	.....	4	2	.....
Maltese	5	6	4	1	16	.....	.....	.....	2	.....	.....	2	.....	.....
Mexican	.....	1	.....	1	2	.....	.....	.....	.....	.....	1	.....	.....	.....
Moravian	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Negro	69	32	4	5	110	.....	1	.....	22	1	1	21	1	.....
North American Indian	.....	1	4	6	11	.....	.....	.....	.....	.....	.....	.....	.....	.....
Persian	2	.....	2	.....	4	.....	.....	.....	.....	.....	.....	.....	.....	.....
Polish	96	76	89	75	336	10	3	1	8	4	.....	37	8	3
Portuguese	14	8	8	4	34	1	1	.....	4	.....	.....	3	.....	.....
Roumanian	4	3	9	5	21	.....	.....	.....	1	.....	.....	1	1	2
Russian	11	49	35	50	145	.....	2	1	2	.....	.....	4	2	.....
Ruthenian	.....	4	49	50	103	.....	.....	.....	.....	.....	.....	.....	1	.....
Scandinavian—														
Danish	19	32	16	16	83	1	1	1	5	.....	.....	7	2	.....
Icelandic	.....	.....	8	6	14	.....	.....	.....	.....	.....	.....	.....	.....	.....
Norwegian	100	29	56	50	235	6	2	.....	20	.....	1	44	4	1
Swedish	10	19	33	26	88	2	.....	.....	.....	.....	.....	3	2	.....
Serbian	1	2	2	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	.....
Slovak	2	3	.....	.....	5	.....	.....	.....	.....	.....	.....	1	.....	.....
Spanish	5	25	3	4	37	.....	.....	.....	1	1	.....	2	1	.....
Spanish American	3	3	1	.....	7	.....	.....	.....	.....	.....	.....	.....	.....	.....
Swiss	7	33	13	17	70	1	.....	2	.....	.....	.....	1	.....	1
Syrian	1	5	2	1	9	.....	.....	.....	.....	.....	.....	.....	.....	.....
Turkish	.....	2	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	1	.....
Totals	6,319	33,451	7,919	7,891	55,580	607	290	251	852	337	198	2,313	835	584

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at Ocean Ports for the Fiscal Year Ended March 31, 1947

