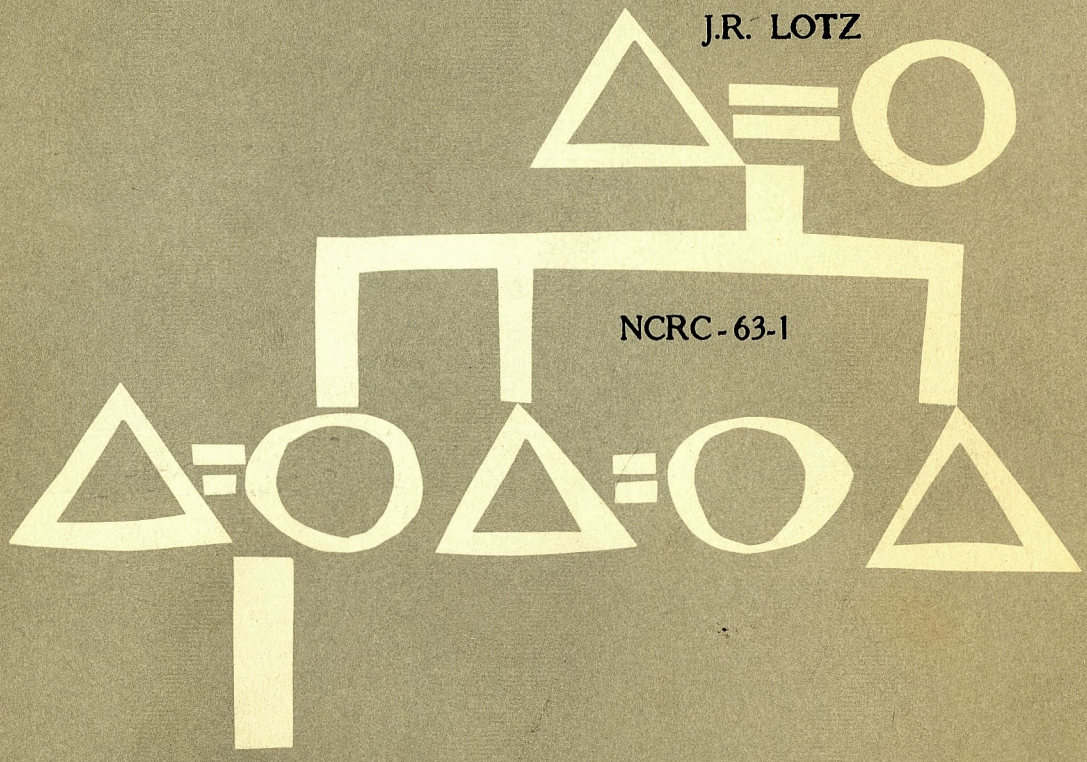
northern co-ordination and research centre department of northern affairs and national resources

GOVERNMENT RESEARCH AND SURVEYS IN THE CANADIAN NORTH 1956-61

J.R. LOTZ



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GOVERNMENT RESEARCH AND SURVEYS IN THE CANADIAN NORTH 1956-61

Edited by

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Northern Research Officer

This publication is based on the series of annual reports entitled "Government Activities in the North", issued by the Advisory Committee on Northern Development.

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January, 1963.

TABLE OF CONTENTS

INTRODUCTION

Each year, since 1954, the Advisory Committee on Northern Development (A.C.N.D.) has issued a report entitled "Government Activities in the North", describing the activities of each federal department in the North in the previous calendar year. Before 1961, the report appeared in outsize binders; the 1961 report was the first to appear in bound form.

Among other aspects of northern work, the A.C.N.D. reports included a great deal of information on scientific research and surveys. The material in this report has been abstracted from the A.C.N.D. reports for the calendar years 1956 to 1961. The aim is to give as complete account as possible of the type of research and the sort of surveys that have been carried out in the North during these six years. Laboratory and other work in southern Canada that has a bearing on northern Canada has also been included.

Nothing has been added to the reports from the various federal departments that have appeared in the A.C.N.D. reports, although some rewriting has been necessary to avoid repitition.

The North in this report refers to the area north of 60°N, and also includes Northern Quebec, Churchill, Moosonee, and Wood Buffalo Park.

J. R. Lotz,
Northern Research Officer,
Northern Co-ordination
and Research Centre.

January, 1963.

DEPARTMENT OF AGRICULTURE

The responsibilities of the Department of Agriculture in northern research include the investigation of agricultural possibilities in the North, the study of the biology, distribution, and systematics of northern insect and plant diseases, and the carrying out of soil, botanical and ecological surveys as required.

1956

Experimental work on field crops, garden crops, beef cattle and poultry was continued on the experimental farms at Mile 1019, Alaska Highway, Yukon Territory, and Fort Simpson, N.W.T. Off-station work continued at several points throughout the Yukon and Mackenzie River valley.

Some experimental work with hay, pasture and garden crops was continued at Fort Chimo, P.Q. A small flock of sheep, chickens and geese was introduced in the Fort Chimo and False Lake area.

A soil and vegetation survey was conducted at Great Whale River on the east coast of Hudson Bay.

A general reconnaissance survey was made of gardens and crops in the Mackenzie River basin from Fort Smith to Aklavik, and from Fort Nelson, B.C., to Fort Simpson. The status of agriculture and possibilities for expansion in the future were noted.

A general insect survey, with emphasis on the biting flies, was conducted on the Firth River in the Yukon.

1957

Experimental work on field and garden crops, beef cattle and poultry continued at Mile 1019, Y.T. and Fort Simpson, N.W.T.

Experiments with vegetable crops were begun at Inuvik, in an area underlain by permafrost.

Some experimental work with garden crops was continued at Fort Chimo. Chickens and geese were introduced at False River, some ten miles east of Fort Chimo.

A soil survey was begun in the Yukon from Whitehorse to Bear Creek, mainly along the Alaska Highway.

A general insect survey, with emphasis on the biting fly, was conducted at Fort McPherson.

An ecological survey was made of the reindeer ranges in the Northwest Territories.

1958

Experimental work on field and garden crops, beef cattle, swine, and poultry was continued at Mile 1019, Y.T. Tests were also conducted with field and garden crops at Fort Simpson.

Experiments with vegetable crops on newly cleared land at Inuvik were continued.

Domestic geese were again grazed on the tidal flats at False River, P.Q. Chickens were hatched, for the first time, at Fort Chimo.

A soil survey, begun in 1957, was continued in the Dezadeash Valley in the Yukon Territory.

A general insect survey, with emphasis on the biting fly, was conducted at Clyde River on Baffin Island, and at Payne Bay, P.Q.

A party collected plants at various points on Somerset Island.

1959

Experimental work on field and garden crops, beef cattle, swine and poultry continued at Mile 1019, Y.T. Tests were continued with field and garden crops at Fort Simpson.

Experiments with vegetable crops on newly cleared land at Inuvik were continued, and a survey made of the possibilities of developing community gardens at Fort Simpson, Fort McPherson, Inuvik and Aklavik.

Domestic geese were again grazed on the tidal flats at False River, and investigations continued to determine the cause of the heavy mortality in these birds from blood parasites.

1960

Experimental work on field and garden crops, beef cattle, swine and poultry was continued at Mile 1019, Y.T., and included experiments for the production of certain vegetable crops using plastic shelters.

At Fort Simpson, tests were continued with field and garden crops. A limited number of vegetables were also tested at Inuvik, where one acre has been under test since 1956. Plastic shelters for the production of certain tender crops were used at both places.

At False River, some vegetables were grown both in the shelters and in the open field.

During the summer a brief exploratory survey was conducted on the soils at Norman Wells, Inuvik, and Reindeer Station. Samples of soil over permafrost were collected for laboratory analyses and further study.

The Department took part in a joint study with the Canadian Wildlife Service on the reindeer in the Northwest Territories. Entomological surveys were conducted in conjunction with the Defence Research Board to establish the incidence of biting flies.

Work continued in the extreme northern part of British Columbia and south-central Yukon on a project dealing with taxonomic, floristic and phytographic problems in the area. One research officer was attached to the Polar Continental Shelf Project, and worked on Ellef Ringnes Island collecting fungi, lichens, bryophytes and vascular plants. Entomological parties were engaged in collections north of Ross River, Y.T., and at Isachsen, N.W.T.

1961

Experimental work on field and garden crops, beef cattle, and poultry continued at Mile 1019, Alaska Highway. Experiments included the production of certain vegetable crops and flowers using plastic shelters and mulches. Carrying capacity studies of native and seeded pastures were begun. Studies were begun to determine the feed consumption of beef cattle.

At Fort Simpson tests were continued with field and garden crops, which were studied in relation to climatic and soil conditions on the island. A limited number of vegetables were again tested at Inuvik.

At False River, work was continued on land cleared during the past two or three years. Some vegetables were successfully grown in plastic-covered greenhouses, cold frames, and in the field.

During the summer a reconnaissance soil survey was made along the Liard River from Fort Simpson to the British Columbia border, and a typical area of brown wooded upland soil was selected on the mainland near Fort Simpson for experimental purposes in the future. Botanists collected plants in the same general area.

An entomological survey of the Lake Hazen area, in northern Ellesmere Island, was made.

AIR TRANSPORT BOARD

1961

The Board, in co-operation with other departments and agencies, began a detailed survey of the Canadian government transportation requirements in the North, related to the development of the air services required.

CENTRAL MORTGAGE AND HOUSING CORPORATION

The responsibilities of the Crown Corporation include the design of housing, and the drafting of town development plans as requested from time to time by the Department of Northern Affairs and National Resources.

1956

The Architectural and Planning Division undertook the design of several projects for the Department of Northern Affairs and National Resources. Town plans were developed for Frobisher Bay, and for Inuvik, the latter in conjunction with the Department of Public Works.

Work began on a development plan for Fort Smith.

Two prototype houses were designed for the use of Northern Service Officers in towns and remote locations.

1957

Town plans were prepared for Great Whale River, and for Tuktoyaktuk, and work continued on the new town of Inuvik.

A development plan for Fort Smith was completed, and a sketch layout for Frobisher Bay prepared.

1958

The working drawings for dwellings for government personnel at Inuvik were completed, as were those for the shopping centre at Fort Smith.

1961

The Architectural and Planning Division began to prepare a plan for the overall development of Metropolitan Whitehorse. Preliminary information and maps were compiled for a site visit in July and August, at which time a survey of land use was carried out. A series of survey maps and a report were prepared as a basis for development proposals for Whitehorse.

DEPARTMENT OF FISHERIES

The Conservation and Development, and Inspections Services of this Department are concerned with the conservation, protection and development of fisheries through the enforcement of the Fisheries Act, Fish Inspection Act, and other regulations. The Fisheries Research Board of Canada is charged with the investigation of the marine, fresh-water, and anadromous animal resources of the Canadian Arctic, their biology and utilization, and the study of biological oceanography in relation to these resources.

1956

Conservation and Development and Inspection Services

In the Yukon Territory, fish culture biologists and engineers examined local sources of pollution, and investigated industrial developments where controls are required for runs of anadromous fish. The work included surveys of the Yukon River in connection with the Yukon-Taku hydro power project, and specific consideration of fishway facilities in a 70-foot high dam under construction at Whitehorse Rapids near Whitehorse. Investigations were made of pollution caused by the United Keno Hill mines and the Haines-Fairbanks pipeline.

Fisheries Research Board of Canada

Investigations of the fish population in Great Slave Lake were continued. Data were gathered on the catch during the summer and winter fishing seasons.

Studies were made of the fish resources, white whales and seals of the Beaufort Sea area in the vicinity of the Mackenzie River delta. Some investigations were made of the resources of some lakes in the Back River system.

The research vessel "Calanus" was frozen in near Igloolik during 1955-56, and year-round hydrographic and marine zoological work was carried out in the adjacent areas of Foxe Basin. During the open water season these studies were extended to other areas of Foxe Basin.

White whale studies were continued during the open water season in the vicinity of Churchill.

Oceanographic and biological studies were carried out from H.M.C.S. "Labrador" during her Arctic cruise.

1957

Fisheries Research Board of Canada

Fisheries' studies were carried out in the vicinities of the Firth River, Yukon, the Mackenzie and Coppermine Rivers, and Rowley Island in Foxe Basin, and in Ogac Lake near Frobisher Bay. Records were made of the availability of various species of fish and marine mammals and assessments of populations were attempted. Biological oceanographic data were collected in association with fisheries studies. The work in Foxe Basin was restricted because the M.V. "Calanus" was prevented by severe ice conditions from leaving the vicinity of Rowley Island. An oceanographic team took part in the cruise of H.M.C.S. "Labrador" to the

Canadian Arctic and oceanographic and biological data were collected from the Labrador Sea, Davis Strait, Hudson Strait, Frobisher Bay, Baffin Bay, Lancaster Sound, Prince Regent Inlet, Bellot Strait, Gulf of Boothia, Peel Sound, Barrow Strait, Franklin Strait and Wellington Channel.

The regular checks on the fish populations of Great Slave Lake were continued during the summer and winter fishing seasons.

1958

Fisheries Research Board of Canada

Fish studies were carried out in the vicinities of the Anderson and Horton Rivers, around part of Banks Island, near Tuktoyaktuk, in the lower Thelon River lakes, and in rivers and lakes of the Frobisher Bay area. A special study was made at Lake Hazen. The basic plan included species distribution, condition of stocks, and size of stocks. Because of adverse conditions in the areas of proposed studies of marine mammals, only limited operations were carried out in the field, but a great deal was accomplished in working up material from previous field trips. Biological oceanographic data were collected from 23 stations by the M.V. "Calanus" on its voyage from Foxe Basin to Moose Factory, and from 21 stations by a party working from the Belcher Islands.

The regular checks on the fish populations of Great Slave Lake were continued during the summer fishing season and the winter.

1959

Conservation and Development and Inspection Services

Personnel of the department's Fish Culture Branch undertook an assessment program at the Whitehorse Rapids Dam to determine the effectiveness of the facilities. Departmental biologists in co-operation with the local fishery officer continued their investigation of the Yukon River system.

Fisheries Research Board of Canada

The major effort was a fish survey of the water systems of the Barren Grounds of the Mackenzie and Keewatin districts east from Great Bear Lake to the coast of Hudson Bay. These operations were serviced by aircraft based at Yellowknife and Churchill, which made possible a sampling of fifteen different streams.

The char fishery in the vicinity of Sylvia Grinnell River was studied. Using shore parties and the M.V. "Calanus", fishery studies were carried out on and in the vicinity of the Belcher Islands, along with biological oceanography of the area and of James Bay.

An aerial survey of walrus and white whale was made in the vicinity of Southampton and Coats Islands and around Churchill.

The regular checks on the fish populations of Great Slave Lake were carried out during the summer and winter fisheries.

1960

Conservation and Development and Inspection Services

Technical personnel from the Fish Culture Development Branch continued the assessment programme begun in 1959 to determine the effectiveness of the fish facilities at the Whitehorse Rapids power development. Counts of adult grayling and spring salmon were made throughout the season. Downstream migrant salmon were collected in floating traps located in the Yukon River to obtain information on the timing of the downstream migration and the success of the 1959 spawning. Biological field personnel with Fishery Officers examined spawning areas to determine the extent and distribution of the salmon spawners. Surveys were completed on a number of small lakes in the Territory.

Fisheries Research Board of Canada

By means of the new shallowdraft M.V. "Salvelinus" exploratory gill-netting, bottom trawling, and beach seining operations were carried out off the Yukon coast at Herschel Island and around the Mackenzie River Delta.

Surveys in Ward Inlet, Frobisher Bay and on the southwest coast of Baffin Island between Cape Dorset and Chorkbak Inlet were carried out to estimate char fishery potential in these areas, and to select a site for construction of a small field station in 1961.

A fisheries survey was carried out in Richmond Gulf, on the east coast of Hudson Bay.

Marine mammal investigations were carried out from the M.V. "Calanus" in the Belcher Islands area.

Marine biological collections were made at Ellef Ringnes Island in conjunction with the Polar Continental Shelf Project.

1961

Fisheries Research Board of Canada

Field studies on Arctic char were conducted at Frobisher Bay, on the Sylvia Grinnell River, as a biological check on the commercial, Eskimo and sports fisheries there.

Char studies were begun at Cambridge Bay, Victoria Island, with the initiation of a commercial export fishery based on the stock from the Greiner Lake system. A study of the char and lake trout potential of the Ferguson Lake system of Wellington Bay was also initiated.

Because of the imminent opening to commercial export fishing of Lakes Quiet and Laberge in the Yukon, sampling of fishes for growth, food, and parasites, was done, and limnological collections made.

The M.V. "Salvelinus" continued exploratory fishing in the Tuktoyaktuk-Liverpool Bay-Husky Lakes region of the Mackenzie District coastline. Hydrographic stations were occupied and numerous samples collected and examined.

Aerial surveys of white whales were made in the Mackenzie Bay area, and of walrus stocks at Coats and Southampton Islands.

DEPARTMENT OF FORESTRY

Before the Department of Forestry was formed in 1960, research in forestry in the North was the responsibility of the Forestry Branch of the Department of Northern Affairs and National Resources. For convenience, all research in forestry is given below. The Department of Forestry is responsible for preparing forest inventories, and for formulating forest management plans for lands administered by the Crown.

1956

Provisional forest cover maps were prepared for 3,500 square miles in the southern part of Wood Buffalo National Park, and 3,200 square miles of similar mapping was completed for the northwest corner of the Alberta part of the Park.

A party measured 578 plots in the vicinity of the Birch and Athabasca Rivers. A second party spent one month on the Peace River Delta. They measured 20 plots for studies of volume and limits of the Swanson Lumber Company, sectioned 154 trees for the preparation of volume studies, and made cull studies on balsam poplar. Standard volume tables applicable to the Peace River, and probably other northern regions, were prepared from these data.

1957

Provisional forest cover maps were prepared for 12,560 square miles along the Lower Mackenzie, Arctic Red, and Peel Rivers, and in the Mackenzie River Delta.

Provisional forest cover maps of the 3,500 square miles in the southern part of Wood Buffalo National Park and the 3,200 square miles in the northwest corner of the Alberta portion of the Park have been revised for final drafting.

Detailed forest studies were made along the Peace River; 247 plots were measured in the vicinity of the Peace River Timber Berth #253 of the Eldorado Mining and Smelting Company, 299 plots near Big Island at the western boundary of the Park, 2,900 height-diameter measurements taken, and forest regeneration and cull studies made. Preliminary studies in forest ecology, forest mensuration, forest soils and forest sites were made during a three-week period.

Remote sections of Wood Buffalo Park were visited to obtain additional data and to improve aerial photographs through observation of forest conditions. Seventy-seven plots along the Athabaska River, 11 plots on the north slopes of Birch Mountains, 16 plots on the eastern slopes of Caribou Mountains, and 30 plots in the vicinity of Conibear Lake were measured.

1958

Forestry Operations Division

Forest Management Section

General forest cover mapping was completed for the Alberta part of Wood Buffalo Park, entailing 2,712 square miles of new mapping.

General forest cover mapping was completed for 6,068 square miles of the Slave and Hay River Lowlands, bounded by the 60th parallel, Hay River, Great Slave Lake, and Slave and Taltson Rivers.

Detailed forest cover maps were prepared for approximately 400 square miles of the alluvial flats of the Peace River in Wood Buffalo Park and 600 square miles of the alluvial flats along the Slave River between Fort Smith and Fort Resolution.

A field party measured 226 plots on the Peace River Delta and 283 plots along the lower Slave River to gather forest data and to check air photo interpretation of these areas.

Forest Research Division

Forest Inventories Section

Data on the Peace River and the Slave River were collected for stand volume tables for use in estimating standing timber from characteristics discernible in air photographs. Measurements were made of 290 sample plots, 222 being white spruce and 68 balsam poplar.

Northern Research Unit

A forestry officer with soils and site specialists and other assistance, studied forest site classification, soil temperatures, vegetation and vegetation dynamics, and the origin, structure and development of white spruce forests in Wood Buffalo Park. Emphasis was placed on stands on the alluvial deposits along the lower Peace River.