Occupation											Destination									
Trading and Clerical Classes			Mining Class			Female Domestic Servants		Other Classes												
Males	Females	Children	Males	Females	Children	18 Years and Over	Under 18 Years	Males	Females	Children	Nova Scotia	New Brunswick	Prince Edward Island	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon Territory	Northwest Territories
.....	.....	.....	.....	.....	.....	.....	.....	3	4	6	.....	.....	.....	1	8	.....	1	2	1	.....	.....
6	8	2	.....	.....	.....	.....	.....	3	661	69	33	41	8	217	247	53	52	55	59	1	.....
2	1	1	.....	.....	.....	.....	.....	1	2	3	.....	.....	.....	1	7	.....	.....	.....	3	.....	.....
924	753	262	20	6	8	377	59	655	19,814	8,513	2,431	1,453	259	3,821	14,971	2,447	2,531	2,926	4,748	6	3
66	75	17	3	.....	.....	72	7	67	1,446	894	265	140	41	403	1,283	183	205	230	323	.....	.....
169	150	64	2	.....	.....	42	.....	136	4,692	2,077	509	398	76	819	3,380	553	536	739	1,156	.....	.....
39	22	10	.....	1	.....	2	.....	20	748	131	57	39	8	114	453	73	96	124	177	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	3	4	.....	.....	.....	1	2	.....	.....	.....	4	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	2	1	.....	.....	.....	2	2	.....	1	.....	.....	.....	.....
37	22	22	.....	.....	.....	.....	.....	12	16	20	1	.....	.....	6	153	5	.....	4	7	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	7	12	.....	.....	.....	1	.....	14	2,003	282	164	98	9	229	937	188	252	239	248	.....	1
.....	.....	.....	.....	.....	.....	.....	.....	.....	2	3	1	.....	.....	1	.....	.....	.....	.....	5	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	5	1	1	.....	.....	1	4	1	.....	1	1	.....	.....
.....	.....	.....	1	.....	.....	.....	.....	.....	5	17	.....	.....	.....	1	26	.....	.....	1	3	.....	.....
14	17	5	.....	.....	.....	16	3	23	212	1,265	90	118	18	667	452	67	46	62	94	1	.....
7	8	2	.....	.....	.....	2	.....	19	92	167	6	7	.....	56	108	20	49	40	52	.....	.....
16	.....	.....	.....	1	.....	.....	.....	2	12	16	3	6	1	24	17	.....	1	5	3	.....	.....
80	37	19	1	.....	.....	.....	.....	42	231	95	11	4	3	221	240	51	20	20	35	.....	.....
6	1	1	.....	.....	.....	1	.....	2	69	47	6	7	1	42	53	6	7	7	13	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....
1	.....	.....	.....	.....	.....	1	.....	.....	5	2	.....	.....	.....	1	15	.....	.....	.....	1	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	1	5	2	3	.....	.....	.....	2	.....	1	1	1	.....	.....
.....	2	.....	.....	.....	.....	1	.....	.....	11	4	.....	.....	1	8	8	.....	1	1	4	.....	.....
2	1	.....	.....	.....	.....	.....	.....	1	26	24	.....	.....	.....	4	27	3	8	9	13	.....	.....
1	.....	.....	.....	.....	.....	.....	.....	.....	6	5	3	1	.....	.....	9	1	.....	.....	2	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	1	.....	.....	.....	1	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....
8	4	.....	.....	.....	.....	.....	.....	18	25	8	11	.....	.....	72	25	1	.....	.....	1	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	10	1	.....	.....	.....	7	2	.....	.....	1	.....	.....
1	.....	2	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4	.....	.....
18	5	5	.....	.....	.....	1	.....	23	55	155	2	2	1	76	137	44	27	27	20	.....	.....
4	2	7	.....	.....	.....	.....	.....	2	5	5	2	1	.....	16	13	.....	1	.....	1	.....	.....
1	.....	.....	.....	.....	.....	.....	.....	1	2	12	.....	.....	.....	6	6	2	4	2	1	.....	.....
3	5	.....	.....	.....	.....	.....	.....	2	40	84	1	.....	.....	16	43	29	16	19	21	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	3	99	.....	.....	.....	4	33	27	16	16	7	.....	.....
1	1	2	.....	.....	.....	1	.....	5	27	29	5	2	.....	16	11	8	4	20	16	.....	1
.....	.....	1	.....	.....	.....	.....	.....	.....	.....	13	.....	.....	.....	.....	1	11	1	.....	1	.....	.....
21	1	2	1	.....	.....	2	.....	8	20	102	27	4	.....	23	82	11	24	35	29	.....	.....
.....	.....	.....	1	.....	.....	.....	.....	4	17	59	.....	5	.....	5	26	13	6	14	19	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	1	2	2	.....	.....	.....	.....	2	1	.....	.....	2	.....	.....
1	1	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	5	.....	.....	.....	.....	.....	.....
.....	2	.....	.....	.....	.....	.....	.....	2	21	7	.....	.....	.....	6	17	2	3	.....	9	.....	.....
2	.....	.....	.....	.....	.....	.....	.....	1	3	1	1	.....	.....	.....	4	1	.....	.....	1	.....	.....
3	1	1	.....	.....	.....	.....	.....	2	32	26	2	4	.....	16	22	1	2	9	14	.....	.....
.....	.....	.....	.....	.....	.....	1	.....	1	4	3	2	.....	.....	1	4	.....	1	.....	1	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	1	.....	.....
1,446	1,126	437	29	8	8	520	69	1,072	30,335	14,263	3,638	2,332	426	6,898	22,846	3,804	3,912	4,608	7,103	8	5

TABLE

Origin, Sex, Occupation, and Destination of Immigrant Arrivals

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
Albanian	1	2	1	.....	4	.....	.....	.....	.....	.....	.....	.....	.....	.....
Armenian	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Belgian	11	10	10	.....	31	7	3	8	.....	.....	.....	3	2	.....
Bohemian	7	5	4	1	17	1	1	.....	1	.....	4	.....	.....	.....
British—														
English	1,140	1,340	649	638	3,767	169	90	74	115	42	42	227	84	68
Irish	482	461	246	252	1,441	86	24	40	71	16	23	108	29	37
Scottish	489	545	289	233	1,556	72	29	68	64	23	21	94	39	29
Welsh	42	33	7	21	103	7	4	2	2	2	.....	11	4	1
Bulgarian	2	.....	1	.....	3	.....	.....	.....	.....	.....	.....	1	.....	.....
Croatian	2	3	.....	1	6	.....	.....	.....	.....	.....	.....	.....	.....	.....
Czech	5	12	2	1	20	1	.....	2	.....	.....	.....	2	1	.....
Dutch	110	108	43	37	298	24	16	16	8	4	.....	23	8	7
East Indian	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Esthonian	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Finnish	13	19	10	8	50	1	1	2	2	1	1	3	3	.....
French	450	484	221	265	1,420	102	30	67	65	14	22	96	41	35
German	268	377	118	98	861	54	23	38	20	12	9	49	14	19
Greek	17	21	4	7	49	2	.....	.....	1	.....	.....	2	.....	.....
Hebrew	245	233	69	53	600	3	.....	2	15	1	.....	41	20	13
Italian	60	58	26	15	159	7	4	5	13	1	3	12	1	2
Japanese	.....	2	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	1	.....
Jugo-Slavian	7	10	1	1	19	.....	1	.....	1	.....	.....	.....	.....	.....
Lettish	.....	1	1	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lithuanian	5	5	.....	2	12	.....	.....	.....	.....	.....	.....	3	1	.....
Magyar	25	28	13	8	74	13	6	5	2	1	1	2	.....	.....
Negro	25	14	4	.....	43	2	1	1	13	1	.....	5	3	.....
North American Indian	4	1	11	10	26	3	....	1	.....	.....	....	1	.....	.....
Persian	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Polish	57	69	24	13	163	10	6	6	10	4	2	12	3	5
Portuguese	4	6	.....	.....	10	.....	.....	.....	.....	.....	.....	3	.....	.....
Roumanian	9	10	2	5	26	1	1	.....	2	.....	.....	.....	.....	.....
Russian	23	22	9	10	64	5	1	7	1	.....	.....	4	1	.....
Ruthenian	9	17	12	11	49	3	.....	.....	2	1	4	2	2	.....
Scandinavian—														
Danish	30	26	10	14	80	7	3	3	4	1	6	7	1	3
Icelandic	.....	2	3	2	7	.....	1	1	.....	.....	.....	.....	.....	.....
Norwegian	61	57	25	33	176	17	7	6	6	2	.....	16	2	4
Swedish	48	62	20	24	154	12	3	11	5	2	3	12	3	1
Serbian	3	8	3	.....	14	1	.....	.....	.....	.....	.....	2	.....	.....
Slovak	6	8	1	.....	15	1	.....	.....	1	.....	.....	1	1	.....
Spanish	2	4	.....	.....	6	.....	.....	.....	.....	.....	.....	.....	.....	.....
Spanish American	2	5	4	1	12	.....	.....	.....	.....	.....	.....	.....	.....	.....
Swiss	22	11	6	1	40	7	.....	.....	1	.....	.....	4	.....	1
Syrian	7	11	1	7	26	.....	.....	.....	.....	.....	.....	1	.....	.....
Turkish	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	3,694	4,093	1,850	1,773	11,410	618	255	365	425	128	141	747	264	225