1959

Forestry Operations Division

Forest Management Section

The section completed detailed forest management maps of the Peace River Delta and of the Big Island portions of Wood Buffalo Park. The compilation of the Peace delta portion was completed and compilation of volumes for the Big Island portion is under way.

Preliminary forest cover maps were prepared for about 600 square miles along the Liard River near Watson Lake, Yukon Territory. A field survey there during the summer of 1959 measured 700 field plots, took 3,316 height-diameter measurements and sectioned 26 trees for individual tree volume measurements. After the field work, mosaics were prepared to provide a better base for the final maps.

A second field party made a survey of the cull in balsam poplar located along the Wood Buffalo Park portion of the Peace River. Eight hundred and seventy-three trees were sectioned and the areas of rot recorded on appropriate forms. In order to obtain an early report, 176 trees were selected at random and then the data compiled as soon as possible.

Forest Research Division

Alberta District Office

A Forestry Officer specialized in soils and site, studied forest classification, soil temperatures, vegetation and vegetation dynamics, and the origin, structure and development of the white spruce forests in the Wood Buffalo Park for three weeks, and on the lower Liard River for approximately three months. In the Wood Buffalo Park emphasis was placed on stands on the alluvial deposits along the lower Peace River, while in the lower Liard River area all productive stands within easy access of the river were studied. A second Forestry Officer spent approximately six weeks surveying the cut-over and disturbed areas along the lower Peace River in the Wood Buffalo Park to determine the reproduction rate of white spruces stands following disturbance, and to classify different areas according to the difficulty of spruce regeneration.

1960

Detailed management-type forest inventory maps were completed of the alluvial flats portion of the Liard River watershed in the vicinity of Watson Lake, Y.T., and the forest estimate is being completed.

1961

Administration Branch (Forest Management Section)

A field party conducted forest management studies in the Watson Lake area and along the lower Yukon, Pelly, and Stewart Rivers in the Yukon Territory.

The Buffalo River series of forest cover maps were completed and made available for distribution. They cover roughly the area between longitudes 113° and 116°W, and latitude 60°N and Great Slave Lake, and include Pine Point.

Forest cover mapping at a scale of four miles to the inch began in the Liard River watershed as an aid to fire protection, to show where more detailed forest cover mapping is justified, and to indicate the forest potential near areas of high mineralization.

A field party completed field observations for a fire danger table applicable in the southern part of the Northwest Territories and Wood Buffalo National Park.

Forest Entomology and Pathology Branch

Officers of the Forest Entomology and Pathology Laboratory in Calgary carried out surveys of the spruce budworm and larch sawfly outbreaks along the Slave, Liard, Nahanni, and Mackenzie Rivers. Officers of the Vernon Laboratory carried out forest insect and disease surveys along the Alaska Highway.

DEPARTMENT OF LABOUR

The Economics and Research Branch of this Department carries out annual surveys in the Yukon and Northwest Territories, one on wage rates and hours of labour, the other on working conditions. For the period 1956-61, the following number of establishments were covered by these surveys.

	Yukon Territory	Northwest Territories
1956	6	12
1957	5	10
1958	5	10
1959	13	18
1960 *	19(5)	25(7)
1961 * *	17	25

* Figures in brackets show number of establishments surveyed for working conditions only.

* * Includes one along the DEW Line, and one at Frobisher Bay.

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

Dominion Observatories

The aim of the Dominion Observatories is to extend to Northern Canada the same geophysical research and mapping techniques as are used in the South. This includes regional gravity surveys of the Northwest Territories including the Arctic Islands, the maintenance of seismic and magnetic observatories, the study of heat flow and electrical conductivity in the earth's crust and beneath, and investigation of possible meteorite craters and other interesting geological structures by geophysical methods.

1956

Magnetic observatories were maintained at Resolute and Baker Lake. With the aid of automatic recording equipment, daily, annual and seasonal variations in the earth's magnetic field were studied. A seismic observatory was maintained at Resolute to study local seismicity and, in co-operation with other stations, to help to locate earthquakes through the world, and to study the earth's interior.

1957

Magnetic observatories were maintained at Resolute, Baker Lake and Yellowknife. A seismic observatory was maintained at Resolute.

1958

Magnetic observatories were maintained at Resolute and Baker Lake during the year, and at Yellowknife until August. A seismic observatory was maintained at Resolute.

Continuous records of changes in gravity for earth-tide research were made at Resolute during January, February and March.

Magnetic surveys, both airborne and ground, were made in the Yukon Territory, and along the Mackenzie River.

1959

Magnetic observations were maintained at Resolute and Baker Lake, and a seismic observatory operated at Resolute. Continuous records of changes in gravity for earth-tide research were made at Resolute during January, February and March. Magnetic surveys, both airborne and ground, were made in the Yukon and along the Mackenzie River.

1960

Magnetic observatories were maintained at Resolute and Baker Lake, through the year, and a seismic observatory was maintained at Resolute.

1961

Magnetic observatories were maintained at Resolute and Baker Lake throughout the year, and at Alert and Mould Bay during the latter part of the year. Airborne three component magnetometer surveys of the southern part of the Northwest Territories were completed. Ground magnetic survey parties operated in the Arctic Islands.

A gravity survey of the southern half of Baffin Island was completed. Some 2,200 stations at intervals of eight to ten miles were established.

Geographical Branch

The responsibilities of the Geographical Branch in the North include obtaining data on physical, economic and social geography, and preparing suitable maps and explanatory reports describing and interpreting these geographic factors, and assisting in other phases of planning and development through the provision of fundamental geographical data.

1956

Surveys were made during the summer in the area around Bathurst Inlet, on King William Island, on Cornwallis Island, and on Southampton Island, mainly for the purpose of preparing photo-interpretation keys by which surface conditions over larger areas might be interpreted. Observations of ice distribution were carried out in the Resolute and Eureka areas.

1957

During the summer, surveys were made on Foxe Peninsula, Melville Peninsula, and in the area about Mackenzie delta mainly for the purpose of preparing photo-interpretation keys by which surface conditions over larger areas might be interpreted. Observations of ice distribution were also carried out.

1958

During the summer, field studies on surface conditions and geomorphology were carried out in the Mackenzie delta area and along the Peel River, at various points of the western sector of the Distant Early Warning Line, on Boothia and Melville Peninsulas and in northwestern Ungava. One geographer carried out geographical investigations at Lake Hazen as part of Canada's programme for the International Geophysical Year.

1959

Field studies of terrain conditions and geomorphology were continued in southern Melville Peninsula and commenced in the Great Whale River area in northern Quebec. Two geographers conducted terrain mapping and ice distribution studies in the area of Ellef Ringnes Island. Twenty-two settlements were surveyed by a geographer assigned as an observer on the C.G.S. "C.D. Howe", and potential settlement sites were examined by another geographer in the Lancaster Sound area. Periglacial studies were conducted at Resolute on Cornwallis Island. An area economic survey was undertaken in the Mackenzie delta.

1960

Field studies of terrain conditions and geomorphology were continued in the Mackenzie delta area, Arctic Red River area, Ellef Ringnes Island and inaugurated on Axel Heiberg Island. Periglacial studies were continued on Meighen Island. An area economic study was carried out in eastern Hudson Bay. Geographers accompanied vessels of the Eastern Arctic Patrol to carry out sea ice observations and littoral investigations. A terrain analysis study on Great Bear Lake was carried out. Settlement studies were conducted at 20 settlements in the Eastern Arctic.

1961

Field studies of terrain conditions and geomorphology were continued on Ellef Ringnes Island and inaugurated on Borden Island and Baffin Island. Glaciological studies were continued on Meighen Island, and initiated on Baffin, Bylot, and southern Ellesmere Islands. An airborne reconaissance survey of sea ice conditions in the central Queen Elizabeth Islands was begun from bases at Isachsen and Resolute. Settlement studies were conducted at 34 settlements in the central Arctic.

Investigation was completed for 285 new names and 188 contentious names in conjunction with 14 new maps, 11 new charts, and 44 general submissions. Some 1,500 previously approved names were reviewed for orthography and application.

Geological Survey of Canada

The responsibilities and long-term plans of the Survey are as follows:

The preparation of suitable geological maps and explanatory reports of all bedrock and unconsolidated deposits; assessment of mineral resources (metallic, non-metallic, fuels, and construction materials) and the definition of geological factors affecting their discovery and development; assistance in other phases of planning and development through the provision of fundamental geological data concerning engineering projects, water supply, and other factors affecting land use; contributing to the science of geology.

The task of highest priority is to complete the preliminary reconnaissance mapping, bearing in mind the legitimate requirements of other parts of Canada, and the constant need for certain more detailed investigations designed to solve scientific problems vital to reconnaissance mapping, mineral exploration, or other phases of economic development. A complete reconnaissance should go far towards meeting the immediate demands of the mining industry for geological data in remote areas, will permit a preliminary estimate of the mineral potentialities, and should afford data urgently required for planning future geological and other development work. The reconnaissance will, in so far as practicable, proceed outwards from the most accessible and economically promising areas. Large, helicopter-supported field parties have proved to be an admirable means of conducting extensive, rapid, good quality, and economical reconnaissance surveys in the barren grounds of the mainland Canadian Shield, and in the Arctic Islands. It is planned to continue to make full use of this technique throughout the north, including the mountainous and timbered terrain of the Yukon and western District of Mackenzie. Provided Geological Survey appropriations, staff, and services continue to increase at about the same rate as during the past quarter-century, the geological reconnaissance of the Northwest Territories and Yukon should be completed within about twenty years without detriment to the requirements of other parts of Canada. Progressively greater emphasis will be placed on detailed investigations as the initial reconnaissance nears completion.

1956

	4-mile, 8-mile, or less detailed mapping	1-mile mapping in metallic mineral areas, and special investigations	Totals
Yukon			
Field parties	2	-	2
Personnel	11	-	11
Mackenzie and Keewatin			
Field parties	1	-	1
Personnel	5	-	5
Franklin			
Field parties	2	-	2
Personnel	6	-	6

1957

A helicopter-supported geological reconnaissance of about 100,000 square miles of the upper Mackenzie River Basin (Operation Mackenzie) was completed.

	4-mile, 8-mile, or less detailed mapping	1-mile mapping, and special investigations	Totals
Yukon			
Field parties	1	1 + Resident Geologist	2
Personnel	7	6	13
Mackenzie and Keewatin			
Field parties	2	Resident Geologist	2
Personnel	35	1	36
Franklin			
Field parties	4	--	4
Personnel	10	--	10

1958

A programme of exploratory geological survey, using the Piper Super Cub, was carried out on Melville, Brock, Borden, Prince Patrick, and Mackenzie King Islands.

Systematic mapping, confined to regular map areas, was started on the south coast of Baffin Island.

	4-mile or less detailed mapping	1-mile mapping, and special investigations	Totals
Yukon			
Field parties	2	+ Resident Geologist, Whitehorse	2
Personnel	14	2	16
Mackenzie and Keewatin			
Field parties	3	2 + Resident Geologist, Yellowknife	5
Personnel	17	15	32
Franklin			
Field parties	2	1	3
Personnel	5	8	13
Mackenzie and Yukon			
Field parties	-	1	1
Personnel	-	5	5

1959

Operation Pelly, a helicopter-supported geological mapping programme, was begun in the Yukon.

Piper Super Cubs were used to map 115,000 square miles of Banks and Victoria Islands.

	4-mile or less detailed mapping	1-mile mapping, and special investigations	Totals
Yukon			
Field parties	1	2-Resident Geologist, Whitehorse; and Clerk	3
Personnel	15	8	23
Mackenzie and Keewatin			
Field parties	2	2-Resident Geologist, Yellowknife; and Clerk	4
Personnel	20	12	32
Franklin			
Field parties	2	--	2
Personnel	15	--	15
Mackenzie and Yukon			
Field parties	-	1	1
Personnel	-	2	2

1960

In the District of Franklin geological mapping was continued in southern Baffin Island and a geological reconnaissance made in southern Ellesmere Island. Reconnaissance mapping of the surficial geology was conducted in Banks and Victoria Islands. Submarine geology and geophysical investigations were made as part of the Polar Continental Shelf Expedition.

A large helicopter-supported party, Operation Back River, completed the reconnaissance geological mapping of about 55,000 square miles of the northwestern part of the District of Keewatin. In the Mackenzie District ground water surveys were made at a number of settlements along the Mackenzie River. Parties worked on geological problems in the Great Bear Lake-Great Slave Lake area and around Beaulieu and Prosperous Lakes. Aeromagnetic surveys were flown in the southern part of the District. Detailed geological mapping was undertaken in the area of the Big Bend of the Coppermine River. Engineering geological studies were made of the dam sites along the south Nahanni River.

In the Yukon Territory studies were made of the surficial geology and geomorphology of the Klondike area and of the copper deposits. A helicopter-supported party, Operation Pelly, completed the geological reconnaissance mapping of approximately 14,000 square miles in the southern part of the territory. Engineering geology studies were made at several possible dam sites on the Yukon River.

1961

Twelve parties operated in the Yukon and Northwest Territories.

In the District of Franklin reconnaissance bedrock mapping of Grenville-type Precambrian rocks in southwest Baffin Island was continued from previous years, as was reconnaissance bedrock mapping of Precambrian and lower Palaeozoic strata in southern Ellesmere Island. An aircraft-supported operation began reconnaissance mapping of Palaeozoic, Mesozoic, and Tertiary rocks and surficial deposits on Axel Heiberg and north-western Ellesmere Islands. About 30,000 square miles of this region were examined. Submarine geology investigations were made as part of the Polar Continental Shelf Project in the Arctic Islands, and submarine geology and geophysical studies carried out in Hudson Bay with the support of the Division of Oceanographic Research.

In the Mackenzie District a study of pegmatites in relation to surrounding rocks, begun in the spring of 1960, was continued, with field examinations concentrated in the Yellowknife-Beaulieu area. A regional study of two major Precambrian rock groups and several granitic masses associated with them, northwest of Yellowknife, was also undertaken to re-define, confirm, or revise the current correlation of the various map-units used to date in this region. An aeromagnetic survey was made of the Muskox ultra-basic complex northeast of Great Bear Lake to help delineate the horizontal and vertical extent of this magnificently exposed example of differentiated subcrustal rock.

An aeromagnetic survey was made, by contract, of an area between Uranium City and Fort Reliance, thus filling the remaining gap in aeromagnetic surveys of the Canadian Shield of the southern Mackenzie District.

In the Yukon Territory, Operation Ogilvie, an helicopter and fixed-wing aircraft-supported project, completed bedrock and surficial geology reconnaissance mapping of 14,500 square miles of terrain south of the 65th parallel. Studies continued from 1960 on the surficial geology and geomorphology of the Klondike area, and on the copper deposits in the Territory and adjacent British Columbia. Engineering geology studies were made at ten possible dam sites on rivers in the Yukon and Mackenzie River drainage basins. To date 32 possible dam sites have been examined in this project.

An aeromagnetic survey was made, by contract, of an area between Whitehorse and Watson Lake bounded by 60°00' and 62°00' and 128°00' and 135°00'.

Mines Branch

The responsibilities of the Mines Branch include the giving of technical assistance for the development of mining and metallurgical industries in the North, and for the development and utilization of petroleum and natural gas resources, and providing advice and carrying out investigations on metals, metallic and non-metallic minerals, fuels, petroleum, natural gas, and industrial waters as related to northern development.

1956

Uranium - The Radioactivity Division's facilities were largely occupied for about two months in pilot plant tests on treating ore from Rayrock Mines Ltd., Yellowknife area. The Division co-operated with Eldorado Mining and Refining Limited; three staff members spent one-month periods at Port Radium in connection with pilot plant work on a solvent extraction process for recovering uranium from leach liquors, and two others visited Port Radium regarding radiometric analysis and to demonstrate an underwater radiometric probe. At Ottawa, ore treatment investigations were done for Great Bear Lake Uranium Mines Ltd. as well as for Rayrock; mineralogical studies were made for Eldorado, Rayrock and Great Bear; and analytical work was done on 148 radioactive ore samples from N.W.T.

Other metallic ores - The Mineral Dressing and Process Metallurgy Division investigated and issued a report on two bulk samples of lithium ore from a property 50 miles northeast of Yellowknife for Boreal Rare Metals Limited; made flotation tests and reported on a copper-lead-zinc ore sample from a property 7 miles east of Yellowknife for N. W. Byrne; reported on nickel concentrate prepared from ore from the Rankin Inlet property for North Rankin Nickel Mines; examined and reported on the constituents of two samples obtained through research in the Giant Yellowknife Gold Mines laboratories at Yellowknife; investigated a series of samples from dredging operations in efforts to reduce the tailing losses of the Yukon Consolidated Gold Corporation. The Division also completed assays and chemical analyses on 19 samples from N.W.T. and Yukon.

Non-metallic minerals - The Chief of the Industrial Minerals Division examined in detail a major asbestos property north of Dawson City and large samples of the asbestos-bearing rock were milled in the Division's mill; a deposit of rhodonite (manganese silicate which in quantity might have industrial possibilities) east of Whitehorse was investigated and samples obtained.

Industrial waters - Samples of Mackenzie River water from sampling stations established near Norman Wells and Aklavik were forwarded at specific times throughout the year for analysis in the Industrial Minerals Division; the Industrial Waters laboratory also analyzed monthly samples of boiler feed water from heating plants of 10 Army camps in N.W.T. and advised on methods of water treatment; similar boiler feed water service was given on two monthly samples from Whitehorse.

Fuels services - The solid fuels laboratory of the division analyzed 22 samples from the Geological Survey's "Operation Franklin".

Economic studies - The Mineral Resources Division made, for the Department of Northern Affairs and National Resources in co-operation with officers of that department and of the Department of Trade and Commerce, a preliminary study of economic factors relating to an integrated oil pipeline and refinery project in the Yukon; for Northern Affairs and National Resources made a study of economic mineral possibilities along seven possible rail routes in respect to a proposed rail extension to Great Slave Lake area; and for the Defence Research Board prepared and delivered lectures on problems encountered in mining operations in sub-arctic areas of Canada.

1957

Uranium - The Radioactivity Division completed exploratory investigations and reports for Great Bear Lake Uranium Mines Ltd. on an ore sample from the company's property about 20 miles from Conger Bay on Great Bear Lake, N.W.T. Work in the Ottawa laboratories was undertaken in connection with treatment of ores from the properties of Rayrock Mines Ltd. and Consolidated Northland Mines Ltd. in the Yellowknife area. Other samples of radioactive ores and products received from N.W.T. during the calendar year totalled 150. These were mainly for assays and came largely from the Crown company, Eldorado Mining and Refining Limited.

Other Metallic Ores - The Mineral Dressing and Process Metallurgy Division conducted assay work and chemical analysis on 33 samples from the N.W.T. and the Yukon.

Industrial waters - The Industrial Mineral Division conducted analyses on some 35 samples of water from N.W.T.

Fuels services - The Fuels Division analyzed a sample of coal from Lake Hazen, Ellesmere Island, received from the Geological Survey.

Problems in the use of metals - The Physical Metallurgy Division has been engaged in research on developing steels resistant to failure in low temperatures. A lengthy research project concluded during 1957 concerned the operation of welding structural grade steels while exposed to very low atmospheric temperatures.

1958

Radioactive ores - The Radioactivity Division completed testwork on a sample of uranium ore submitted for beneficiation testwork by Rayrock Mines Ltd., Marian River area. Work was started on a sample of uranium ore from the Ridley Uranium Mines (Canada) Ltd., Stark Lake, to confirm earlier test results, and to determine uranium recoveries and grades in concentrates suitable for possible treatment elsewhere. A research project on the possibilities of saving reagents, by recycling of leach solutions in which Rayrock ore was used as feed material, was completed during the year. Other samples and products from the N.W.T. during the year totalled 143, mainly from Eldorado Mining and Refining Limited.

Other metallic ores - The Mineral Dressing and Process Metallurgy Division conducted ore dressing investigations on gold ore samples from United Keno Hill Mines Ltd., Y.T., North Goldcrest Mines Ltd., N.W.T. and Taurcanis Mines Ltd., N.W.T. A microscopic study was made of iron-bearing rock samples from the Nastapoka Islands in Hudson Bay. Assays and chemical analyses were made on 69 samples of minerals submitted by prospectors.