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from the United States for the Fiscal Year Ended March 31, 1947

Occupation											Destination										
Trading and Clerical Classes			Mining Class			Female Domestic Servants		Other Classes													
Males	Females	Children	Males	Females	Children	18 Years and Over	Under 18 Years	Males	Females	Children	Nova Scotia	New Brunswick	Prince Edward Island	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon Territory	Northwest Territories
								1	2	1					4						
									1						1						
								1	5	2	2				26	1			2		
3	1	1	1					1	3						11	1	1	1	3		
283	198	121	5	1	2	19		341	906	980	277	392	48	335	1,661	139	71	203	639	2	
94	52	45	9	3	2	6	1	114	331	350	82	110	19	117	739	41	53	99	177	4	
115	90	38	2	1		11	1	142	352	365	144	146	44	96	687	64	45	70	260		
12	4	7	1	1				9	18	18	5	3		8	42	1	4	8	32		
1										1					3						
								2	3	1	1				4				1		
	2							2	9	1	1			4	6		1	7	1		
27	14	12	2			1		26	65	45	19	4	2	19	151	11	11	34	47		
									1										1		
										1								1			
1		3						6	14	12	1				31	4	1	4	9		
77	51	46	2	1		13	1	108	334	315	78	150	9	675	353	18	19	32	83	2	1
78	57	24	2		1	6		65	265	125	25	7	5	39	457	62	63	78	124	1	
11	5	4						1	16	7	3	6		5	22	3	3	1	6		
146	48	27						40	164	80	9	12	1	233	259	32	2	16	36		
13	8	3						15	44	28	4	2	1	36	89	2		3	22		
									1						2						
3	3		1			1		2	5	2					17		1		1		
									1	1	1			1							
	1							2	3	2	1	1		1	7		1	1			
5	2	1				1		3	18	14	2			9	42	5	4	3	9		
4	1					1		1	7	3	2	1	1	10	24	1		1	3		
									1	20	1	1		6	7			1	10		
								1								1					
13	4	3				2		12	50	21	1	4		5	122	14	2	9	6		
	3							1	3		1			3	3			2	1		
4	2	1						2	7	6				4	13	5	1		3		
8	5	1						5	15	11				5	17	8	6	13	15		
	3	2						2	11	17				2	23	17	3	2	2		
4	3			1				8	17	12	3	4		3	24	11	4	16	15		
									1	4						3		1	3		
8	3	5	1					13	43	43	3	2		16	31	15	25	42	42		
12	6	2	1					6	48	27	7	1		3	61	13	4	31	34		
									8	3				1	9			1	3		
1	3							2	4	1				1	11		1	2			
	1							2	3					2				2	2		
1	1	2						1	4	3				5	6	1					
3	1	1						7	10	5	3	1	1	3	13		3	3	13		
5	2	3						1	9	5	2	3		14	5			1	1		
									1					1							
932	574	352	27	8	5	61	3	945	2,803	2,532	678	850	131	1,662	4,983	473	329	688	1,606	9	1

TABLE

Total Immigration to Canada, Showing Racial Origin by Country of Last

Country of Last Permanent Residence	Totals	Albanian	Armenian	Belgian	Bohemian	English	Irish	Scottish	Welsh	Bulgarian	Chinese	Corsican	Croatian	Czech	Dalmatian	Dutch	East Indian
Africa (Not British)	25					10											
Africa (British)	112					75	4	12						2		3	
Argentine	25					11	4	3								1	
Australia	260					166	23	48	4		2					2	
Austria	23													1			
Bahamas	28					23	1	2									
Barbados	53					27		3	1							1	
Belgium	867			716		38	6	9						1		9	
Bermuda	51					42	2	1								1	
Brazil	32					12	4	1						3		4	
Central America, N.E.S.	14					2	2									1	
Chili	8					4		1									
China	114					68	5	16								4	
Cuba	22					13	2										
Czecho-Slovakia	151				2					1				132			
Denmark	40					1		2									
Ecuador	9					6	1										
Eire	446					46	340	22								2	
Egypt	10					1											
England	37,615		8	37	5	31,409	1,389	1,796	525		4		2	24		130	1
Esthonia	4																
Finland	15																
France	244			5		10	2	1						1			
Germany	66					3										2	
Greece	41																
Guiana (British)	21					12		2									
Holland	2,460			5	1	155	22	29	1					1		2,135	
Honduras, British	4					3		1									
Hong Kong	10					9											
Hungary	17																
India	151		1			104	7	10	3					5		2	6
Ireland, Northern	657					63	543	29	6								
Italy	49					1							1				
Jamacia	141					73	6	22						1			
Japan	17					6		1								1	
Jugo Slavia	9												2		1		
Latvia	3																
Lesser British Isles	36					30		2									
Lithuania	2																
Malta	9					3											
Mexico	42					3		2	1							11	
Newfoundland	2,453					1,919	321	82	15							2	
New Zealand	116					77	7	24	3							1	
Norway	162					25	3	3									
Palestine	15		1				1										
Peru	16					8	3	2									
Poland	121					1											
Porto Rico	4					4											
Portugal	10					4											
Roumania	7					1											
Russia	1																
Scotland	7,437			3		720	322	5,970	22					2		29	
South America, N.E.S.	20					11	1	3									
Spain	11					1											
St. Pierre & Miquelon	12					1											
Sweden	28																
Switzerland	26					3	2										
Syria	3																
Trinidad	61					22	5	5				1					
Turkey	3		3														
United States	11,416	4	1	31	17	3,770	1,442	1,557	103	3			6	20		299	1
Venezuela	10					6	3										
Wales	1,007				3	316	32	46	557		1			3		9	
West Indies (British) N.E.S.	86					29	4	5	1		1						
Others	62					16	5	10	2							14	
Total	66,990	4	14	797	28	39,363	4,514	9,722	1,244	4	7	1	11	196	1	2,663	8

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Permanent Residence, for the Fiscal Year Ended March 31, 1947