Industrial waters - The Industrial Minerals Division, at the request of the International Union of Geodesy and Geophysics initiated, in June 1958, a quarterly sampling program on the Mackenzie River below the mouth of the Arctic Red River. A survey of water quality of the Mackenzie River delta area was completed for use by the Geographical Branch, Department of Mines and Technical Surveys. Samples of water from the Keno Hill district, Y.T., were analyzed for the Geological Survey of Canada.

Problems in use of metals - Much research in the Physical Metallurgy Division on use of metals is relevant to development of Northern Canada. The problem of steel becoming brittle and fracturing at low temperatures has recently received considerable attention. The objective of much of the investigations on the effect of additives to mild structural steel is to improve low temperature properties. A high priority programme under way relates to quenched and tempered steels for low-temperature uses. These programs are largely oriented to requirements of the Department of National Defence but the results will be generally applicable to steel uses at low temperatures.

Previous research on welding of steel at low temperatures is being followed up, and in 1958 work was begun to evaluate some types of weldability test methods and to explore fundamental causes of cracking. The work aims to delineate conditions under which welding at low ambient temperatures can be undertaken satisfactorily.

1959

Radioactive ores - About 144 samples, mainly from Eldorado Mining and Refining, Port Radium, were received for mineralogical examination and chemical analysis and a staff member visited Port Radium in connection with analytical problems. About 36 radiometric assays were made on monthly composite samples received from the Eldorado mill.

Other metallic ores - Investigations, to be continued into 1960, were undertaken on methods for sintering and smelting lead concentrates of United Keno Hill Mines Ltd., Y.T. This project also involved ore dressing investigations on United Keno lead-zinc concentrates as well as mineralogical and other scientific studies.

Ore dressing investigations included: completion of work on gold ore from Taurcanis Mines Limited, N.W.T.; gold ore from Consolidated Discovery Yellowknife Mines, Ltd., N.W.T.; concentration tests on iron ore from Maguse Lake, N.W.T., submitted by the Valentine Syndicate, Montreal. Mineralogical examinations were completed on the Taurcanis gold ore, manganese-bearing rock from N.W.T., submitted by Eldorado Mining and Refining Limited, and on the Maguse Lake iron ore. Under the coupon arrangement for free assays for prospectors, assays for both gold and silver were conducted on 28 samples.

Industrial waters - Quarterly sampling on the Mackenzie River below the mouth of the Arctic Red River was completed in June in connection with a study of dissolved solids run-off requests by the International Union of Geodesy and Geophysics. Personnel of the Polar Continental Shelf Project were assisted in planning and sampling equipment for study of sediment in, and chemical quality of, fresh waters on Ellesmere Island.

Coal - An analysis of "High Volatile A" bituminous coal from Watercourse Valley, Ellesmere Island, was made at the request of the Geological Survey of Canada.

Mine air - Analyses of three samples of mine air from the Consolidated Discovery Yellowknife Mines, N.W.T., were made at the request of the Department of Northern Affairs and National Resources.

Port Radium mineral study - During several weeks in August and September a senior officer and an assistant collected mineral specimens from the newer underground workings of the Eldorado mine at Port Radium.

Development of steel for northern use - Work was expanded to produce cheaper but stronger steels to build equipment for northern uses. The major objective is to achieve optimum low-temperature properties and higher strength while maintaining relatively low cost.

A program now well under way seeks to evaluate the use of "direct reduction" iron as a furnace charge for the production of high-quality steels. This program may indicate uses for such iron that would have a bearing on the economic utilization of iron ore deposits in Canada's north.

1960

Metallic ores - Extensive investigational work was related to the tungsten (scheelite) ore from the deposit under development by Canada Tungsten Mining Corporation in the Flat River area, N.W.T. After laboratory-scale tests, ore dressing investigations for concentration of the scheelite were conducted at pilot-plant scale on five tons of representative ore. Investigations were also conducted on the application of electrolysis as a method for producing tungsten metal from the concentrates. For Turner Baffin Prospecting Syndicate, concentration tests were carried out on iron (magnetite) ore from a deposit on Baffin Island, and for Precambrian Mining Services, investigations were made on the recovery of residual gold from cyanide residues at the former Negus mine, Yellowknife. To assist northern uranium operations, radiometric assays were made on 15 monthly composite samples from the Port Radium mine of Eldorado Mining and Refining.

Non-metallic minerals - Samples of a pozzolan from near Whitehorse and of marl from a Yukon occurrence were examined and evaluated.

Industrial waters - A five-year sampling and analysis programme on waters of the Mackenzie River was started as part of the chemical quality survey of larger Canadian rivers. The industrial waters staff also analyzed ice and water samples from Ellef Ringnes Island, as part of the Polar Continental Shelf Project study of sediment load in waters of the Arctic Islands; assisted the Geographical Branch in its study of freezing and spring break-up of Mackenzie River by analyzing water samples of surface waters, ground waters, and waters from mineral hot springs collected in N.W.T. and Yukon.

Coal - Two samples from a coal outcrop at Darnley Bay, Mackenzie District, were analyzed for the Geological Survey of Canada.

Mineralogical studies - The tungsten ore from Canada Tungsten Mining Corporation was subjected to detailed examinations. Progress was made on the long-term intensive study of the suites of mineral specimens from the Eldorado mine at Port Radium.

Development of steels for northern use - Progress was made in evaluation of commercially produced notch ductile steels developed in Mines Branch laboratories, and staff metallurgists participated in Canadian Standards Association discussions that resulted in setting a specification for an improved low-temperature steel having particular application to northern construction. As various iron deposits in the far north are located in areas subject to costly transportation, the economic utilization of such resources may depend on a "direct" iron reduction process; hence studies were under way covering technology of such processes and the marketing outlook for products.

1961

Metallic ores - Investigation continued into the processing of a tungsten (scheelite) ore from a deposit in the Flat River area, N.W.T., being developed by Canada Tungsten Mining Corporation. A new acid leaching process was developed for producing a shipping grade tungsten concentrate from a flotation concentrate, using sulphurous acid produced from sulphides in the ore as the leaching agent. A preliminary investigation demonstrated the feasibility of producing metallic tungsten from the acid leach concentrate by fused salt electrolysis. The concentration of a silver-lead-zinc ore by differential flotation was studied for Conwest Exploration Company Limited; the ore is from a deposit northwest of Watson Lake.

Non-metallic minerals - Samples of gypsum from an occurrence in southern Yukon Territory were examined, and the physical properties of the gypsum determined.

Industrial waters - A five-year program of sampling and analysis of northern waters, started on the Mackenzie River in 1960, was extended to the Yukon River. Samples of surface and ground waters were analyzed for the Geological Survey of Canada.

Chemical analyses - Only one sample from the Territories was analyzed for gold. A spectro-chemical analysis was made of two samples of tungsten ore from Canada Tungsten Mining Corporation, Watson Lake.

Development of steels for northern use - Because of accelerated construction in the North, the long-term project on welding at low temperatures was reopened in order to evaluate the codes set up for the construction of bridges, buildings, pipelines, etc., under severe conditions. By rigid evaluation it is hoped to eliminate unnecessary precautionary measures that would delay progress in construction. Because of the expense and difficulty of transporting heavy objects in the far North, the Branch continues to search for new alloys with increased strength-to-weight ratio for use in land and air vehicles and other equipment.

Polar Continental Shelf Project

The aim of this Project is to carry out a long-term investigation of the continental shelf lying to the north and west of the Canadian Arctic Archipelago and the waters above it, together with the islands of the archipelago where relevant, and the straits and sounds between the islands.

1958

The project was drawn up and approved in principle, and arrangements were made for mounting the preliminary reconnaissance.

1959

Field work was carried out in two separate areas. One party was based at Isachsen on Ellef Ringnes Island and investigated parts of the central section of the polar continental shelf. The other party carried out oceanographic work from the C.G.S. "Labrador" in Hudson Strait and southern Foxe Basin.

In the Isachsen area the reconnaissance party had the following principal objectives:

(1) To determine the most suitable method of surveying and position fixing on the Arctic pack ice.

(2) To establish trial oceanographic stations to obtain preliminary information on the physical oceanography of the area, and to gain experience in the operational and logistic problems of conducting oceanographic studies of ice covered waters.

(3) To obtain preliminary gravity and magnetic information to plan a more detailed programme, and to test instruments and equipment.

(4) To begin a study of the regional physiography of Ellef Ringnes Island.

(5) To make initial measurements and observations in connection with the continuing glaciological programme on the ice-cap of Meighen Island, and to begin the study of the sea ice in the area.

(6) To make a geological investigation of selected parts of the islands.

(7) To obtain information on the most suitable means of field transport and communication, and to gain experience in the integration of various scientific disciplines.

(8) To determine the best field season for the various aspects of the programme.

Field work was carried on between March and October, by a party of seventeen men, not all of whom were in the field at the same time.

Approximately 250 miles of tellurometer and theodolite traverse were run, mostly across sea ice, connecting points on Meighen Island, the Fay Islands, Amund Ringnes Island, Ellef Ringnes Island, and Borden Island. Three complete oceanographic stations were established in the northern part of Prince Gustaf Adolf Sea. Additional hydrographic information was secured in nearby areas and late in the season echo-sounding profiles were made in ice-free inshore waters near Isachsen, which was linked with Resolute by repeated gravity traverses; gravity measurements were made in all areas visited by the field parties. A number of reconnaissance and detailed magnetic observations were made in the northern part of Ellef Ringnes Island.

Physiographic and glaciological studies were started as planned and a careful series of experiments carried out, to determine the effect on the melting of sea and lake ice, by artificially changing the index of solar absorption. Repeated measurements were made of the strength and stability of electro-magnetic ground wave radiation over distances up to 230 miles across the ice from two transmitters located on an accurately measured baseline 23 miles long. The speed of propagation of the radio waves was measured at different seasons of the year, and the ground conductivity in permafrost was determined at different times during the summer. From this information it has been possible to design a system of electronic position fixing that will give a repeatability and accuracy adequate for oceanographic, hydrographic, and geophysical work up to distances of 300 miles from the shore. Limited geological and geophysical investigations were made on some of the gypsum diapir structures and the ring-like igneous bodies of Ellef Ringnes Island.

A brief but valuable oceanographic cruise in southern Foxe Basin and western Hudson Strait was carried out in early October when the icebreaker C.G.S. "Labrador" was made available by the Department of Transport. In some 1300 miles of traverse the oceanographic party of four men completed 85 oceanographic stations and made collections of plankton and of bottom materials.

1960

Field work was based at Isachsen, on Ellef Ringnes Island. A party totalling about seventy persons investigated the central section of the polar continental shelf and adjacent islands.

Oceanography - The oceanographic programme is designed to investigate the structure and composition of the waters overlying the continental shelf, and in the channels between the islands. A series of oceanographic stations was occupied in the entrance to each of the channels leading from the Arctic Ocean into the archipelago between Axel Heiberg and Prince Patrick Islands, and an oceanographic traverse was run approximately 230 kilometers out to sea from the northwest point of Ellef Ringnes Island, across the continental shelf, and down the continental

slope to a depth of about 1,300 meters. Temperatures and water samples were taken at all standard depths at each of these stations; bathythermographic casts were made, and bottom samples obtained. Standard chemical and electrical measurements were carried out on the water samples collected.

Hydrography - The hydrographic survey is designed to produce information for bathymetric mapping, on a scale of 1:500,000. Work was carried out in 1960 in Peary Channel, the Prince Gustaf Adolf Sea, and adjacent parts of the Arctic Ocean, using wire line and echo sounding methods on traverses carried out by motor toboggan and helicopter transport. A special technique of obtaining echo sounding in open cracks and leads from a helicopter was developed with the aid of the National Research Council and proved to be successful. In the latter part of the season, experiments were carried out with various techniques of echo sounding through the sea ice.

Submarine Geology - The programme in submarine geology is designed to provide information on the character and stratigraphy of the sediments on the floor of the channels of the Arctic Archipelago, and covering the polar continental shelf. The 1960 activities in this field were divided into two separate programmes. A reconnaissance of the off-shore sediments was carried out in connection with the oceanographic work, and grab samples and short cores were obtained, which give a preliminary indication of the nature of the material lying off-shore in the channels and on the shelf. The second programme was a detailed study of the sediments carried by arctic rivers and distributed in the shallow, near-shore areas of the present ocean. This work involved the obtaining of several hundred samples from the sea bed, at carefully spaced intervals, to trace the mineralogical and mechanical distribution of sedimentary material. All of the material obtained is being examined for its mineralogical, geochemical, organic and fossil content.

Terrestrial Geology - Studies were made of specific stratigraphic and structural geological problems on Ellef Ringnes Island by a technical officer of the Geological Survey of Canada, who worked in cooperation with the geomorphologists of the Geographical Branch and the various geophysical parties.

Seismic Surveys - The geological structure lying beneath the surface of the islands and under the sea were investigated by a series of reflection and refraction seismic profiles. Information on the thickness of the sedimentary sequence and of the underlying granitic material, and the depth of a still deeper, denser layer was obtained at a number of selected places ranging from near the centre of the assumed "Sverdrup Sedimentary Basin", near the south end of Ellef Ringnes Island, to what appears to be near its northwestern flank, north of Borden Island. Special techniques of seismic sounding in ice-covered waters and on permafrost were developed, and a successful method of carrying out seismic traverses from motor toboggans and from helicopters was evolved. A subsidiary seismic activity was the running of sounding traverses across the ice-cap on Meighen Island to obtain information on its thickness and the shape of the underlying bed-rock surface.

Gravity Investigations - More than 400 gravimeter readings were obtained on Ellef Ringnes, Amund Ringnes, Meighen, Borden and Mackenzie King Islands, and much of the intervening sea, as part of the regional gravity survey of Canada. Ultimately, it is desired to cover the entire area with gravity stations, spaced about twelve kilometers apart. A network of control "base loops" was established throughout the area and these have been linked with the absolute gravity station at Resolute. A control tie was extended to western Axel Heiberg Island to provide a base for the gravity investigations of the Jacobsen-McGill Arctic Research Expedition. A detailed gravity survey was undertaken of the Meighen Island ice-cap, and gravity traverses were run across selected geological features in an attempt to determine their structure.

Magnetism - A magnetic observatory was established at Isachsen to record the magnetic field and its fluctuations in this critical area, north of the north magnetic pole. A series of regional magnetic observations was taken at scattered localities throughout the area, from Meighen Island to Borden Island, providing some of the ground control for a regional aero-magnetic survey planned for 1961. Studies of earth resistivity were begun on Ellef Ringnes Island. Magnetic traverses were run across selected geological features; these, combined with the gravity information, provided clues to the geological structure of the area.

Physiography - The detailed investigation of the land forms of Ellef Ringnes Island was all but completed, as a contribution to the study of the regional geography of Canada, and as a special research into the evolution of the arctic landscape. The regional studies were supplemented by detailed, quantitative measurements of the sediment load in seasonal arctic rivers throughout the summer, and by measurements of ground temperature, the rate of solifluction, and the behaviour of permafrost in typical areas.

Glaciology - A glaciological research station on the ice-cap of Meighen Island was occupied for four months and measurements were made of accumulation and ablation, mass wastage, ice movement, temperatures at depth, and other parameters which serve to determine the response of the glacier to its climatic environement. Observations of the meteorological and micro-meteorological conditions were made and an examination was carried out of the behaviour of the ice-cap margin. The results of this work will be combined with those of the seismic, gravity, and botanical studies in the area, to give a picture of the climatic history of this part of Canada.

Ice Studies - A record was kept of the distribution and nature of the sea ice throughout the season in the areas covered by aircraft servicing the various field parties of the Project.

Marine Biology - Scientists from the Arctic Unit of the Fisheries Research Board undertook a study of the primary production of the Arctic Ocean waters in the area, and made collections of zooplankton, phytoplankton, and larger organisms.

Botany - The flora of Ellef Ringnes Island and adjacent areas was studied by an officer from the Plant Research Institute of the Department of Agriculture.

Entomology - The insect life of the high Arctic Islands was investigated by an officer of the Entomology Research Institute of the Department of Agriculture.

Surveying - The baselines run between Ellef Ringnes Island and Meighen and Borden Islands in 1959 were extended by further tellurometer and theodolite traverses into control loops which tied the Decca transmitter stations to the geodetic Shoran network. The control network was extended to Axel Heiberg Island, to serve as a tie for the surveys of the Jacobsen-McGill Arctic Research Expedition, and a baseline was measured on Axel Heiberg Island for those surveys. A further control traverse was run from Meighen Island, across northern Axel Heiberg Island to the geodetic station in north-central Ellesmere Island, thus providing control along a large part of Canada's northern coast line. Perimeter surveys were run around Ellef Ringnes Island to serve as control for detailed topographic maps, and numerous special surveys carried out to aid in the calibration and checking of the Decca survey network.

1961

Field work was co-ordinated from Isachsen, on Ellef Ringnes Island. A party totalling 86 persons investigated the central section of the arctic continental shelf and adjacent islands and straits.

Oceanography - A series of oceanographic stations was occupied across M'Clure Strait, and in Eureka Sound, completing a programme of investigation of each of the channels leading from the Arctic Ocean into the archipelago, and across the continental shelf. Temperatures and water samples were taken at all standard depths of each of these stations; bathythermograph casts were made, and bottom samples obtained. A series of detailed investigations of the characteristics of the waters beneath bay ice was carried out near the coast of Ellef Ringnes Island. This work included studies of the water chemistry, light penetration, and plankton distribution.

Hydrography - Approximately 74,000 square kilometers have been sounded to date in this programme, with soundings about 8 kilometers apart, covering Peary Channel, part of Sverdrup Channel and Vincent Massey Sound, Hassel Sound, Hendriksen Strait, Danish Strait, Maclean Strait, the eastern half of Prince Gustaf Adolf Sea, and the Arctic Ocean seaward from Meighen and Ellef Ringnes Islands out to the outer edge of the continental shelf, which in this area has an offshore width of approximately 150 kilometers. The development of a method of obtaining echo soundings from the top of the sea ice, using helicopter-borne equipment, has been successful and has resulted in an approximately tenfold increase in the speed of obtaining hydrographic data. Development has also been under way on Helicopter-borne sounding equipment capable of obtaining continuous depth profiles from cracks and pools of open water.

The hydrographic party also reconnoitred the terrain and beaches, and charted the ship approaches, at possible sites for an isotope-powered automatic weather station in the Norwegian Bay area. The report and preliminary navigation chart contributed to the successful establishment of the station on Sherwood Head, Axel Heiberg Island.

Submarine Geology - The inshore programme was carried out along the coasts of Ellef and Amund Ringnes Islands, in Hassel Sound, and adjacent areas. A party travelling by dog teams with helicopter and fixed-wing aircraft support obtained samples of the bottom materials at carefully spaced intervals out to sea from the mouths of selected rivers, in order to obtain a quantitative picture of the mineralogical and mechanical distribution of the sedimentary material being delivered to the present ocean. A complementary study was made of the lithology, erosion, and sediment transport within the river basin, in order to observe the relation between the present-day arctic marine sediments and the source area.

The offshore geological studies, designed to investigate the unconsolidated material on the continental shelf, were limited by the loss of bottom sampling equipment during an early phase of the work. Bottom samples were obtained at the oceanographic stations.

Seismic Surveys - The geological structures lying beneath the surface of the island and under the seas were investigated by a series of reflection and refraction seismic profiles. Information on the thickness of the sedimentary sequence and of the underlying crystalline material was obtained at a number of selected places which make a composite profile from near the assumed centre of the "Sverdrup Sedimentary Basin" at the south end of Ellef Ringnes Island, to what appears to be near its northwestern flank, north of Borden Island. The sediments in the central part of the Basin have an apparent thickness in excess of 10,000 metres. The techniques of seismic survey in ice-covered waters and on permafrost, pioneered in 1960 were further refined, and with the equipment and methods now available it is possible to carry out effective seismic surveys using motor toboggan or helicopter transport. An incidental result of the seismic surveys is that in some places it appears possible to identify the base of the permafrost layer.

Gravity Investigations - The regional gravity survey was extended in 1961 with a network of control "base loops" linking stations about 80 kilometers apart, supplemented by detailed gravity stations at about 12 kilometer intervals, to cover the area from west-central Devon Island to eastern Melville Island, and from Parry Channel northward to the limit of 1960 coverage in the seas south of the Sverdrup Islands.

Geomagnetism - Comparative studies of the strength, variations, and rates of fluctuation of the magnetic field were made at Isachsen, Mould Bay, Meighen Island, the Jacobsen-McGill camp on western Axel Heiberg Island, Eureka, and southern Axel Heiberg Island.

Aeromagnetic Surveys - Approximately 25,000 line kilometers of aerial magnetic survey were flown in the area of the Ringnes Islands and the ocean to the northwest. Flight line spacing varied from 1 to 15 kilometers. The information gained gives an indication of the depth of the crystalline basement rocks, and the distribution of igneous rocks, gypsum bodies, and other masses with distinctive magnetic properties.

Physiography - The detailed investigation of the land forms of Ellef Ringnes Island was completed, and a comparative study undertaken on Borden Island.

Geographical Branch - The regional studies have been supplemented by quantitative measurements of the sediment load in a selected seasonal arctic river throughout the summer, and by measurements of ground temperatures, the rate of solifluction, the development of ground ice, and the behaviour of permafrost in silty ground near Isachsen.

Glaciology - The glaciological research station on the ice cap of Meighen Island was occupied for the third consecutive season. Measurements were made of accumulation and ablation, mass wastage, ice movement, temperatures at depth, and other parameters. Observations of the meteorological and micro-meteorological conditions on and surrounding the ice cap were continued, and a physiographic study made of the ice cap margin.

The experiments investigating the effect of altering the index of solar heat absorption of the ice, begun in 1960 with the application of various amounts and kinds of heat-absorbing materials to the surface, were continued with the spreading of a variety of reflecting and protective substances on the surface of the ice cap.

Sea Ice Studies - Systematic patrols were made of all major water areas of the Queen Elizabeth Islands, part of Parry Channel, and the adjacent Arctic Ocean, throughout the season of significant sea ice activity. Information on the nature, break-up, amount, distribution, dispersal, and formation of sea ice was recorded, and will be related to meteorological and oceanographic observations.

Biology - Collections of plankton and small marine organisms were made at the oceanographic stations.

Samples of bottom muds were taken and shipped in sterile containers to the laboratories of the University of British Columbia and the National Research Council in connection with investigations of the distribution of bacteria in arctic regions.

Topographical Survey - The tellurometer and theodolite base line traverse, through which the Decca sites are linked to the geodetic network, was completed along the Arctic Ocean front from Ellesmere Island to Banks Island. The site for the Decca transmitter on Brock Island was surveyed. Control surveys in greater detail were run for hydrographic

surveys off the shores of western Ellef Ringnes Island. Vertical control profiles for 1:250,000 mapping were run across Ellef Ringnes Island, and ground control established on King Christian Island. A survey was carried out on southern Melville Island to establish a meridian reference line in connection with the boundaries of commercial leases in the area.

Surveys and Mapping Branch

The responsibilities of this Branch are to carry out all geodetic, topographic, oceanographic and legal surveys, and to produce topographical maps and aeronautical and hydrographic charts required for administration, development, and defence purposes.

1956

Geodetic Control - The shoran net was extended with the co-operation of the R.C.A.F. to cover the Arctic Islands south of the 75th parallel of latitude. Some aerial reconnaissance was done over the Queen Elizabeth Islands.

Mapping--Yukon - One party working northeast of Lake Laberge established control for 2,300 square miles of 1:50,000 mapping. A second party using helicopters established control for 3,700 square miles of 1:50,000 and 5,600 square miles of 1:250,000 mapping along the Arctic Coast of Yukon.

Hydrographic Charting - Two chartered vessels carried out surveys on the Labrador, Ungava Bay and Hudson Bay coasts, needed for defence requirements and mining developments. One hydrographer with an echo sounder-equipped launch was assigned to each of the Department of Transport vessels "C.D. Howe" and "D'Iberville". Data for harbour charts were obtained at the thirty-seven ports of call and over 9,300 linear miles of sounding along the routes were recorded for general chart use.

A shore based party of three hydrographers with launches conducted charting operations in Tuktoyaktuk Harbour.

Four hydrographers were assigned to H.M.C.S. "Labrador" for charting operations in Foxe Basin and other strategic Arctic areas.

One hydrographer was assigned to United States hydrographic ships on the western sealift to the D.E.W. Line.

1957

Geodetic Control - The shoran net was extended to cover the Arctic Islands with the most northerly station at latitude 81° 49'. Reconnaissance for an arc of triangulation along the Mackenzie Highway from the Alberta-Northwest Territories boundary to Great Slave Lake was completed.

Mapping--Yukon - Two parties working along the Yukon River established control for 6,000 square miles of 1:50,000 mapping while another ran spirit levels from Lake Laberge for 225 miles down the Yukon River.

Northwest Territories - One party using helicopters put in control for mapping 16,300 square miles at the scale of 1:50,000. Another party with conventional aircraft established spirit level elevations over routes totalling 1,050 miles from the boundary with Saskatchewan to the Arctic Coast.

Hydrographic Charting - One chartered vessel carried out surveys in Hudson Strait and Hudson Bay for mining developments. One hydrographer with an echo sounder-equipped launch was assigned to each of the Department of Transport vessels "C.D. Howe" and "D'Iberville". Data for harbour charts were obtained at the thirty-five ports of call and over 4,200 linear miles of sounding along the routes were recorded for general chart use.

A shore-based party of four hydrographers, with launches, conducted charting operations of the approaches to Tuktoyaktuk.

Three hydrographers were assigned to H.M.C.S. "Labrador" for charting operations in Bellot Strait and other Arctic areas.

Two hydrographers carried out triangulation in Frobisher Bay.

One hydrographer was assigned to a United States hydrographic ship on the western sealift to the D.E.W. Line.

Tide gauges were established at Resolute and Brevoort Island as an International Geophysical Year project.

Aeronautical Charting - The plotting of planimetric detail by tri-camera methods continued for the northerly charts not yet completed. Critical heights and contours were obtained by oblique multiplex methods for the Frobisher Bay chart.

1958

Geodetic Control - The arc of triangulation along the Mackenzie Highway from the Alberta-Northwest Territories boundary to Hay River was completed. Reconnaissance for arcs of triangulation from Hay River to Fort Reliance along the south shore of Great Slave Lake and from Black Lake in Saskatchewan to Wholdaia Lake in the District of Mackenzie were also completed.

Mapping - A party completed spirit levelling of the Yukon River to the Yukon-Alaska Boundary, a distance of 180 miles, and secured control for topographical mapping of 500 miles in that area.

Hydrographic Charting - The C.G.S. "Baffin" started work on the long-term programme of standard charting in the Eastern Arctic, completing the survey of the channels in the vicinity of Pike and Resor Islands in the approaches to the head of Frobisher Bay. A large area in the approaches to the Bay was also sounded, using two-range Decca control.

A chartered ship carried out a small survey in the Belcher Islands and completed the survey of the approaches to the Rankin Inlet nickel mine. A survey of the Tavani-Whale Cove area was made at the request of the Department of Northern Affairs. Another chartered ship, working in Ungava Bay, carried out surveys in Payne Bay and Hopes Advance Bay.

A hydrographer and the crew for a survey launch were attached to each of the Department of Transport vessels, "C.D. Howe" and "D'Iberville" and gathered survey information during their northern voyages.

A party using two launches carried out a detailed survey of the Sans Sault Rapids in the Mackenzie River.

Two hydrographers were attached to the U.S.C.G.S. "Storis", the icebreaker supporting the Western Arctic D.E.W. Line supply operations, and carried out reconnaissance surveys in several critical areas for navigation. Two hydrographers were attached as observers to the U.S. Navy Hydrographic Office ships which carried out offshore surveys on the east coast of Baffin Island.

Permanent tide gauges were maintained at Resolute and Brevoort as part of Canada's contribution to the International Geophysical Year. Five temporary gauges were installed on the east coast of Baffin Island.

Aeronautical Charting - The plotting of planimetric detail by tri-camera methods was continued for the most northerly charts. Ground profiles by radar altimetry were obtained by contract of an area covered by four 8 mile to 1 inch aeronautical charts in the vicinity of Aberdeen Lake, N.W.T. Critical height and contours were being established by oblique multiplex methods for the Craig Harbour chart.

1959

Geodetic Control - The arc of triangulation along the south shore of Great Slave Lake from Hay River to Fort Reliance was completed except for a small gap near Fort Resolution.

Mapping - Spirit levelling totalled 295 miles on the Pelly and MacMillan rivers for investigation of potential power resources of the Yukon River basin. In mapping, the last five map sheets to effect 1:250,000 coverage of the Yukon Territory were completed as well as 25 map sheets at 1:50,000 along the Yukon River. In the Northwest Territories 2 map sheets on Baffin Island were completed at 1:250,000 and 2 sheets

at 1:50,000 on Great Bear Lake in the Sawmill Bay area. Special large-scale plots were made of areas around Old Crow, Y.T., the Coppermine River, Frobisher Bay, Resolution Island, and Alert.

Hydrographic Charting - The C.G.S. "Baffin" in company with a chartered ship carried out a detailed survey of the central portion of Hudson Strait between Big Island and Wakeham Bay. A survey was also made of Lake Harbour and its approaches and a reconnaissance survey made of the entrance to Exeter Bay. The chartered ship M.V. "Algerine" completed a survey of the head of Frobisher Bay. Another chartered ship M.V. "Theta" made tidal current and oceanographical observations in Hudson Strait.

Two hydrographers and crews for two survey launches were attached to C.G.S. "C.D. Howe" and gathered survey information on the Eastern Arctic Patrol. A party using two launches started a survey of Beaver Lake on the Mackenzie River.

Two hydrographers were attached to the U.S.C.G.C. "Storis", the icebreaker supporting the Western Arctic D.E.W. Line supply operation, and carried out reconnaissance surveys in several critical areas for navigation.

The tide gauge established at Resolute as part of Canada's contribution to the International Geophysical Year is now maintained on a permanent basis. A new permanent gauge was established at Tuktoyaktuk, and a temporary one at Hay River, on Great Slave Lake.

Aeronautical Charting - The plotting of planimetric detail by tri-camera methods, for the most northerly charts was completed. Ground profiles by radar altimetry were obtained by contract of an area covered by five 1-inch to 8-mile aeronautical charts in the Keewatin District, N.W.T. Critical heights and contours were established for two aeronautical charts by oblique multiplex methods.

1960

Geodetic Control - The gap in the arc of triangulation from Hay River to Fort Reliance was completed and the arc was projected from Fort Reliance to the area east of Whitefish Lake. Triangulation reconnaissance was completed from Fort Reliance to Wholdaia Lake and from Fort Resolution via Yellowknife to Rae Lake. Astronomic control was established at Wholdaia Lake, Fort Reliance and Goulet Island.

Mapping: Field work included:

1. Establishing control for 1:50,000 mapping of 21,700 square miles in the Liard River watershed in the Yukon and Northwest Territories for forestry and mining needs.

2. Traversing of 1,800 miles of the south half and eastern coasts of Baffin Island for 1:250,000 mapping.

3. Spirit levelling of the Teslin River and of the Canol Road to Ross River totalling 270 miles for the investigation of potential power resources in the Yukon River basin.

4. Surveys for plans of 28 northern settlements, 26 in the Hudson Bay-Baffin Island area and 2 in the Yukon.

In mapping at the 1:250,000 scale, 4 map sheets were completed on Baffin Island and one of Nonacho Lake; at the 1:50,000 scale, 19 map sheets were completed along the Yukon and Klondike Rivers and six around Great Slave Lake. Special plots were made of areas at Whitehorse, Chesterfield Inlet, Resolute, Buchanan Bay, Radstock Bay, Coral Harbour and Frobisher.

Hydrographic Charting - C.H.S. "Baffin" carried out surveys in Lancaster Sound and Fury and Hecla Strait. Radstock Bay, a possible alternative harbour to Resolute Bay, was also surveyed. The M.V. "Theta" was chartered to carry out a tidal and oceanographic survey of part of Lancaster Sound.

Two hydrographers were assigned to the C.M.S. "C.D. Howe" and carried out surveys as opportunity permitted during the Eastern Arctic Patrol. They also made a reconnaissance survey of the western part of Barrow Strait from C.M.S. "Labrador". In the Western Arctic two hydrographers carried out control surveys at various sites by air before joining the C.M.S. "Camsell" to continue the charting of past seasons and a third travelled on two Hudson's Bay Company ships gathering Sailing Directions information.

Two chartered ships carried out surveys in Hudson Bay and Hudson Strait. The "Arctic Sealer" completed a survey of Lake Harbour and its approaches, observed a tellurometer traverse to tie in the islands in the western end of Hudson Strait, and started a survey of Povungnituk. The "Theron" completed the survey of the southern shore of Hudson Strait between Cape Prince of Wales and Davies Island. A survey was also made of Deception Bay and Sugluk Inlet and their approaches.

In James Bay a launch party made a survey of Moosonee and its approaches to provide information for the study which is to be made of the feasibility of developing it into a major port. Another launch party continued the survey of Beaver Lake on the Mackenzie River.

Two new tide gauges were established, one at Alert, and the other at Cambridge Bay.

Thirty-seven new or revised charts were issued for the Western Arctic to provide complete coverage for the first time from Canadian sources.

Aeronautical Charting - Ground profiles by radar altimetry were obtained by contract of an area covered by four 1-inch to 8-mile aeronautical charts in the vicinity of Bathurst Inlet-Aberdeen Lake, N.W.T.

1961

Geodetic Control - The large arc of triangulation extending from McLennan, Alberta, to Prince Albert, Saskatchewan, was completed. The two arms of this arc meet near Beaverhill Lake, 150 miles east of Fort Reliance. From this junction-point the arc was extended eastward to Dubawnt Lake. An arc of triangulation was completed from Cambridge Bay to Bathurst Inlet and south to Beechey Lake. Astronomic control was established at Cambridge Bay, Bathurst Inlet, and near Beaverhill Lake.

Topographic Mapping - Field work included:

1. Traverse of about 3,000 miles in the northwest quarter of Baffin Island, Devon Island, and the southern end and west coast of Ellesmere Island, for 1:250,000 mapping.

2. Spirit levelling of 315 miles along the Stewart River, for investigation of potential power resources in the Yukon River basin.

3. Surveys for plans of 30 northern settlements on the Arctic coastline and in the Mackenzie River basin.

4. Surveys in support of the Continental Polar Shelf Project.

In mapping at the 1:250,000 scale 2 map sheets were completed on Baffin Island, and 2 north of Fort Smith, and at the 1:50,000 scale one map sheet in the Klondike district, 12 map sheets at the east end of Great Slave Lake, and 9 map sheets around Fort McPherson. Special plots were made of areas around outer Frobisher Bay, Pangnirtung, Cape Dyer, Dorset Island, Fury and Hecla Strait, Ellef Ringnes Island, Coppermine River, Watson Lake, Whitehorse and Mayo. Material was prepared for plots of 27 northern sites by contract.

Hydrographic Charting - The eastern half of Barrow Strait was sounded by the C.H.S. "Baffin" using Two-Range Decca for positioning. The horizontal control was established by a closed tellurometer traverse between Devon and Cornwallis Islands, and across Barrow Strait to Somerset Island. A tellurometer traverse was also carried out in the Lady Franklin and Monument Island groups with the traverse extending from Brevoort Island to Cyrus Field Bay. Launches from the "Baffin" charted Erebus Bay and Gascoyne Inlet.

The M.V. "North Star", under charter for the season, ran lines of soundings along the east side of Hudson Bay to Moosonee at the south end of James Bay. The survey was terminated when this vessel struck an uncharted reef in James Bay and became a total loss.

The charter vessel, "Arctic Sealer", conducted surveys in the vicinity of Durban and Broughton Islands off the east coast of Baffin Island.

Hydrographers aboard three Department of Transport vessels, "John A. Macdonald", "C.D. Howe", and "D'Iberville", carried out reconnaissance sounding surveys in the eastern Arctic, including extensive areas of Hudson Strait and Ungava Bay. Horizontal control was established in Strathcona Sound and a hydrographic survey of the sound and approaches was completed.

Data on tides, currents, and chart revision were obtained using the R.C.M. Police launch "Spalding" in Coronation Gulf. Similar information was obtained in various areas of the Western Arctic visited by the Department of Transport vessel "Camsell".

A launch party based at Moosonee completed the charting, and tidal and current investigations in the Moose River, and approaches in connection with a proposed seaport.

Charting of the Beaver Lake sector of the Mackenzie River, and a reconnaissance survey of the Slave River, from Fort Smith to the estuary, were completed.

Five tide gauges at Tuktoyaktuk, Cambridge Bay, Alert, Resolute and Churchill were checked and maintained.

Division of Oceanographic Research

1960

Oceanographic studies were carried out in three general locations from three bases:

1. Polar Continental Shelf Project - as described in that section of this report.

2. Chartered Vessel M.V. "Theta" - two oceanographers made bathythermograph and sampling sections of temperature and salinity in sections across the eastern entrance to Lancaster Sound in conjunction with tidal current studies in that area.

3. C.M.S. "Labrador" - a party of four oceanographers were carried in C.M.S. "Labrador" for 5 weeks. They conducted a synoptic survey of Lancaster Sound, Barrow Strait, Prince Regent Inlet, Gulf of Boothia, Fury and Hecla Strait and the mid-western area of Baffin Bay.

1961

Oceanographic studies were carried out in three general locations from three bases:

1. Polar Continental Shelf Project - as described in that section of this report.

2. Chartered Vessel M.V. "Theta" - an oceanographic study of Hudson Bay extending from late July to early October included two quasi-synoptic surveys of the Bay. In addition to serial measurements of water properties at 250 stations, bottom studies including photography, sampling, coring, and gravity observations were carried out. Magnetometer and seismic profiling records were obtained.

3. C.M.S. "Labrador" and C.M.S. "John A. Macdonald" - a team of oceanographers carried in C.M.S. "Labrador" undertook an extensive oceanographic survey of Davis Strait, Baffin Bay, Lancaster Sound and Smith Sound. Isolated observations in McClure Strait were obtained. C.M.S. "John A. MacDonald" occupied stations in the Gulf of Boothia and Fury and Hecla Strait.

INTERDEPARTMENTAL COMMITTEE ON AIR SURVEYS

The responsibilities of this committee are to receive all federal government service requests for air surveys, to prepare air survey priorities, to issue technical instructions for carrying out such programmes, and to co-ordinate the activities of commercial and government air survey organizations.

1957

In the District of Keewatin and the eastern portion of the District of Mackenzie approximately 80,000 square miles of high altitude vertical air photography were obtained by the Photographic Survey Corporation Limited and Spartan Air Services Limited.

1958

In the Arctic Islands, three companies carried out air photography as follows:

Photographic Survey Corporation Ltd.	103,500	sq. mi.
Spartan Air Services Limited	128,500	" "
Aero Surveys Limited	11,000	" "
Total	243,000	" "

In the District of Keewatin, only two companies operated as follows:

Photographic Survey Corporation Ltd.	9,000	sq. mi.
Spartan Air Services Ltd.	22,200	" "
Total	31,200	" "

In addition the Ottawa Islands were photographed by Spartan Air Services. The Liard River and its upper tributaries in the Yukon were photographed by the Photographic Survey Corporation Ltd., at large scale, and the area north of 60° Latitude in Quebec, west of Ungava Bay was completed by Photographic Survey.

Vertical air photography is now complete for the Yukon and the Northwest Territories mainland, apart from a few small gaps, and for the Arctic Islands south of Viscount Melville and Lancaster Sounds except for the west part of Victoria Island, the northeastern half of Banks Island, Coats and Mansel Islands (in the northern part of Hudson Bay), and Akpatok Island in Ungava Bay.

1959

In the Arctic Islands, three companies carried out air photography as follows:

Photographic Survey Corporation Ltd.	124,500	sq. mi.
Spartan Air Services Ltd.	115,500	" "
Aero Surveys Ltd.	8,000	" "
Total	248,000	" "

This area, combined with the 1958 total of 243,000 square miles, represents about 89% of the Arctic Islands and leaves approximately 60,000 square miles still to be photographed.