Esthonian	Finnish	French	German	Greek	Hebrew	Italian	Jugo-Slavian	Lettish	Lithuanian	Magyar	Maltese	Mexican	Moravian	Negro	North American Indian	Persian	Polish	Portuguese	Roumanian	Russian	Ruthenian	Danish	Icelandic	Norwegian	Swedish	Serbian	Slovak	Spanish	Spanish American	Swiss	Syrian	Turkish	Japanese
1	....	1	....	....	12	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	1	....	....	....	1	....	....	....	....	....
....	....	6	3	....	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	1	....	....	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	1	2	1	2	3	1	....	....	....	....	....	....	....	....	....	....	....	....	1	2	....	....	....	....	2	....	....	....	....	....	....	....	....
....	....	....	9	....	13	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	1	....	....	....	....	....	....	....	....	20	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	58	5	....	15	1	....	....	1	2	....	....	....	....	....	....	4	....	....	....	1	....	....	....	....	....	....	1	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	1	....	3	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	3	....	....	....	....	....	....	....	....	....
....	....	2	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	4	1	....	....	....	....
....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....
....	....	2	1	....	4	....	....	....	....	1	....	....	....	....	....	....	1	....	....	8	1	2	....	1	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	4	....	....	....	....
....	....	....	1	....	7	....	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	4	....	....	....	....	....	....
....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35	....	....	....	....	....	....	....	....	....	....	....
....	....	....	1	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	22	5	1	1	....	....	....	....	....	....	....	....	....	....	....	4	....	....	1	1	....	....	....	1	....	....	....	....	....	....	....	....
....	....	2	....	1	....	2	1	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....
1	11	969	199	13	374	69	2	2	17	36	7	1	1	17	6	..	151	3	7	91	71	35	12	76	46	3	1	13	..	45	3	2	1
4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	13	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....
....	....	187	3	....	8	4	....	....	....	....	....	....	....	....	....	....	12	..	4	4	....	....	....	....	....	....	....	....	....	2	1	....	....
2	....	....	36	....	18	....	....	1	....	....	....	....	....	....	....	....	2	....	....	....	1	....	....	....	1	....	....	....	....	....	....	....	....
....	....	....	....	39	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	1	....	....	....	....	....	....	....	....	....	....	1	....	....	....	2	1	....	....	....	....	1	....	....	....	1	....	....	....	....	....
....	....	41	19	....	17	2	1	....	....	4	....	....	....	1	1	..	11	..	1	5	3	....	5	3	....	....	....	1	..	1	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	1	....	1	....	....	....	....	15	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	4	1	....	2	1	....	....	....	....	....	....	....	....	....	....	1	1	1	....	....	1	....	....	....	....	....	....	....	....	1	....	....
....	....	9	....	....	1	2	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	1	2	....	....	....	....	....	....	....	....
....	....	1	1	....	5	39	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	2	....	....	1	1	....	....	....	....	....	....	....	27	....	3	....	1	....	2	....	3	....	....	....	....	....	3	..	3	1	....	....
....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	3	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	1	....	....	....	....	....	....	....	....	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	1	....	....	....	....	....	....	....	....	....	1	....	....	....	....	16	..	6	....	....	....	....	....	....	....	....	....	1	....	....	....	....
....	....	82	1	....	13	1	....	....	....	....	....	....	....	....	1	..	1	4	....	1	1	2	....	5	....	....	....	1	..	....	1	....	....
....	....	....	....	....	....	1	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	3	....	1	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	125	1	....	....	....	....	....	....	....	....
....	....	....	1	....	10	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	1	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	21	....	1	....	....	....	....	....	....	....	....	....	98	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	1	....	4	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	1	3	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	6	175	31	2	18	16	....	....	4	5	2	....	....	....	1	..	25	..	3	15	23	2	1	18	13	....	....	1	..	8	....	....	....
....	....	1	....	....	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1	....	....	....	....	....
....	....	....	....	....	9	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....
....	....	10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....
1	....	....	....	....	4	....	....	3	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	19	....	....	....	....	....	....	....	....
....	....	1	8	....	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	8	....	....	....
....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....
....	....	2	....	....	2	....	....	....	....	....	....	....	....	9	....	....	....	9	....	....	....	....	....	....	....	....	....	2	1	3	....	....	....
1	50	1,420	861	49	600	159	19	2	12	74	..	..	..	43	26	1	163	10	26	64	49	80	7	176	154	14	15	6	12	40	26	1	2
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....
....	....	23	3	....	2	2	....	....	....	....	....	....	....	1	....	....	4	..	....	3	1	....	1	....	1	....	....	....	....	....	....	....	....
....	....	3	....	....	1	....	....	....	....	....	....	....	....	33	1	....	....	7	....	....	....	3	....	....	....	....	....	1	....	....	....	....	....
....	....	4	....	1	5	....	....	....	....	....	....	....	....	1	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
10	81	3,035	1,199	109	1,205	301	36	10	35	138	16	2	1	153	37	5	499	44	47	209	152	163	21	411	242	19	20	43	19	110	35	3	3

TABLE 13

Immigration Showing Nationality and Sex for the Fiscal Year 1946-1947

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.	
Argentinian	3	1	1	1							3
Austrian	31	20	8	1	2	4	2	2			35
Belgian	99	18	48	21	12	3	1	2			102
Brazilian	5	1	1	1	2						5
British	54,036	5,690	32,833	7,763	7,750	1,771	339	935	272	225	55,807
Bulgarian	2	2				2	1	1			4
Central American	6	3	1	1	1	1	1				7
Chilian						3	1			2	3
Cuban	2	1	1								2
Czecho-Slovakian	188	84	62	17	25	3	2	1			191
Danish	37	17	13	5	2	4	2	2			41
Danzig						1	1				1
Dutch	359	42	222	49	46	5	5				364
Estonian	4	3	1			1		1			5
Finnish	9	5	1	2	1	2	1	1			11
French	95	42	35	9	9	10	3	6	1		105
German	106	57	39	4	6	8	1	7			114
Greek	34	27	4	1	2	4	2	1		1	38
Haitian	1	1									1
Hungarian	27	15	9	2	1	3	2	1			30
Italian	20	13	2	2	3	6	3	3			26
Jugo-Slavian	8	6	2								8
Latvian	4	1	1	2							4
Lithuanian	3	1	2			1		1			4
Mexican	6	1		3	2						6
Norwegian	159	97	48	7	7	10	9	1			169
Peruvian	2	1			1						2
Polish	210	123	59	17	11	7	3	3		1	217
Portuguese	1	1									1
Roumanian	20	6	8	5	1	2	1	1			22
Russian	18	9	9			9	5	4			27
Spanish	1		1								1
Swedish	12	6	4	1	1	1		1			13
Swiss	18	6	9	1	2	3	2	1			21
Syrian	3	1	2								3
Turkish	3		1	1	1						3
U.S.A. Citizens	46	17	23	3	3	9,546	3,307	3,118	1,577	1,544	9,592
Uruguaian	1	1									1
West Indian (Not British)	1		1								1
Total	55,580	6,319	33,451	7,919	7,891	11,410	3,694	4,093	1,850	1,773	66,990

TABLE 14

Rejections from Overseas, by Causes and Nationality, from 1902-03 to 1946-47 and Total Rejections from the United States from 1908-09 to 1946-47

—	Fiscal Years													
	1902-3 to 1912-13	1913-14 to 1922-23	1923-1924	1924-1925	1925-1926	1926-1927	1927-1928	1928-1929	1929-1930	1930-1931	1931-1932	1932-1933	1933-1934	1934-1935
FROM OVERSEAS														
By Causes														
Medical	4,162	1,029	130	83	40	95	104	94	78	39	26	16	17	9
Civil	5,094	5,604	862	948	226	594	215	266	243	444	298	213	177	206
Totals	9,256	6,633	992	1,031	266	689	319	360	321	483	324	229	194	215
By Nationality														
British	1,240	978	187	199	109	209	150	154	160	251	180	126	123	150
American	175	134	6	11	.....	5	2	3	8	6	4	13	11	13
Other countries	7,841	5,521	799	821	157	475	167	203	153	226	140	90	60	52
Totals	9,256	6,633	992	1,031	266	689	319	360	321	483	324	229	194	215
	1908-9 to 1912-13													
TOTALS FROM U.S.A.	68,454	171,009	10,311	10,553	12,219	12,819	15,938	18,110	24,718	39,434	36,867	28,939	18,878	14,426
GRAND TOTALS	77,710	177,642	11,303	11,584	12,485	13,508	16,257	18,470	25,039	39,917	37,191	29,168	19,072	14,641

—	Fiscal Years												
	1935-1936	1936-1937	1937-1938	1938-1939	1939-1940	1940-1941	1941-1942	1942-1943	1943-1944	1944-1945	1945-1946	1946-1947	Totals
FROM OVERSEAS													
By Causes													
Medical	13	11	8	7	10	11	20	16	16	16	24	24	6,098
Civil	183	236	202	170	167	225	129	122	169	130	314	403	17,840
Totals	196	247	210	177	177	236	149	138	185	146	338	427	23,938
By Nationality													
British	123	138	86	94	124	95	90	89	141	110	246	260	5,812
American	7	7	4	9	5	4	1	1	1	5	.....	7	442
Other countries	66	102	120	74	48	137	58	48	43	31	92	160	17,684
Totals	196	247	210	177	177	236	149	138	185	146	338	427	23,938
TOTALS FROM U.S.A.	12,290	13,178	11,094	10,160	9,996	11,821	7,368	3,424	2,866	2,716	6,396	8,561	582,545
GRAND TOTALS	12,486	13,425	11,304	10,337	10,173	12,057	7,517	3,562	3,051	2,862	6,734	8,988	606,483