In the District of Keewatin, only two companies operated as follows:

Photographic Survey Corporation Ltd.	3,000	sq. mi.
Spartan Air Services Ltd.	9,000	" "
Total	12,000	" "

The latter includes Coats and Mansel Islands. In addition large-scale photography was taken of the Teslin River in the Yukon.

1960

In the Arctic Islands, three companies carried out air photography as follows:

Hunting Survey Corp. Ltd.	6,450 sq. mi. (some reflights)
Spartan Air Services Ltd.	6,500 sq. mi.
Aero Surveys Ltd.	15,000 " "

This area combined with '58 and '59 operations gives a total of acceptable photography amounting to 519,000 sq. miles or about 94% of the Arctic Islands and leaves about 33,000 sq. miles still to be photographed, mostly in the area north of Amundsen Gulf and Prince Albert Sound and west of 112° Longitude.

In the Arctic Islands, Spartan Air Services produced 2,100 line miles of Air Profile Recordings, and Aero Surveys produced 1,200 line miles.

In the Arctic Islands and the northern mainland, contracts were entered into to photograph northern sites for large-scale maps required for settlement planning. The 58 sites were evenly distributed between Aero Surveys, Spartan Air Services and Hunting Surveys, and 37 were completed during the summer.

In the Yukon, Aero Surveys completed photography of about 1,700 line miles of main rivers at large scale for the Forestry Branch and Water Resources Branch.

Bradley Air Services completed some 2,700 line miles of high altitude photography of the area at the head-waters of the Flat and South Nahanni Rivers.

The area adjoining the Mackenzie Highway was photographed at medium scale from 60° Latitude to Great Slave Lake and the water route from Waterways to Great Slave Lake was photographed at medium scale.

In the Keewatin District, Spartan Air Services photographed at high altitude about 2,500 line miles of an area between 60° Latitude and Chesterfield Inlet.

1961

The high level photo and APR program in the Arctic Islands progressed satisfactorily. All that remains to be done in the Arctic Islands is about half of Banks Island, half of Melville Island, and a very small gap on Prince Patrick Island.

The remaining twenty-one Arctic sites, mentioned in last year's report, were completed in 1961, as was the contract in the Yukon being carried out by Aero Surveys Limited.

Bradley Air Services Limited completed, apart from a few gaps, their contract in the head waters of the Flat and South Nahanni Rivers, and Spartan Air Services Limited completed their area in the Keewatin District.

The Mackenzie River was photographed from Great Slave Lake to Wrigley.

Very little photography was obtained in the 50,000 square mile area southeast of Ungava Bay.

The Barnes Ice Cap area on Baffin Island was photographed for the preparation of special large scale maps, and additional APR control lines were run across Baffin Island to strengthen the existing APR north-south lines.

DEPARTMENT OF NATIONAL DEFENCE

Canadian Army

The Canadian Army is responsible for the operation and the maintenance of the research, development and training centre at Fort Churchill, and for defence mapping.

1957

Fort Churchill

Cold weather tests on various infantry weapons, vehicles and clothing were conducted.

Army Survey Establishment

Levelling operations were carried out in the area north of Great Bear Lake. Photographic Survey Corporation provided shoran control for mapping in central Baffin Island, while Spartan Air Services Ltd. were operating north-east of Baker Lake, N.W.T., completing the shoran control work started in 1956.

1958

Fort Churchill

Cold weather tests on various infantry weapons, vehicles and clothing were carried out. The main activity was the IGY programme.

Army Survey Establishment

Activities of the Army Survey Establishment included winter levelling operations in the area north and east of Great Slave Lake, N.W.T. Spartan Air Services Ltd. under contract to the department, provided shoran control for 1:250,000 mapping in southern Baffin Island. An Army Survey helicopter party, using tellurometers for the first time, established ground control in the area east of Great Slave Lake, for future mapping.

1959

Fort Churchill

Cold weather tests were conducted on various vehicles, and on items of clothing and personal equipment.

Army Survey Establishment

Defence mapping operations by the Army Survey Establishment included:

1. Spirit and altimeter levels, and tellurometer traverses in the Churchill and Ennadai areas.

2. Tellurometer-helicopter traverses and altimeter levels on Victoria Island.

3. Spirit levels in the Back River area.

4. Radar altimetry in the Pelly Lake area by civilian contract in conjunction with similar operations by the Department of Mines and Technical Surveys.

1960

Fort Churchill

Various tests and trials of equipment, including tests of a missiles system for a combined Canada-United States team, were carried out. The investigation of upper atmosphere phenomena, by means of instruments carried aloft in the nose cones of rockets, continued in 1960.

Army Survey Establishment

Over a period of three months during the summer the Army Survey Establishment completed survey operations to establish horizontal and vertical control for mapping purposes on Banks Island, and continued these operations on Victoria Island.

1961

Army Survey Establishment

From April to August inclusive, tellurometer traversing was carried out for horizontal control on Cornwallis, Bathurst, western Devon, Cornwall, Amund Ringnes and Lougheed Islands. From June to August, tellurometer traversing was also carried out in the Keewatin District.

Royal Canadian Navy

1956

After a period of preparation at Halifax, H.M.C.S. "Labrador" departed on 1 July for her third voyage of Arctic operations. During the early stages of the operations, hydrographic surveys of uncharted areas were conducted and charts prepared.

Following the supply operations, H.M.C.S. "Labrador" and U.S.S. "Edisto" traversed the difficult Fury and Hecla Strait to carry out further hydrographic and scientific surveys in the Gulf of Boothia. On completion of the surveys, H.M.C.S. "Labrador" returned to Halifax via Prince Regent Inlet and Lancaster Sound.

1957

H.M.C.S. "Labrador" departed Halifax on 25 June, 1957, for Arctic operations. Aboard were twenty-four officers, seven civilian scientists, and one hundred and ninety-five men. On 29 June H.M.C.S. "Labrador proceeded to carry out site surveys at Lascie and St. Anthony, Newfoundland; Fox Harbour, Spotted Island, Cartwright, Cuthroat Island, Cape Makkovik, Hopedale and Saglek in Labrador; and Resolution Island, Northwest Territories. These surveys were completed by 12 July.

H.M.C.S. "Labrador" returned to Resolution Island on 23 July proceeded up Frobisher Bay to Ney Harbour where a Department of Fisheries research party was resupplied. After calling at Frobisher H.M.C.S. "Labrador" discovered a new deep water approach channel which greatly eases the difficulty of reaching Frobisher. The ship then carried out a survey at Brevoort Island.

Transit of Bellot Strait was carried out on 24 August and subsequent escort of the U.S. ships "Storis", "Spar" and "Bramble" through the Strait on 6 September. Surveys were continued in the area until 11 September when H.M.C.S. "Labrador" departed for oceanographic and hydrographic tasks in the Barrow Strait area.

The period 11-17 September was spent in probing Barrow Strait, Wellington Channel, Maury Channel, and Queens Channel to Pelham Bay on Grinnell Peninsula. Further survey was carried out in Prince Regent Inlet and Lancaster Sound until 23 September.

H.M.C.S. "Labrador" then carried out oceanographic surveys in Baffin Bay and Davis Strait. The ship arrived in Halifax on 11 October, 1957, after 109 days at sea during which she steamed 18,500 miles most of them in uncharted waters of the eastern Arctic.

Royal Canadian Air Force

1956

Shoran Survey

Over 800 hours were flown in shoran survey operations on the Arctic coast and over the Arctic Islands up to the 75th parallel.

Arctic Reconnaissance

Ice reconnaissance was carried out in support of ocean shipping engaged in resupply of the Arctic weather stations and the D.E.W. Line. In addition, over 500 hours were flown in general reconnaissance and surveillance of the Arctic Islands and the Polar Basin.

1957

Shoran Survey

Almost 2,000 hours were flown on shoran survey operations north of the 75th parallel. The shoran survey of Canada was completed by 1 June.

Arctic Reconnaissance

Ice reconnaissance was carried out in support of ocean shipping engaged in resupply of the arctic weather stations and the D.E.W. Line. In addition, over 600 hours were flown in general reconnaissance and surveillance of the Arctic Islands and the Polar Basin.

1958

Arctic Reconnaissance

Ice reconnaissance was carried out in support of ocean shipping engaged in resupply of Arctic Weather Stations and the D.E.W. Line. This entailed 429 flying hours. Some 1177 hours were flown on general reconnaissance and surveillance of the Arctic islands and the Polar Basin, and an additional 172 hours on photographic missions in the north.

1959

Arctic Reconnaissance

Seven hundred hours were flown in general reconnaissance and surveillance of the Arctic Islands and of the Polar Basin by the Lancasters of 408 Squadron.

1960

Arctic Reconnaissance

Seven hundred and twenty-five hours were flown in general reconnaissance and surveillance of the Arctic Islands and of the Polar Basin by the Lancasters of 408 Squadron.

1961

Arctic Reconnaissance

Eleven hundred and twenty hours were flown in general reconnaissance and surveillance of the Arctic Islands and of the Polar Basin by Lancasters of 408 Squadron.

Defence Research Board

The responsibilities of the Defence Research Board include conducting research projects on arctic and geophysical problems, and supporting and co-ordinating research in the north by means of grants and contracts to universities, government agencies and non-government research organizations.

1956

H.M.C.S. "Labrador"

The Naval patrol ship, H.M.C.S. "Labrador" spent from June to October 1956 in arctic waters. The ship carried eight Canadian scientists and technicians, in addition to her crew, for studies in oceanography, hydrography, marine biology, and hydro-meteorology. The program was organized and co-ordinated by the Geophysics Section of the Board.

During the summer of 1956 the "Labrador" undertook a most intensive oceanographic program in Foxe Basin, Committee Bay, Prince Regent Inlet, Lancaster Sound and Baffin Bay. In all, 200 oceanographic stations were taken, and nearly 1,000 oxygen and other chemical analyses were completed on board ship.

Medical

The Director of the Arctic Medical Research Unit at the University of Manitoba visited D.E.W. Line sites in 1956.

Text on the Canadian Arctic for Air Navigators

This work was continued by one scientific staff officer and the text is now being printed.

Vehicle Mobility Studies

A small group of one scientist, one technical officer and four technicians was engaged in vehicle mobility and trafficability studies which have a bearing on Arctic transportation problems.

Cold-Weather Welding Techniques

The study of welding techniques at low temperatures was continued by the Department of Mines and Technical Surveys for the Defence Research Board.

Grants and Contracts

A number of extra-mural studies were supported by grants or contracts with universities and other non-governmental agencies.

Grants

1. To the University of Alberta for a study of storage problems in aviation gasoline under cold conditions.

2. To the University of Toronto for a study of the source of trichinosis in arctic marine mammals.

3. To McMaster University for a study of methods of interpreting surface and sub-surface conditions from air photographs.

4. To McGill University for a study of micro-meteorological factors affecting climate in Ungava.

5. To the University of Manitoba for research on arctic medical problems.

6. To Queen's University for physiological studies in cold acclimatization.

7. A number of other universities received funds from the Board for arctic medical research.

Contracts

1. With the Scott Polar Research Institute for a report on "Sea Ice Recording and Reporting Methods", an "Illustrated Ice Glossary", and the provision of data to the D.R.B. resulting from the Institute's work in polar research.

2. With the Arctic Institute of North America for plotting glaciological and other features from air photographs.

3. With the University of Manitoba for an Arctic Medical Research Unit.

4. With the Arctic Institute of North America to examine, collect and extract information of navigation value which is to be included in the new Arctic Pilots.

5. With the Scott Polar Research Institute to produce an ice atlas for the coasts of North America and Greenland similar to one prepared for the Northern Sea Route of the U.S.S.R.

6. With McGill University for research on ice physics with special reference to removing ice from runways, and in conjunction with a program for the study of sea ice.

1957

The Defence Research Northern Laboratory

The Defence Research Northern Laboratory at Fort Churchill has continued in the role adopted in 1956--that of northern base for visiting scientific teams, with a scientific and technical staff to provide assistance to such teams, made up of about five professional and thirty-five technical and administrative staff. In addition to ad hoc and short-term projects and continued active participation in the IGY rocket program, work has been undertaken on the growth and degeneration of sea and river ice.

Operation Hazen

As part of Canada's IGY program a varied programme of research was carried out in the Lake Hazen area of Ellesmere Island. In the summer of 1957 an 8-man party did glaciological, meteorological, seismic and geological work in the area.

H.M.C.S. "Labrador"

The Naval patrol ship H.M.C.S. "Labrador" spent from June to October 1957 in arctic waters steaming a total of 18,500 miles. The ship carried seven Canadian scientists and technicians in addition to her crew. The scientific work was organized and co-ordinated by the Geophysics Section of the Board. An intensive program of hydrography was carried out in Bellot Strait where the existence of a deep water channel was established, and surveys made at Brevoort Island, Resolution Island, and in detail in Frobisher Bay. A new distance measuring instrument, the tellurometer, played an important part in the survey. A program of oceanography was conducted in the waters surrounding Somerset Island, Wellington Channel, Frobisher Bay, and Davis and Hudson Straits. In all 161 stations were occupied, and 25 deep sea cores taken.

Medical

The Director of the Arctic Medical Research Unit at the University of Manitoba participated in the 1957 Eastern Arctic Patrol and Medical Survey aboard the C.G.S. "C.D. Howe" from Resolute Bay to Frobisher Bay. His report again emphasizes problems of environmental hygiene in the north. Blood samples collected from the native population have been studied and a preliminary report on viral antibodies in the Eastern Arctic Eskimos has been issued.

Text on the Canadian Arctic for Air Navigators

This work was completed and the final product, "Arctic Canada from the Air", by Moira Dunbar and Keith R. Greenaway, was published in August by the Queen's Printer.

Vehicle Mobility Studies

A small group of one scientist, one technical officer and four technicians was engaged in vehicle mobility and trafficability studies which have a bearing on arctic transportation problems.

Cold-Weather Welding Techniques

The study of welding techniques at low temperatures was continued by the Department of Mines and Technical Surveys for the Defence Research Board. The experimental work was completed.

Grants and Contracts

A number of extra-mural studies were supported by grants or contracts with universities and other non-governmental agencies.

Grants

1. To the University of Alberta for a study of storage problems in aviation gasoline under cold conditions.

2. To McMaster University for a study of methods of interpreting surface and sub-surface conditions from air photographs.

3. To McGill University for a study of micro-meteorological factors affecting climate of Canadian forests.

4. To the University of Toronto for the study of hypothermia and hibernation, the effect of cold on physiological and pharmacological reactions, and the source of trichinosis in arctic marine mammals.

5. To the University of Manitoba for research on frost bite and acclimatization, and for the support of the Arctic Medical Research Unit.

6. To Queen's University for studies on cold acclimatization.

7. To other universities including University of Western Ontario, University of Ottawa, and McGill University for research on local effects of cold and metabolic effects of cold.

Contracts

1. With the Arctic Institute of North America for plotting glaciological and other features from air photographs.

2. With the Arctic Institute of North America to examine, collect and extract information of navigation value which is to be included in the new Arctic Pilots.

3. With the Scott Polar Research Institute to produce an ice atlas for the coasts of North America and Greenland similar to one prepared for the Northern Sea Route of the U.S.S.R.

4. With McGill University for research on ice physics with special reference to removing ice from runways, and in conjunction with a program for the study of sea ice.

5. With McGill University for meteorological work at Lake Hazen.

6. With the University of Toronto for seismological and survey work at Lake Hazen.

7. With the Arctic Institute of North America to provide limited consultant services.

8. With the Scott Polar Research Institute for the provision of data resulting from the Institute's work in polar research.

1958

The Defence Research Northern Laboratory

In addition to ad hoc and short-term projects and continued active participation in the International Geophysical Year programme for 1958, together with other related studies in the physical sciences, work was undertaken on the growth and degeneration of sea and river ice, and auroral observation studies.

Operation Hazen

As part of Canada's IGY programme, a varied programme of research was carried out in the Lake Hazen area. A party of four wintered at Lake Hazen and were joined by a further sixteen during the 1958 summer. A complete meteorological record at Lake Hazen was obtained, and glaciological, micro-meteorological, geophysical, and geological work was carried on. Biological and archaeological studies were made by officers from other government departments in the party.

Floating Station "Bravo"

The Defence Research Board, through the cooperation of the United States Air Force and the United States National Academy of Sciences, arranged for a Canadian oceanographer on this station. The Fisheries Research Board of Canada (Atlantic Oceanographic Group), in continuation of the arctic programme previously carried out aboard H.M.C.S. "Labrador", provided this oceanographer.

Vehicle Mobility Studies

A small group of one scientist, one technical officer, and four technicians was engaged in vehicle mobility and trafficability studies which have a bearing on arctic transportation problems.

Grants and Contracts

A number of extra-mural studies were supported by grants or contracts with universities and other non-governmental agencies.

Grants

1. To the University of Alberta for a study of storage problems in aviation gasoline under cold conditions.

2. To McMaster University for a study of methods of interpreting surface and sub-surface conditions from air photographs.

3. To McGill University for a study of micro-meteorological factors affecting climate of Canadian forests.

4. To the University of Toronto for the study of hypothermia and hibernation, and the effect of cold on physiological and pharmacological reactions.

5. To the University of Manitoba for research on frost bite, acclimatization, and for the support of the Arctic Medical Research Unit.

6. To other universities including University of Western Ontario, University of Ottawa, Queen's University, and McGill University for research on local effects of cold and metabolic effects of cold.

Contracts

1. With the Arctic Institute of North America for plotting glaciological and other features from air photographs. This contract was completed, and from the information gained a new glacial map of Canada, compiled by the University of Toronto, was published in March 1958.

2. With the Scott Polar Research Institute to produce an ice atlas for the coasts of North America and Greenland similar to one prepared for the Northern Sea Route of the U.S.S.R.

3. With McGill University for research on ice physics with special reference to removing ice from runways, and in conjunction with a programme for the study of sea ice, and the design of an airborne ice thickness measuring device.

4. With McGill University for meteorological and geophysical work at Lake Hazen.

5. With the University of Toronto for gravity work at Lake Hazen.

6. With the Arctic Institute of North America to provide limited consultant services.

7. With the Scott Polar Research Institute for the provision of data resulting from the Institute's work in polar research.

1959

The Defence Research Northern Laboratory

In addition to ad hoc and short-term projects and continued active participation in the International Geophysical Co-operation Year programme for 1959, together with other related studies in the physical sciences, work was continued on the growth and degeneration of sea and river ice, and auroral observation studies.

Radio Physics

A comprehensive programme of ionospheric research was continued as in previous years with the co-operation of the Department of Transport, with stations at Alert, Resolute and Churchill. Other work included measurements of oblique incidence between Resolute and Winnipeg, electron density and infra-red measurements above Churchill with rocket-borne instruments, auroral zone and atmospheric noise studies, and active support of the United States I.G.C. rocket programme at Churchill.

Operation Hazen

A party of two spent the summer at Lake Hazen, continuing meteorological and climatological studies begun earlier.

Cold Weather Welding Techniques

Work continued on this problem, welds being made under closely controlled conditions at temperatures as low as -80°F.

Biting Flies

Research on the distribution of biting flies was supported, as in the past, in co-operation with the Department of Agriculture, which also carried out the work.

Under-Ice Acoustics

Work on a study of acoustic propagation and ambient noise under ice was begun at the Pacific Naval Laboratory and preliminary field work done in Barrow Strait.

Cold Environmental Studies

The Defence Research Medical Laboratories have continued to carry out a varied programme of studies designed to alleviate the effects of cold on man. These cover studies of the physical properties of prospective materials for environmental clothing, development of survival food packs and ration packs, studies of lightweight, quickly prepared food items such as freeze-dried meats, and physiological and biochemical studies of hypothermia and the process of recovery from such conditions.

Vehicle Mobility Studies

A small group of one scientist, one technical officer and four technicians, was engaged in vehicle mobility and trafficability studies which have a bearing on arctic transportation problems.

Grants and Contracts

A number of extra-mural studies were supported by grants or contracts with universities and other non-governmental agencies.

Grants

1. To McMaster University for a study of methods of interpreting surface and sub-surface conditions from air photographs.

2. To McGill University for a study of micro-meteorological factors affecting climate of Canadian forests.

3. To McGill University for research on the shearing characteristics of frozen soil.

4. To the Royal Military College for research into the physical problems involved in designing a superconducting gyroscope.

5. To the University of Toronto for studies of adaptation to cold, the effects of cold on pharmacological reactions and the effect of nutritional conditions on metabolism in the cold.

6. To McGill University for studies of the effects of cold injury on the vascular system.

7. To the University of Western Ontario for studies of metabolic reactions to cold and damp.

8. To the University of Manitoba for studies of frostbite, cold acclimatization and support of an Arctic Medical Research Unit.

9. To the University of Ottawa for studies of resistance and acclimatization to cold.

10. To Laval University for a study of circulatory adaptation to cold stress.

11. To the University of Montreal for a study of fat metabolism and resistance to cold.

Contracts

1. With the Scott Polar Research Institute to produce an ice atlas for the coasts of North America and Greenland similar to one prepared for the Northern Sea Route of the U.S.S.R.

2. With McGill University for research on ice physics with special reference to removing ice from runways, and in conjunction with a programme for the study of sea ice, and the design of an airborne ice thickness measuring device.

3. With McGill University for meteorological and geophysical work at Lake Hazen.

4. With the University of Toronto for gravity work at Lake Hazen.

5. With the Arctic Institute of North America to provide limited consultant work.

6. With the Scott Polar Research Institute for the provision of data resulting from the Institute's work in polar research

1960

The Defence Research Northern Laboratory

In addition to ad hoc and short-term projects, work was continued on the growth and degeneration of sea and river ice, and auroral observation studies. A series of ten rocket-launchings was conducted by the Canadian Armament Research and Development Establishment at Churchill for the purpose of testing propellants, determining certain gaseous components of the upper atmosphere, and measuring radio wave absorption in disturbed ionospheric conditions.

Radio Physics

A comprehensive programme of ionospheric research was continued as in previous years with the co-operation of the Department of Transport, with arctic stations at Resolute and Churchill. A line of stations running north through Great Whale River and Coral Harbour to Resolute was set up by the Defence Research Telecommunications Establishment to measure cosmic noise, and at the same stations low-power VHF scatter circuits were established, with transmitter at Coral Harbour and receivers at Resolute and Great Whale. Other work included measurements of oblique incidence between Resolute and Winnipeg, electron density and infra-red measurements above Churchill with rocket-borne instruments, and auroral zone studies.

Operation Hazen

A two-man party spent a few weeks at Lake Hazen in May-June.

Conjugate Point Experiment

The Pacific Naval Laboratory, in cooperation with Stanford University, is conducting a combined programme to obtain simultaneous measurements of geomagnetic micropulsations at Byrd Station in the Antarctic, and at Great Whale River and Churchill in Canada, both of which lie near the conjugate point to Byrd Station.

Under-Ice Acoustics

A study of acoustic propagation and ambient noise under ice was begun at the Pacific Naval Laboratory in 1959. A reconnaissance trip to Isachsen was made to select a work site for 1961 and to test new equipment.

Biting Flies

As in the past, the Northern Insect Survey of the Department of Agriculture was supported by a transfer of funds.

Cold Environmental Studies

The Defence Research Medical Laboratories have continued to carry out a varied programme of studies designed to alleviate the effects of cold on man. These cover studies of the physical properties of prospective materials for environmental clothing, development of survival food packs and ration packs, studies of lightweight, quickly prepared food items, and physiological and biochemical studies of hypothermia and the process of recovery from such conditions. The production of freeze-dried meats has progressed to the commercial development stage and a contract has been let to industry.

Vehicle Mobility Studies

One scientist, two technical officers and four technicians were engaged in vehicle mobility and trafficability studies which have a bearing on arctic transportation problems.

Grants and Contracts

A number of extra-mural studies were supported by grants or contracts with universities and other non-government agencies.

Grants

1. To McMaster University for a study of methods of interpreting surface and sub-surface conditions from air photographs.

2. To McGill University for a study of micro-meteorological factors affecting climate of Canadian forests.

3. To McGill University for research on the shearing characteristics of frozen soil.

4. To McGill University for work on the reactions of the constituents of the upper atmosphere.

5. To the University of Saskatchewan for the support of the Institute of Upper Atmospheric Physics.

6. To the University of Western Ontario for research on the physics of the troposphere as related to UHF radio transmissions.

7. To the Canadian Military Services College, Royal Roads, for a study of the roles of the ionosphere and sun in the origin of the natural electromagnetic background in the frequency range 0,001 c/s to 100 Mc/s.

8. To the University of Toronto for studies of adaptation to cold, the effects of cold on pharmacological reactions and the effect of nutritional conditions on metabolism in the cold.

9. To McGill University for studies of the effects of cold injury on the vascular system and the pathogenesis of cold injury.

10. To the University of Western Ontario for studies of metabolic reactions to cold and damp.

11. To the University of Manitoba for studies of frostbite, cold acclimatization and support of an Arctic Medical Research Unit.

12. To the University of Ottawa for studies of resistance and acclimatization to cold.

13. To Laval University for a study of circulatory adaptation to cold stress.

14. To the University of Manitoba Arctic Medical Research Unit for a field study on cold tolerance of Eskimos, in collaboration with NRC.

15. To the University of Toronto for a study of the sense organs of mosquitoes.

16. To the Ontario Veterinary College for research on repelling bloodsucking insects.

17. To the University of Alberta for research on the flight range of biting flies.

18. To Queen's University for research on the reactive principles and specificity of bites of blood sucking arthropods with particular reference to mosquitoes.

19. To the University of Western Ontario for a study of factors in the attractiveness of objects to adult Aedes aegypti.

20. To the University of Manitoba for research on the behaviour of biting flies with special reference to orientation and feeding.

21. To the University of Alberta for field studies on mosquito biology.

22. To the Ontario Agricultural College for studies on the life history and ecology of Simulium rugglesi.

23. To the University of Saskatchewan for research on the retrocerebral endocrine system in prairie mosquitoes.

24. To the University of Western Ontario for a study of the reaction of men and animals to cold and damp.

Contracts

1. With McGill University for research on ice physics with special reference to removing ice from runways, and in conjunction with a programme for the study of sea ice, and the design of an airborne ice thickness measuring device.

2. With McGill University for meteorological and geophysical work at Lake Hazen.

3. With the Arctic Institute of North America to provide limited consultant work.

4. With the Scott Polar Research Institute for the provision of data resulting from the Institute's work in polar research.

5. With McGill University for stratospheric research, and for the production of an atlas of 25-mb synoptic weather maps for the Northern Hemisphere.

6. With McMaster University for the compilation of a muskeg map of Canada.

7. With the University of Alberta for a study of the mode of action of insect repellants.

8. With the University of Alberta for a study of the the reaction of insects to the stimuli presented by an aerial spray.

1961

The Defence Research Northern Laboratory

In addition to ad hoc and short-term projects, work was continued on the growth and degeneration of sea and river ice, and auroral observation studies.

The rocket research operations at Fort Churchill were sharply curtailed as a result of a fire in February.

Radio Physics

A programme of ionospheric research continued as in previous years with the cooperation of the Dept. of Transport. This included routine vertical-incidence ionospheric soundings at Resolute and Churchill, and oblique-incidence soundings from Resolute to Ottawa. Low-power VHF scatter circuits were operated during the year but were closed down at the end of 1961. The chain of riometer stations measuring cosmic noise across the auroral zone continued in operation, and constituted a major portion of the research effort.

Operation Hazen

Previous work in the Lake Hazen area of northern Ellesmere Island, organized or sponsored by the Defence Research Board, included meteorological, glaciological, geological and soil studies. These studies were continued during the summer and in addition, geomagnetic investigations and entomological studies were initiated by scientists from the Dominion Observatory and the Dept. of Agriculture. Eight men were in the field from the middle of May until late August.

Ice Atlas of Arctic Canada

This atlas, compiled under a contract with the Scott Polar Research Institute, was published in April.

Under-Ice Acoustics

A study of acoustic propagation and ambient noise under ice was begun at the Pacific Naval Laboratory in 1959. Two field operations were undertaken. Investigations were made in April under polar pack ice in the area near Isachsen, and in summer under polar pack ice in McClure Strait, working from the icebreaker C.M.S. "Labrador".

Conjugate Point Experiment

The Pacific Naval Laboratory, in cooperation with Stanford University, is conducting a combined programme to obtain simultaneous measurements of geomagnetic micropulsations at Byrd Station in the Antarctic, and at Great Whale River and Churchill in Canada, both of which lie near the conjugate point to Byrd Station.

Vehicle Mobility Studies

Two scientists, two technical officers, and five technicians were engaged in vehicle mobility and trafficability studies which have a bearing on arctic transportation problems, with particular emphasis on the performance of tracked vehicles in snow and muskeg.

Biting Flies

The Northern Insect Survey, a project conducted by the Department of Agriculture with Defence Research Board support, made an

exploratory examination of the Lake Hazen area. An extremely varied and interesting insect fauna was indicated.

Clothing and Cold-weather Refuelling

A critical literature survey was made to evaluate the hazard in aircraft refuelling from static electricity generated by clothing, following several incidents that were attributed to this cause.

Environment Physiology

The Defence Research Medical Laboratories initiated preliminary studies on human subjects to examine the effects of environmental temperature on body fluids, electrolytes and metabolites, and on the cardio-vascular system. This work will be in abeyance pending re-building of part of the climatic suite to meet the design specifications.

Experiments continued to elucidate the metabolic alterations in hypothermia in a variety of animal species.

Grants

1. To McMaster University for a study of methods of interpreting surface and sub-surface conditions from air photographs.

2. To McGill University for a study of micro-meteorological factors affecting climate of Canadian forests.

3. To McGill University for research on the shearing characteristics of frozen soil.

4. To the Institute for Northern Studies, University of Saskatchewan, for research on the sub-arctic sand dunes south of Lake Athabasca.

5. To McGill University for work on the reactions of the constituents of the upper atmosphere.

6. To the University of Saskatchewan for the support of research at the Institute of Upper Atmospheric Physics.

7. To the University of Western Ontario for research on the physics of the troposphere as related to UHF radio transmissions.

8. To the Canadian Military Services College, Royal Roads, for a study of the roles of the ionosphere and sun in the origin of the natural electro-magnetic background in the frequency range 0,001 c/s to 100 Mc/s.

9. To the University of Toronto for studies of hypothermia and endocrine function, the biochemical mechanisms involved in cold adaptation, and the effects of cold on pharmacological reactions.

10. To McGill University for studies of the effects of cold injury on the vascular system and the pathogenesis of cold injury.

11. To the University of Manitoba for studies of frostbite and cold acclimatization and for support of an Arctic Medical Research Unit.

12. To the University of Ottawa for studies of resistance and acclimatization to cold.

13. To Laval University for a study of circulatory adaptation to cold stress.

14. To the University of Manitoba Arctic Medical Research Unit for a field study on cold tolerance of Eskimos, in collaboration with NRC.

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16. To Queen's University for research on the reactive principles and specificity of bites of bloodsucking anthropods with particular reference to mosquitoes.

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19. To the University of Alberta for field studies on mosquito biology.

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4. With the Scott Polar Research Institute for the provision of data resulting from the Institute's work in polar research.

5. With McGill University for stratospheric research, and for the production of an atlas of 25-mb synoptic weather maps for the Northern Hemisphere.

6. With the University of Western Ontario for spectroscopic studies of upper-atmospheric excitation, ionization, and recombination processes.

7. With the University of Saskatchewan for optical studies of auroral phenomena at Fort Churchill, Manitoba.

DEPARTMENT OF NATIONAL HEALTH AND WELFARE

1959

A preliminary study was made of the available literature on mental health problems in the north, as they relate to the southern Canadian going north on duty.

The Public Health Engineering Division began research into the sanitation problems peculiar to the North. Preliminary work consisted of gathering and translating literature on the subject from U.S.S.R. sources.

NATIONAL RESEARCH COUNCIL

The responsibility of the National Research Council in the north comprises the investigation of various phases of pure and applied science.

1956

Division of Pure Physics

Cosmic ray equipment was put into operation at Resolute.

Division of Radio and Electrical Engineering

The Auroral radar equipment and associated instruments were installed and tested at Baker Lake and Resolute Bay.

10. To McGill University for studies of the effects of cold injury on the vascular system and the pathogenesis of cold injury.

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Division of Radio and Electrical Engineering

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Division of Building Research

The permafrost staff continued their studies at the new site of Aklavik, at Norman Wells and at other points in the Mackenzie Delta. Northern building studies were continued by a visit to Churchill, Yellowknife, Norman Wells and Aklavik. A survey of basement construction at the original town of Aklavik was also carried out. The new site of Aklavik was included in the Division's programme for a study of snow loads on roofs across Canada. Co-ordination of northern research continued, with one research officer assigned especially to this duty.

1957

Division of Pure Physics

This Division continued to operate its cosmic ray equipment consisting of a neutron monitor and a counter telescope in the National Research Council building at Resolute. A second counter telescope, which had been in operation at Resolute for several years, was rebuilt and placed in operation. Similar equipment was installed in the Defence Research Northern Laboratories at Fort Churchill in March and was kept in operation by the staff of D.R.N.L. Certain geophysical observations were made in other disciplines as part of the IGY programme.

Division of Radio and Electrical Engineering

Photographic and radio equipment were placed in operation at Baker Lake and Resolute, and photographic equipment only at Alert, in connection with the Auroral programme of the IGY. Observations were carried out with this equipment beginning in July.

Division of Building Research

This Division continued its study of permafrost and of the performance of building foundations and roads at the new site of Aklavik and at Norman Wells on a seasonal basis. Installations of thermocouples under the new air strip at Inuvik were completed, and regular readings were taken. Northern building studies were continued by visits to Whitehorse, Churchill and Frobisher Bay. Laboratory studies of the use of Arctic Grade Diesel Oil in vaporizing-type space heaters were begun. A research officer was assigned to a study of northern housing, and a start was made on the study of costs in relation to northern construction.

1958

Division of Pure Physics

This Division continued its measurements of cosmic rays at Resolute and at Churchill, and in co-operation with the Department of Transport Telecommunications Division, and the Dominion Observatory operated the buildings at Resolute and at Baker Lake, where work on aurora research, geomagnetism, seismology, tide studies and gravity were carried on. The National Research Council, through this Division,

supported International Geophysical Year work in aurora and geomagnetism at several locations in the north through grants to the University of Saskatchewan's Department of Physics. Measurements were made at Bird, Ennadai Lake, Yellowknife, O'Day, and Fort Norman.

Division of Radio and Electrical Engineering

At Alert, an auroral all-sky camera was operated by Defence Research Board personnel. At Resolute and Baker Lake, auroral radar, all-sky camera, Patrol Spectrograph and Auroral Intensity Recorder were operated by this Division. At Yellowknife, an all-sky camera was operated until the summer by an officer of the Magnetic Division of the Department of Mines and Technical Surveys and later by officers of the Meteorological Branch of the Department of Transport.

Division of Building Research

This Division continued its study of permafrost and of the performance of foundations and roads at Inuvik, during the summer of 1958. Readings of thermocouples under the airstrip at Inuvik were continued. Two 200-feet deep holes were drilled at Norman Wells and thermocouples installed, with the object of obtaining long-term records of temperatures at depth in the permafrost. Investigations were carried out with a shallow refraction seismograph, and with electrical resistivity apparatus to assess the practicability of using these instruments to determine the depth to the permafrost layer. Permafrost investigations, including soil and ice analyses were carried out at Fort Simpson.

The Division continued to operate the evapotranspiration site at Norman Wells, on behalf of the Ontario Research Foundation. A general assessment of prefabrication in northern building was prepared, and assessments of specific prefabricated systems were begun. Laboratory studies of the use of Arctic grade diesel oil in vapourizing type space heaters were continued with the assistance of the Fuels and Lubricants Laboratory of the Division of Mechanical Engineering, and further work was done on the Whitehorse Escarpment problem.

Division of Mechanical Engineering

Wind tunnel and other experimental programmes to determine the most promising aircraft configurations for a required range, speed and payload, in connection with investigations on vertical take-off aircraft were carried out. An evaluation was begun on a catalytic heater for the pre-heating of aircraft prior to starting. Work was done on the cold starting of gasoline injecting engines, the evaluation of several starting fluids and the discharge characteristics of various types of batteries at low temperatures. A study of refrigerated storage buildings for remote northern locations was undertaken, resulting in a proposal for a simple regenerative system, using latent heat of sodium chloride brine and without any moving machinery.

1959

Division of Pure Physics

This Division continued its measurements of cosmic rays at Resolute and at Churchill. Through this Division, the National Research Council supported an extension of the International Geophysical Year work during 1959, under the auspices of the Year of International Geophysical Co-operation.

Division of Radio and Electrical Engineering

This Division carried out instrumental auroral observations at Alert, Resolute, Baker Lake and Yellowknife in accordance with commitments made for the International Geophysical Co-operation Year. Generally speaking the equipment operated consisted of an auroral radar, an all-sky camera, an intensity recorder and a patrol spectograph.

At Alert the auroral all-sky camera was operated until March 17.

At Resolute, NRC personnel manned all the equipment until June 1. Between April 17 and June 1 a solar noise intensity program was carried out.

At Baker Lake, two NRC officers operated all the instruments until May.

At Yellowknife, only the auroral all-sky camera was operated at the meteorological station until May 20.

Division of Building Research

This Division continued its study of permafrost and engineering facilities at Inuvik during the summer of 1959. Elevation reference points were established on the pile foundations of most of the major structures. In addition, three specially designed deep Bench Marks were installed in drilled holes to a depth of 50 feet to serve as reliable permanent datum points. Observations of ground temperatures were continued by means of thermocouple installations placed in undisturbed natural areas, under roads, at the airstrip, and on building, utilidor and bridge piling, involving timber, concrete and steel piles. Two thermocouple were installed at depths of 100 feet to assess long-term changes in permafrost at this site. Some further measurements were taken on the refreezing characteristics of piles placed in steamed holes.

Studies of the basic climatic and terrain components of the energy exchange at the earth's surface affecting the occurrence of permafrost were initiated at the Division's Northern Research Station at Norman Wells during the summer of 1959. Evapotranspiration, evaporation and net radiation measurements through various types of vegetative cover were recorded as well as ground temperatures in the seasonally thawed layers under these vegetative types. The objectives of this initial field study were to develop instrumentation techniques and to obtain quantitative

values of some of the energy components at the ground surface. The study of prefabrication in northern building was continued with visits to a number of Canadian prefabricators, and the preparation of detailed reports on currently manufactured prefabricated building systems. Preparation of a comprehensive report on prefabrication in northern housing was undertaken. Laboratory studies of the use of Arctic grade diesel oil in vapourizing type space heaters were completed.

Division of Mechanical Engineering

This Division continued research and development work on catalytic combustion heaters for preheating aircraft engines operating in low temperatures and for standby heating of the RAT vehicle. Laboratory work was also conducted on various types of catalytic elements for this project. In co-operation with the Division of Radio and Electrical Engineering, a study was begun on the possible uses of thermal electric power generators. A study of cold storage facilities for remote locations undertaken in 1958 was completed in the low temperature laboratory. To facilitate the acquisition of tide data in Arctic waters, where the presence of ice renders the use of conventional tide gauges hazardous and unreliable, the Division designed and built a tide recording system particularly suited for use in these waters.

Work was continued on aerodynamics and propulsion problems of vertical take-off and landing aircraft. An economic study of this form of transport was also begun through the co-operation of the Air Transport Board.

Division of Applied Physics

This Division co-operated with glacier studies being undertaken by the Jacobsen-McGill Expedition to Axel Heiberg Island. This project comprises the study of topographical phenomena encountered on glaciers, the various cartographic problems involved and the production of precise measurements which would permit the survey of glacier movement using aerial photogrammetry.

1960

Division of Pure Physics

Cosmic ray measurements were continued at Resolute.