TABLE 15

Deportations, After Having Been Admitted, by Causes, Nationalities, and Provinces, from 1902-03 to 1946-47

—	Fiscal Years													
	1902-3 to 1912-13	1913-14 to 1922-23	1923-1924	1924-1925	1925-1926	1926-1927	1927-1928	1928-1929	1929-1930	1930-1931	1931-1932	1932-1933	1933-1934	1934-1935
By Causes														
Medical causes	2,296	2,213	649	420	410	470	519	650	600	789	697	476	301	144
Public charges	2,853	4,517	775	543	506	354	430	444	2,106	2,245	4,507	4,916	2,991	464
Criminality	1,083	3,989	511	520	453	447	426	441	591	868	1,006	836	493	267
Other civil causes	530	793	93	58	189	149	257	194	107	200	270	277	250	172
Accompanying deported persons	145	262	78	145	158	165	254	235	559	274	545	626	439	81
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
By Nationalities														
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
American	1,066	4,566	417	321	330	351	297	294	228	279	260	331	319	199
Other countries	1,483	1,982	312	380	487	426	542	587	752	998	2,517	2,549	1,437	544
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
By Provinces														
Maritime Provinces	147	409	38	32	43	48	48	70	93	148	252	244	260	62
Quebec	1,589	2,197	301	206	233	233	240	255	480	509	984	1,343	596	163
Ontario	2,896	4,243	547	675	620	581	646	600	1,115	1,788	2,828	2,626	1,827	347
Manitoba	.....	1,310	802	242	195	177	279	403	1,296	625	1,014	858	408	71
Saskatchewan	1,783	691	110	115	113	118	197	173	277	414	767	490	261	91
Alberta	.....	1,041	102	134	178	169	260	187	396	511	631	738	467	184
British Columbia	491	1,876	206	282	334	259	216	276	306	381	549	832	655	210
Yukon Territory	1	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
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

—	Fiscal Years												Totals
	1935-1936	1936-1937	1937-1938	1938-1939	1939-1940	1940-1941	1941-1942	1942-1943	1943-1944	1944-1945	1945-1946	1946-1947	
By Causes													
Medical causes	81	47	42	36	29	12	14	20	15	21	24	17	10,992
Public charges	125	110	46	45	18	8	1	.....	2	3	1	11	28,021
Criminality	207	117	101	114	110	83	69	100	111	99	95	127	13,264
Other civil causes	163	240	203	229	237	322	371	121	101	58	178	179	5,941
Accompanying deported persons	34	57	21	10	5	3	3	3	1	.....	.....	.....	4,103
Totals	610	571	413	434	399	428	458	244	230	181	298	334	62,321
By Nationalities													
British	157	202	134	135	127	108	135	82	74	62	165	153	35,001
American	146	167	138	145	147	124	107	104	96	82	61	100	10,675
Other countries	307	202	141	154	125	196	216	58	60	37	72	81	16,645
Totals	610	571	413	434	399	428	458	244	230	181	298	334	62,321
By Provinces													
Maritime Provinces	42	61	27	40	61	136	150	96	85	67	150	101	2,910
Quebec	106	129	102	112	103	139	178	48	48	35	68	102	10,499
Ontario	167	127	123	121	96	80	82	59	43	41	35	60	22,373
Manitoba	43	32	21	22	8	14	4	5	6	3	6	4	18,894
Saskatchewan	36	26	14	28	9	.....	1	9	9	3	5	8	
Alberta	79	77	40	19	32	9	9	7	6	8	7	7	
British Columbia	137	119	86	92	90	50	34	20	33	24	27	52	7,687
Yukon Territory	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8
Totals	610	571	413	434	399	428	458	244	230	181	298	334	62,321