Division of Building Research

The major installations for the study of permafrost and the performance of engineering facilities at the townsite of Inuvik were completed in 1960 and arrangements were made for year-round observations to be taken on a number of ground temperature instruments. A field reconnaissance was carried out in the vicinity of Inuvik in preparation for a survey of permafrost beneath lakes and rivers located in the Mackenzie Delta. Studies of climatic and terrain factors affecting the existence and distribution of permafrost were continued at the Northern Research Station at Norman Wells, together with evapotranspiration observations

which were carried out for the Ontario Research Foundation. A field survey of the performance of prefabricated buildings at Churchill and Resolute was carried out.

Division of Mechanical Engineering

Catalytic combustion heaters developed for pre-heating aircraft engines were further improved during 1960 on the basis of laboratory studies. Such heaters weighing seven pounds and measuring $12\frac{1}{2}$" x 8" x $4\frac{1}{2}$" are being tested in the north by a Canadian carrier. Development work was also undertaken for the Department of Northern Affairs and National Resources on a type of catalytic heater suitable for use in vehicles under northern conditions. Work continued on a programme of helicopter de-icing with the emphasis on electro-thermal as well as liquid applications as a means of preventing ice build-up on the rotor blades. Low temperature tests were conducted in the low temperature laboratory on vehicles, loading equipment, etc., to be used in Arctic operations.

Division of Applied Physics

A member of the Photogrammetric Research Section was attached to the Jacobsen-McGill expedition to Axel Heiberg Island to study the mapping of glaciers and glacier movement using photogrammetric methods.

Division of Applied Biology

Studies were carried out on cold adaptation in Eskimos at Pangnirtung, Baffin Island, by an international team of scientists from Norway, U.S.A. and Canada. A group of adult male Cumberland Sound Eskimos and control (white) subjects were studied during moderate cold stress.

1961

Division of Pure Physics

Cosmic ray equipment was operated at Resolute, to study intensity changes in the cosmic ray flux in relation to solar activity and magnetic fields in the interplanetary plasma which affect the cosmic ray flux.

Division of Building Research

A drilling programme to investigate the effect of bodies of water on the occurrence and distribution of permafrost was carried out in the Mackenzie River Delta during April. Field studies were continued at the townsite of Inuvik to follow the performance of various structures constructed on permafrost. The collection of information relating to the occurrence and distribution of permafrost in Canada as a whole but with particular emphasis on the southern boundary region was continued. Several thermocouple cables for measuring ground temperatures were fabricated and installed in permafrost near Sugluk. The Division co-operated with the Federal Department of Public Works in a study of the temperature and humidity conditions in buildings at Inuvik in relation to

potential condensation problems.

Division of Mechanical Engineering

Laboratory work on development of consumer and commercial models of catalytic combustion heaters for the standby heating of light aircraft engines continued. In co-operation with the Division of Radio and Electrical Engineering a 10 watt thermo-electric generator using a catalytic combustion heat source is being developed. This power source may be of particular interest for use in the remote areas of the north. The commercial feasibility of commercial-sized absorption refrigeration systems based on the Van Platen-Munters design appears to be comparable with the existing diesel-electric motor driven compressor system and offers greater reliability. Studies began on its application for use in remote area. The helicopter ice spray rig is being used for evaluation of commercial produced protective systems on standard machines. Both electro-thermal and fluid systems have been tested. Icing trials were carried out on two helicopters.

Division of Applied Physics

As a result of the studies carried out by the Photogrammetric Research Section in 1960 on Axel Heiberg Island, when the application of photogrammetric methods to glaciological research was investigated, one 1:500,000 scale map of the Jacobsen-McGill University expedition area, approximately 1000 square km. in size, and several special large scale maps of selected glacier areas were compiled.

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

Canadian Wildlife Service

The responsibilities of the Service comprise the following: conducting surveys and inventories of wildlife resources; conducting research on wildlife species in relation to their habitat; collection and analysis of animal population and utilization data; recommending management procedures for particular species of economic importance; acting as consultants on fisheries and marine mammals; research, management and administration of migratory birds under the Migratory Birds Convention Act; co-ordinating federal, provincial and territorial action on common wildlife species, including such major problems as caribou research and management, predator control, and wildlife diseases studies.

1956

Mammalogical Projects

Aerial and ground studies of barren-ground caribou were continued in the districts of Mackenzie and Keewatin to secure information on numbers, annual increment, and native utilization. Caribou herds in northern Yukon Territory were investigated. The herds in northern Quebec were studied along the east side of Hudson and James Bays.

A biologist at Whitehorse began general wildlife studies of the Yukon Territory.

Continuing surveys of moose, buffalo and muskoxen in the Northwest Territories were carried out. A study of the numbers, distribution and ecology of the Arctic fox was continued in southwestern Baffin Island.

Studies of buffalo life history and ecology were continued in Wood Buffalo Park.

A ground study under winter conditions of musk-oxen in the eastern portion of the Thelon Game Sanctuary, to secure information on biology of the species and nutritive value of its food, was made.

The fisheries resources in the Pelly and Garry Lakes area of the Back River drainage in Northern Keewatin District were surveyed to determine their availability as food to supplement or replace barren-ground caribou.

Experimental wolf control operations were continued in Wood Buffalo Park, southern and central Mackenzie and Keewatin Districts.

Research on fur-bearers, including muskrat, beaver and marten was continued in the Mackenzie Valley.

Ornithological Projects

Life history data on Canada geese in the Ungava Bay area of Northern Quebec were gathered, and ducks banded here also.

A detailed study of the life history, breeding biology, ecology, utilization and down production of eider ducks in the Cape Dorset area, and a waterfowl survey of Foxe Peninsula, were carried out.

The study of the life history, hunting kill, and utilization of blue and lesser snow geese in the James Bay area was continued.

In continuing the studies of murres of the North Atlantic coast, one biologist and an assistant banded 14,000 birds on Funk Island and studied their life history and ecology.

Aerial surveys of whooping crane breeding grounds in Wood Buffalo Park continued.

More than 1,800 ducks, principally mallards and pintails were banded at Mills Lake on the Mackenzie River.

Annual waterfowl studies were carried out in Mackenzie and Keewatin Districts.

1957

Mammalogical Projects

The aerial and ground investigations of caribou were expanded during 1957 into an intensive study financed by the federal, provincial and territorial governments. The study began in April and during the rest of the year a team of investigators was with the herds of caribou continuously. Movements of herds, reproductive activity, disease and parasites, and other mortality factors were studied.

Caribou in the Yukon Territory and the adjacent Mackenzie District were studied.

A study of other big game resources in the Yukon Territory was continued during 1957.

During the year a member of the Canadian Wildlife Service was appointed as the predator control officer for the Northwest Territories with the task of undertaking predator control and research in that region and co-ordinating this work with that of adjacent provinces.

At Yellowknife a study of the relationships between wolves and caribou was continued for a second winter. In Wood Buffalo Park, the experimental predator control study was extended into its seventh year.

The study of white foxes was continued in southern Baffin Island for a second year.

The experimental work with buffalo in the Wood Buffalo Park entered its eleventh year with emphasis diverted from ecology and life history to a study of disease and diseases control.

Investigation of musk-oxen in the Thelon Game Sanctuary placed special emphasis upon nutrition of the animal and the nutritional values of its food.

A pathologist collected material for the caribou study and tested immobilization devices designed to capture animals alive. Preliminary tests of the effects of these devices were made on reindeer at the mouth of the Mackenzie River.

Detailed work on the summer and winter ranges of caribou was carried out to serve as a ground control survey for land form and vegetation analysis of caribou range being done under contract.

A preliminary survey of the big game resources of the South Nahanni River area was carried out. Research on fur-bearing animals continued in the Mackenzie District, and included observations of muskrats, beavers, marten and squirrel.

Ornithological Projects

The breeding behaviour of brant on Southampton Island was studied; 1,700 brant were banded, and specimens collected for histological examination.

The biological study of eider ducks at Cape Dorset being completed, a survey of the potentialities for eiderdown production at Lake Harbour was begun.

Studies of life history, hunting kill, and utilization of blue and lesser snow geese in the James Bay area continued as did the aerial survey work on the whooping crane breeding grounds in Wood Buffalo Park.

More than 2,400 ducks, principally mallards and pintails, were banded at Mills Lake.

The studies of murres of the North Atlantic coast continued in the summer at Cape Hay, Bylot Island, where the life history and ecology of a colony in the high Arctic was investigated.

The breeding behaviour of the greater snow goose on south-western Bylot Island was studied.

1958

Mammalogical Projects

An intensive study of caribou biology which began in April of 1957 was completed in December of 1958. This was intended to investigate the principal reasons for the decline in caribou numbers which had occurred over the previous ten years, and to suggest ways in which it might be stemmed.

Caribou studies were also made in the Yukon Territory as a phase of a big game survey which has continued since 1956.

Predator control operations were extended in the Northwest Territories to the barren-ground areas which previously had received less attention, and continued in the Yukon.

A study of Arctic foxes was continued and reorganized on a longer time basis. The studies were extended to the Baker Lake and Resolute Bay areas.

The experimental studies of disease in Wood Buffalo Park were continued.

Investigations of muskox distribution and life history were brought to a close after being carried out during the summer at Lake Hazen.

Studies of fur-bearing animals in the Mackenzie District were confined to beaver, for the most part, and both extensive surveys and intensive investigations on small areas were conducted. Attention was also given to the biology of the northern red squirrel in Wood Buffalo Park.

Ornithological Projects

A reconnaissance flight was made over the Brackett Lake area to evaluate its possible use as a site for waterfowl banding.

The waterfowl breeding ground in northern Alberta and the Mackenzie valley was surveyed.

Ground investigations at the Anderson River breeding concentration were carried out, and data gathered on breeding biology, food habits and predation of brant, snow geese, white-front geese and ptarmigan.

A wildlife survey of Somerset Island and surrounding islands was carried out, and studies of the life history, hunting kill, and utilization of blue and lesser snow geese in the James Bay area were continued.

Aerial surveys of whooping crane breeding grounds in Wood Buffalo Park continued.

More than 2,000 ducks, principally mallards and pintails were banded at Mills Lake.

1959

Mammalogical Projects

Muskrat studies in the Mackenzie Delta were continued.

Studies of the biology and ecology of squirrels and mink in Wood Buffalo Park were suspended after September 1st.

Comparative studies were conducted of beaver habitats in Wood Buffalo Park and adjacent Precambrian areas of the Mackenzie District.

The annual survey of migrating barren-ground caribou was made in April 1959, to determine their distribution, numbers, calf survival, etc.

Physiological studies of caribou reproduction were continued to elucidate reasons for frequent years of low calf production and survival.

Studies of bison in Wood Buffalo Park and environs to check on the population structure of herds were suspended after the yearly slaughter in November. Studies of diseases in bison of Wood Buffalo Park were continued at the annual slaughter in November.

Investigation of Stone's caribou in the Richardson Mountains west of Aklavik were continued to determine their biology and population statistics.

The pilot study of experimental wolf control in the Salt Plains area of Wood Buffalo Park was terminated.

The study of seasonal movements and population fluctuations of the Arctic fox were carried out in the Baker Lake-Aberdeen Lake region from May 25 to August 10.

Studies of diseases and parasites of northern animals were undertaken.

Ornithological Projects

Population dynamics of lesser snow geese in the Eskimo Point area were investigated from mid-May to mid-July.

Waterfowl studies east of Mackenzie Delta region were conducted from the end of May to September, and a banding operation was carried out at Brackett Lake.

Aerial surveys of whooping crane breeding areas were carried out in Wood Buffalo National Park. A study of the life history, hunting kill and utilization of blue and lesser snow geese in the James Bay area was continued.

1960

Mammalogical Projects

Studies of muskrat were carried out during April in the Old Crow area (Yukon).

The continuing inventory of big game animals of the Yukon was reinstituted during the year.

The biology and ecology of muskrats of the Mackenzie Delta was studied during April.

Studies of beaver distribution and numbers in northern Mackenzie District were carried out during the early spring.

Studies of the biology and ecology of squirrels in Wood Buffalo Park were continued during the year.

Comparative studies of beaver habitat in Wood Buffalo Park were carried out during the summer and will continue into 1961.

Data were gathered during the annual slaughter of bison in Wood Buffalo Park.

Studies of the reproductive physiology of caribou were continued.

Caribou winter range studies were continued to determine the extent and degree of burns, with consequent effects on caribou distribution and numbers.

Wolf-caribou relationships were under study during the year in the Mackenzie and Keewatin districts.

Arctic fox studies were continued in the Baker Lake-Aberdeen Lake area from mid-May to mid-August.

The numbers, distribution, biology, and ecology of the polar bear were under study.

The Keewatin caribou populations were surveyed, segregation counts taken, and tagging operations performed to determine trends in numbers and productivity. A caribou survey of Baffin Island was carried out.

Studies of diseases and parasites of northern animals were undertaken. Reindeer at Aklavik, bison (noted above), Arctic fox, and muskrat were the species most intensively studied.

Ornithological Projects:

A reconnaissance of waterfowl habitat and banding operations was carried out in the western Arctic, including the Anderson River delta area, Banks Island and Parry River drainage areas, Point Parry, King William Island, Victoria Island and Queen Maud Basin Rivers.

Aerial surveys of whooping crane breeding grounds were carried out in Wood Buffalo Park.

The study of the life history, hunting, kill, and utilization of blue and lesser snow geese in the James Bay area was continued.

Mammalogical Projects: 1961

Caribou range studies were continued north of Great Slave Lake in order to assess the extent of forest fire damage and its effect upon plants used as food by caribou in winter.

The wolf study was continued, with special attention being given to the Thelon River drainage. Young wolves were captured, and will be kept in captivity in order to study their biology and behaviour.

Arctic foxes were studied in the Keewatin and Franklin Districts, particularly in the vicinity of Aberdeen Lake.

The distribution, biology, and ecology of polar bears were investigated on Southampton Island and in the vicinity of Cape Christian, Baffin Island.

An attempt was made to conduct an aerial survey of caribou on Baffin Island, but meteorological conditions were so unfavourable that results were little more useful than those achieved during the preliminary survey the previous year.

An aerial survey of large mammals on the Queen Elizabeth Islands was completed during the summer in order to provide accurate information about their numbers and distribution.

A study was conducted in Keewatin District to investigate the survival value of the relationship existing between female caribou and their newly born young.

A study of the diseases and parasites of northern mammals was undertaken, with special attention being accorded to bison in Wood Buffalo National Park, reindeer near Inuvik, Arctic fox from Cornwallis Island, and beaver from southern Mackenzie District.

Studies of bison were continued in Wood Buffalo National Park and the adjacent part of the Mackenzie District with special reference to the mortality caused by high water in the deltas of the Peace and Athabasca Rivers. Attention was also given to delineating home range and movements of the remnant of wood bison in the Park so that some of them could be captured for transplanting elsewhere.

Ornithological Projects

Further studies of breeding waterfowl in the Anderson River Delta were conducted in the spring and summer.

A study of distribution, breeding success, and mortality of blue and lesser snow geese was carried out in the Nettilling Lake-Koukdjuak River area of Baffin Island; 11,744 blue and snow geese were banded during the period July 20th-August 24.

A waterfowl banding operation on Southampton Island was carried out.

A study of the life history, hunting, kill, and utilization of blue and lesser snow geese in James Bay was continued. Aerial surveys of whooping crane breeding areas in Wood Buffalo National Park were continued.

National Museum of Canada

The responsibilities of the National Museum in the North cover investigations relating to archaeology, physical anthropology, ethnology, botany, zoology, and vertebrate palaeontology, and the collection, preservation, and display of specimens required for research and public information.

1956

Human History Branch

Excavation of an archaeological site on the Firth River, northern Yukon, continued.

A three-season programme of archaeological work at an extensive site at Native Point on Southampton Island was completed.

1957

Human History Branch

An archaeological survey in the Yukon Territory, and an archaeological survey and preliminary excavations in Ungava and adjacent coastal islands was carried out.

Ethnological investigations among Indians and Eskimos at Great Whale River, and among Hare Indians near Great Bear Lake were conducted.

Natural History Branch

Biological investigation of Simpson Peninsula and King William Island, with emphasis on the bird and mammal life, were undertaken.

A study of the moss flora of the Yukon Territory, particularly the Whitehorse region, was made.

1958

Human History Branch

An archaeological survey was conducted along the Firth River, Yukon Territory, and an archaeological survey and excavation carried out in the Lake Hazen area.

Natural History Branch

Investigations of the moss flora of the Yukon Territory continued.

A biological investigation of Prince of Wales Island was made, and investigations undertaken of the birds of the District of Mackenzie.

1959

Human History Branch

The archaeology of the southwestern Yukon and of the Ivugivik-Mansel Island area was studied.

The ethnology of Indians of the Mackenzie District, and of Eskimos in the Pelly Bay, Rankin Inlet and Baker Lake regions was studied.

Investigations were undertaken of the physical anthropology of Eskimos of the Eastern Arctic, and of Eskimo blood groups at Southampton Island.

1960

Human History Branch

Archaeological excavations were carried out in the southwestern Yukon Territory, and southern Baffin Island. Ethnological investigations were made among the Eskimos of Pelly Bay, the Chesterfield Inlet area, and Jens Munk Island.

Natural History Branch

Collections were made of the fishes of the Beaufort Sea, the birds of the Eskimo Point area, and the mammals of the southwestern Yukon.

1961

Human History Branch

Archaeological excavations were carried out in the central Yukon, and on Devon, Bathurst, Cornwallis, and Somerset Islands. An ethnological investigation was conducted at Fort Good Hope.

Natural History Branch

Biological specimens from Aberdeen Lake area, and mammal specimens from central Yukon, were collected.

National Parks Branch

1958

A survey was made in the Yukon Territory for a suitable area to be preserved as a National Park, and an area selected in the vicinity of the St. Elias Range.

Northern Administration Branch

1957

Arctic Division

A continuing programme of research and development was carried out in such fields as housing, transportation, use of renewable resources, cottage industry, and agriculture.

1958

Arctic Division

Housing

Eight experimental low-cost houses were constructed at Povungnituk and one in Ottawa. In co-operation with the Building Research Division of the National Research Council information was gathered on the possible use of styrofoam as a building material.

New Materials and Equipment

In co-operation with the Institute of Aviation Medicine and Slingsby Manufacturing Company, a durable nylon duffle was produced and field tests begun. In co-operation with the Institute of Aviation Medicine, and Collins and Aikman Limited a nylon pile fabric was developed for arctic winter clothing. A prototype of an inexpensive unit to dry meat was produced in conjunction with the Defence Research Medical Laboratories and Beardmore Company. A low cost versatile stove, developed by the Department of National Defence and capable of burning fuel oil, animal oils, and solid fuels such as peat, was tested and material for thirty units sent to the Keewatin re-establishment project for testing.

Economic Surveys

A survey was made of population, housing, resources, and transportation along the east coast of Ungava Bay.

Community Planning

A study was made of the probable future development at Tuktoyaktuk.

1959

Engineering Division

Planning and Design

A programme of research and design of more economical and functional structures and facilities was initiated. Greater emphasis was placed on bulk oil storage facilities instead of drum storage to effect long-term savings, and on better insulation of buildings to cut down heating costs. Structures were designed which require little maintenance and which are easily erected in the field under adverse conditions.

Town Planning

A programme of low level aerial photography was inaugurated to provide site information for town planning and building siting. A field survey to supplement the FENCO Report on Site Locations for the proposed Frobisher Bay townsite was carried out. Numerous government departments were approached and meetings held to discuss problems peculiar to Frobisher Bay and to expedite planning of the new townsite. Site investigations were also made for three possible satellite towns in the Rankin Inlet-Whale Cove area.

Research

The officers of this division investigated materials and new methods of construction to produce structures which are more functional and economical for use in the north. Close liaison has been maintained with other companies or departments doing research on new materials and methods.

Industrial Division

Area and Economic Surveys

A survey was made of the resources, transportation facilities, housing and living conditions among the Eskimos and Indians in the Mackenzie Delta region. This survey was undertaken in co-operation with the Geographical Branch of the Department of Mines and Technical Surveys.

1960

Engineering Division

Planning and Design

The programme of research and design of more economical and functional structures and facilities was continued. Greater emphasis was placed on bulk oil storage facilities instead of drum storage to effect long-term savings, and on better design of buildings and heating plants to cut down heating costs. Structures were designed which require little maintenance and are easily erected in the field under adverse conditions. Further attention was given to architectural form and colour.

Town Planning

The Frobisher Bay Consultants completed a town plan for that location. The plan was reviewed by the Frobisher Development Group and was recommended in a reduced version.

Investigations and recommendations were made for water and sewer systems at Fort Providence, Fort Norman and Rae.

The second year of the three-year programme of aerial photography of northern settlements to provide site information for town planning and building siting was carried out; satisfactory vertical air survey photography was flown covering fifty settlements. Precise ground control was established at thirty-one sites, engineering information was collected at twenty-one sites, and physical and cultural features for mapping of twenty-eight sites were gathered.

Research

Investigations were made of materials and new methods of construction to produce structures which are more functional and economical for use in the north. Close liaison was maintained with other departments and agencies doing research on new materials and methods.

Industrial Division

Area and Economic Surveys

An economic survey of the east coast of Hudson Bay between Richmond Gulf and Port Harrison, and including the Belcher Islands, was carried out in co-operation with the Geographical Branch, Department of Mines and Technical Surveys.

Community Planning

A survey of the squatters of Whitehorse, was carried out to enable plans to be drawn up for their relocation. The planning needs of Hay River and Fort Simpson, N.W.T. were studied. A study of the establishment of new mining towns in the north was undertaken to aid in guiding the development of Pine Point.

Technological Development

A fish reduction plant to produce dog food and refine animal oils was designed in collaboration with the Fisheries Research Board and a private firm, Moore Air Equipment Limited.

Northern Welfare Services

Linguistic Services

Work continued on the development of a tentative Standard Eskimo Orthography.

Engineering Division

Planning and Design

The continuing programme of investigation and design has led to buildings that are more functional, pleasing and economical to construct. A programme to obtain air photography and precise ground control at all northern settlements where the Department of Northern Affairs has an interest was completed.

Technical Investigation

Investigations into types of material and equipment for northern installations continued, involving both conventional and new materials.

Industrial Division

Area and Economic Surveys

An economic survey was carried out in the Southampton Island-Repulse Bay-Wager Bay area.

Community Planning

Studies of the planning needs of Inuvik, Aklavik and Dawson were carried out.

Technological Development

A fish-freezing plant for sea trout fillets was designed in collaboration with a commercial firm.

Northern Welfare Services

Linguistic Services

A start was made in introducing a new Eskimo Orthography, including the development of an orthography in its final form, interpretation to all interested agencies, and tentative plans for its implementation.

Resources Division

Publications

The first comprehensive "Schedule of Wells (1920-1960)" was published, listing all the wells and structure test holes drilled to the end of 1960 in the Northwest Territories and the Yukon. A report on "Economics of Oil and Gas Development in Northern Canada" by G.D. Quirin was published.

Lands

A committee from the Departments of Agriculture and of Northern Affairs and National Resources was formed to examine the broad question of the agricultural potential of Yukon Territory with a view to making recommendations for arable land use.

Northern Co-ordination and Research Centre

The responsibilities of the Centre are to conduct research on northern subjects, to encourage northern research by non-government agencies, to co-ordinate departmental and interdepartmental research and to collect and disseminate technical and scientific information on the north.

1956

Two scientists were employed during the summer to carry out research in the north. One study dealt with the administration of relief in the Fort Chimo area and the other was concerned with the effect of the D.E.W. Line employment on the Eskimos of the Western Arctic. A study on legal concepts among the Caribou Eskimos, based on field investigations in 1955, was completed.

Grants-in-aid were awarded for the study of zoological and other material obtained by expeditions in the Western Arctic.

1957

Two scientists were employed during the summer to carry out research in the north. One study dealt with social conditions on Southampton Island and the other was concerned with the community of Tuktoyaktuk and the effect of the D.E.W. Line employment there. Field investigations were completed for a study on legal concepts among the Eskimos of the Pelly Bay area.

The Librarian carried out a study of library facilities in the Yukon Territory.

Contracts for several research projects begun in 1956 were continued in 1957. These included the preparation of a draft Eskimo orthography, the preparation of an index to the many U.K. Parliamentary Papers of the nineteenth century dealing with the Canadian Arctic, a study of the health of the reindeer in the Government Reindeer Reserve, and an examination of the possibility of assessing caribou range conditions by aerial photography. Two scientists under contract visited the Reindeer Reserve to study current herding practices and to recommend steps which might be taken to establish the reindeer herding project on a more satisfactory basis.

1958

During the summer, anthropological research projects were undertaken in five Eskimo communities. The purpose of each was to determine the extent to which the Eskimos were making effective

adjustment to changed social and economic circumstances. These studies were carried out at Rankin Inlet, Coppermine, Frobisher Bay, Port Harrison, and Camp 20(Churchill). Data were collected dealing with the following aspects of Eskimo life:

1. Population composition and movement.

2. The economics of wage employment and its effect on the Eskimos, including such aspects as the number of Eskimos employed as skilled or unskilled labourers, average income, the use to which money was being put, dependence on store goods, and job proficiency.

3. The economics of handicraft industries, hunting, fishing and trapping, and the extent to which Eskimos were making use of available natural resources for food, clothing, housing, and income.

4. The changes which were taking place in traditional social organization as reflected in the family structure, child rearing pattern, marriage system, method of social control, leadership pattern, and community organization.

5. Analysis of the attitudes of Eskimos towards their former way of life, routine work, money, employers, relief measures and education.

6. Assessment of the Eskimos' ability to acquire new skills and the effectiveness of methods training.

During the summer assistance was given under grants for a study on nutrition and growth rates of reindeer fawns and the effect of lactation in reindeer cows at the Reindeer Station near Aklavik, and for a botanist to accompany the Defence Research Board expedition to Lake Hazen. An investigation was also carried out under contract into the possible use of heat pumps in the Arctic, and into the feasibility of using a diesel electric unit, equipped with conventional devices to recover heat, to generate light, power and heat for northern buildings.

Several research projects began in 1956 and 1957 were completed in 1958. These included preparation of a draft Eskimo orthography, an examination of the possibility of assessing caribou range conditions by aerial photography, and a social and economic study of the Tuktoyaktuk community.

1959

During the summer five anthropological research projects were undertaken in four Eskimo communities and one Indian community. The purpose of each was to determine, among other things, the extent to which native peoples are making effective adjustments to changing social and economic circumstances. The studies of Eskimo communities were undertaken at Baker Lake, Sugluk, Eskimo Point, and Aklavik (which also includes an Indian population). The study of a Dogrib Indian community took place at Lac la Martre.

During the summer assistance was given under contract for a study of the effects of environmental temperature and humidity on new-born caribou calves. A grant was awarded to support a study of settlements and settlement patterns in the Mackenzie Valley. Assistance was provided for the publication of a doctoral dissertation on the historical and legal basis for Canada's claims to sovereignty in the Arctic. A survey of library facilities in the Northwest Territories was carried out with the aim of determining the feasibility of establishing community or regional library systems there.

1960

During the summer six anthropological research projects were undertaken in three Eskimo and three Indian communities by seasonal employees and by scientists from universities who were engaged under contract or provided with grants-in-aid. The purpose of each was to determine, among other things, the extent to which native peoples are making effective adjustments to changing social and economic circumstances. The studies of Eskimo communities were undertaken at Baker Lake, Lake Harbour, and Great Whale River. The studies of Indian communities took place at Snowdrift, Lac la Martre, and other settlements in the Mackenzie District.

A study of Eskimo administration was initiated, and a demographic study was carried out from records available in Ottawa. This consisted mainly of an analysis of Eskimo health, welfare and population statistics.

1961

Projects in social anthropology were mainly concerned with the extent to which the Eskimos, Indians and Metis were making effective adjustment to changed social and economic circumstances. The projects were as follows:

1. A social and economic survey of the Metis and Indian population at Old Crow, Yukon Territory.

2. A study of the use of alcoholic beverages by Eskimo, Metis, and Indian groups living in the Inuvik and Aklavik areas.

3. A social and economic study of the Wakeham Bay Eskimo.

4. The amount and source of income and types of expenditures of the Resolute Bay Eskimos was studied and the economy investigated to see if the area could be self-sufficient based on local resources.

5. A sociological survey of settlement patterns was conducted in the Mackenzie District and Eastern Arctic.

6. The examination of Eskimo administration in Alaska, Canada, and Greenland continued and was extended to include Labrador.

7. An investigation of socio-economic conditions of the Eskimo people in the Igloolik and Thom Bay regions was carried out.

8. A social and economic study of the Baker Lake Eskimos was continued.

9. A social and economic study of the living conditions and welfare problems of Indian and Metis groups living in the Fort Good Hope and Snowdrift areas was carried out.

Other projects were:

1. A continuation of a study into the proposal advanced by some Russian scientists to modify the Arctic climate by constructing a dam across the Bering Strait.

2. An assessment of factors effecting landing operations from ships at Winter Harbour, Bridport Inlet and Skene Bay.

DEPARTMENT OF TRANSPORT

1956

Routine aviation forecasts were provided by the Arctic Forecast Team at Edmonton and the district aviation forecasting offices at Winnipeg and Goose. A large number of special forecasts were provided for temporary activities such as photo-survey operations and air and sea supply missions. Weather Services were provided for the trans-polar flights of Canadian Pacific Air Lines and Scandinavian Air Services. D.E.W. Line construction activities resulted in a very heavy demand for weather services including forecast offices at Frobisher and Yellowknife and a temporary office at Coral Harbour.

1957

The Meteorological Branch made two scheduled daily upper air observations at all upper air stations by means of electronic instruments carried by balloons to approximately 80,000 feet. In August, the upper air programme at Arctic Bay was discontinued and replaced by Hall Lake. At the Joint Arctic Weather Stations, in addition to the surface and upper air programme, systematic observations were made of sea ice thickness, snow surface and profile measurements, tidal measurements, and at Resolute temperatures to 650 feet depth in permafrost were measured. Routine weather forecasts from the Arctic forecast team, Edmonton, and facsimile transmitted weather maps were received at Resolute. Forecasts and weather briefings were provided at Resolute for special activities. Special IGY observations included ozone measurements at Resolute, two additional upper air ascents at Resolute and selected high level ascents at most stations, and observations of aurora, radioactive pollution, and ionospheric phenomena at selected stations.

Meteorological Branch Ice Observers participated, for the first time, in the sea ice reporting programme from Cambridge Bay in support of shipping.

The following weather services were provided:

1. Routine Aviation Forecasts for the North.

2. Weather support for various special projects such as photo-survey operations and air and sea resupply.

3. Weather service for commercial trans-polar aviation.

1958

The Meteorological Branch observing programme of the basic network of observing stations operated in accordance with the internationally agreed schedule of observations, and in addition carried out supplementary observations for the IGY. The observing programme at selected stations on the D.E.W. Line was continued and improved. Forecast services for D.E.W. Line operations were provided by the Arctic Forecast Team at Edmonton, by the Main Meteorological Office at Goose Bay, and by the Aviation Forecast Office at Frobisher. The forecast office at Yellowknife continued in operation throughout the year; and an on-request forecast service in Resolute was provided by the Meteorological Officer-in-Charge, supported by the Arctic Forecast Team at Edmonton. Meteorological support was provided for photo-survey operations.

The ice observing programme was expanded considerably and covered the Arctic ship re-supply routes and adjacent areas, as well as Hudson Bay and Hudson Strait. Ice reconnaissance totalled 1309 hours covering more than 200,000 miles.

At the Joint Arctic Weather Stations, Resolute, Mould Bay, Isachsen, Eureka and Alert, the programme consisted of regular surface synoptic observations eight times per day, two upper air rawinsonde and two pilot balloon observations daily, and systematic observations of sea ice thickness, snow surface and profile, and tides. At Resolute two additional rawinsonde ascents were made daily during the IGY using larger balloons, in an attempt to reach 100,000 feet altitude consistently. Additional investigations included soil temperature measurement in permafrost to a depth of 650 feet at Resolute, ozone measurements at Resolute and Alert, radiation measurements at Resolute and ionospheric soundings at Eureka. Large balloons were used on one of the two regular daily rawinsonde ascents at the four satellite Joint Stations during the IGY to obtain very high level ascents. Auroral observations were made at all stations.

1959

The meteorological observing programme for the basic network of observing stations continued to operate in accordance with the internationally agreed schedule. Some stations continued to make supplementary scientific observations related to meteorology and climatology. The meteorological observing programme at selected stations on the D.E.W. Line was continued. Meteorological technicians have been assigned to Cape Dyer and Cape Parry so that all meteorological observations at these stations, as well as at Hall Lake and Cambridge Bay, are taken by fully trained meteorological personnel. Forecast services for D.E.W. Line operations were provided by the Arctic Forecast team at Edmonton, by the Main Meteorological office at Goose Bay and by the Aviation Forecast Office at Frobisher Bay. Forecast services at Frobisher Bay were maintained to meet these requirements and were supported by the Main Meteorological Office at Goose Bay. The Forecast Office at Yellowknife continued in operation throughout the year. An "on-request" forecast service at Resolute was provided by the Meteorological officer in charge, supported by the Arctic Forecast Team at Edmonton.

The Meteorological Branch carried out aerial ice observations and reconnaissance, and ice forecasting services in support of marine shipping in ice infested waters. The program was expanded to provide more complete coverage of the arctic shipping routes as well as the route to Churchill through Hudson Strait and Hudson Bay. During the year, aerial ice reconnaissance flights totalled over 200 hours and covered approximately 300,000 miles. Meteorological Branch ice observers were also assigned to four DOT ice-breakers in arctic waters.

The Ice Central was established at Halifax and the field ice forecasting office at Frobisher Bay provided information to Cambridge Bay to cover marine operations in the central Arctic. Ice forecasts and information along the Churchill route were also provided from the Frobisher Bay ice forecast office. Meteorological support was given as in the previous years to photo-survey operations.

The operation of the Joint Arctic Weather Stations at Resolute, Alert, Eureka, Isachsen and Mould Bay continued. The regular programme at all stations consisted of the following: scheduled surface synoptic observations eight times per day; two rawinsonde and two pilot balloon ascents daily; systematic observations of sea ice thickness, snow surface and profile, and tides and auroral observations. Additional observations at Resolute included: soil temperature measurements in permafrost to a depth of 650 feet and ozone and radiation measurements.

Ionospheric soundings were discontinued at Eureka by the end of March, and at Alert in August.

The Meteorological Branch took over the operation of the rawinsonde station at Goose Bay from the USAF on November 1st. This station takes four full rawinsonde ascents per day using a new improved type of ground equipment capable of observing winds to much higher levels than the standard equipment used at the other upper air stations.

1960

Surface synoptic and/or aviation weather reports were taken, recorded and transmitted from 58 stations north of latitude 60. Included in this total are 16 stations along the DEW Line. At four of these latter stations, Cape Parry, Cambridge Bay, Hall Lake, and Cape Dyer, meteorological observing programme.

All upper air stations maintained their full programme of two rawinsonde ascents each day, sending instruments aloft to heights averaging over 80,000 ft. to measure and transmit temperature, pressure, and humidity data throughout the ascent. These instruments were also tracked in the course of their ascent to determine the upper winds at various levels. At Churchill the U.S.A.F. provided larger balloons, helium gas, and airborne instruments in order that ascents could be obtained to 100,000 ft. Surface and upper air operations were transferred from Aklavik to the new site at Inuvik in September, 1960.

Forecasts for the Arctic were provided as routine forecasts and additional forecasts were provided for special Arctic operations.

Aerial ice reconnaissance in arctic waters and in Hudson Bay have been carried out by field ice reconnaissance units at Churchill, Frobisher Bay, Resolute and Cambridge Bay. Charter aircraft provided 135 flights totalling 1000 hours. In addition, through the courtesy of the R.C.A.F. 408 (R) Squadron and 435 and 436 Transport Squadrons, an additional 850 hours of ice reconnaissance was obtained covering most of the year.

Ice Central, located in Halifax, issued seasonal outlooks, thirty-day forecasts and five-day forecasts for Arctic waters. A Field Ice Forecast Office operated at Frobisher from mid-July to early October, providing short-range forecasts and advice for the Hudson Bay route, Foxe Basin and the Eastern Arctic. A similar office operated at Cambridge Bay from mid-July until late September covering the coastal area from Herschel Island to Shepherd Bay.

At the Joint Arctic Weather Stations, Resolute, Mould Bay, Isachsen, Eureka and Alert, the meteorological programme consisted of regular surface synoptic observations 8 times a day, and two upper air rawinsonde and two pilot balloon observations daily. In addition, systematic observations were made of sea ice thickness, snow surface and profile, and tides. Other investigations included measurement of soil temperature in permafrost to a depth of 650 ft. at Resolute, ozone and radiation measurements at Resolute, and strontium 90 fallout measurements at Alert, Resolute and Mould Bay. Auroral observations were made at all stations. Low frequency radio communication facilities were installed at Mould Bay, Isachsen and Resolute.

1961

Meteorological Branch

Thirteen upper air stations were operated in the north in addition to five stations operated jointly with the U.S. Weather Bureau. Surface synoptic and/or aviation weather reports were taken, recorded, and transmitted from 58 stations north of latitude 60°N, including an automatic weather station at Sherwood Head and 16 stations along the D.E.W. Line. At Cape Parry, Cambridge Bay, Hall Beach, and Cape Dyer meteorological technicians were assigned to provide a more complete meteorological observing program. All the upper air stations maintained their full programme of two rawinsonde ascents per day, sending instruments to heights averaging over 80,000 ft. to measure and transmit temperature, pressure, and relative humidity data through the ascents, and, by tracking, to determine the upper winds at various levels. At the Joint Arctic Weather Stations the daily programme also included two pilot balloon observations, as well as measurements of sea ice thickness, snow profiles, and tides. At Churchill the more up-to-date rawinsonde ground equipment enabled upper winds to be obtained to higher levels than at the other upper air stations. Routine forecasts for the Arctic were supplemented for special Arctic operations.

Ice reconnaissance, using chartered aircraft, was carried out from five field ice reconnaissance units during the shipping season as follows:

Base	Area	Period	No. of Flights	No. of Flying Hrs.
Churchill	Hudson Bay James Bay	June 21st-Nov. 8	22	266
Frobisher Bay	Hudson Strait Foxe Basin Davis Strait	July 2nd-Nov. 11	48	411
Cambridge Bay and Cape Parry	Western Arctic	June 25-Nov. 10	56	368
Resolute	Queen Elizabeth Islands, northern Baffin Bay	July 28-Sept. 13	22	152
Fort Smith	Lake Athabasca Great Slave Lake	April 30 June 19	10	30

Two chartered long-range ice reconnaissance missions totalling 105 hours were completed in the latter part of April and May, to obtain break-up data in arctic shipping lanes south of latitude 75° north. Through the co-operation of the R.C.A.F. ice observers accompanied flights on routine operations totalling 640 hours. Eighty-seven short-range helicopter ice reconnaissance flights were completed from icebreakers totalling 74 hours. In all, over 2000 hours were flown. Shipboard ice observers were assigned to eight departmental icebreakers for a total of 681 days and completed 2730 regular meteorological and ice observations between mid-June and early November. Regular weekly ice thickness measurements were received from 31 northern stations. Daily shore station ice reports from 25 stations supplemented the aerial and shipboard ice reconnaissance.

The Ice Central, located in Halifax, issued seasonal outlooks, thirty-day forecasts, and five-day forecasts. A field ice forecast office operated at Frobisher from mid-July to early October, and provided short-range forecasts and advice for the Hudson Bay route, Foxe Basin, and the Eastern Arctic. A similar office operated at Cambridge Bay, and for a short period from Resolute, from mid-July until late September, to cover the coastal areas of the Central and Western Arctic.

At Resolute temperatures were recorded in permafrost to a depth of 650 feet, and ozone and radiation measurements were made. At Resolute, Alert and Mould Bay strontium 90 fallout was measured and auroral observations made.

An automatic isotope-powered weather station was installed at Sherwood Head, Axel Heiberg Island and began operation on August 17, transmitting barometric pressure, temperature, wind direction, and speed every three hours to Resolute.

Marine Operations Branch

In the Eastern Arctic, an engineering study was made to improve aids to navigation in Hudson Strait and Frobisher Bay.