GEOGRAPHICAL BULLETIN

No. 8 1956

GEOGRAPHICAL BRANCH

Department of Mines and Technical Surveys

OTTAWA, CANADA

GEOGRAPHICAL BULLETIN

Address all correspondence to the Director, Geographical Branch, Department of Mines and Technical Surveys, Elgin Building, Ottawa, Canada. *Geographical Bulletin* will be mailed, post-paid, for 50 cents a copy.

CONTENTS

65270—1½

THE PAS, MANITOBA

Victor W. Sim[1]

The Pas, the largest town in northern Manitoba, is located on the south bank of the Saskatchewan River where it is joined by the Pasquia River, 475 miles northwest of Winnipeg. It is the administrative and economic centre for the portion of the province lying north of latitude 54° and is the southern terminus of the Hudson Bay Railway to Fort Churchill. The town is an effective link between the mining, trapping, and fishing areas of the Canadian Shield to the north and the predominantly agricultural lands of the prairies to the south. All wholesale freight and supplies consigned to northern Manitoba, as well as all fish, furs, and lumber products exported from the north, pass through The Pas.

The strategic position of The Pas as an urban centre of considerable size within the western pioneer fringe makes the town worthy of attention. It is the purpose of this paper to present a topical account of the situation, site, and form of The Pas, together with an analysis of its functions.

SETTLEMENT

The site of The Pas was a Cree Indian encampment for many years before the arrival of the first European explorers and fur traders.[2] The high ground made the location an ideal campsite and the narrow river channel provided an easy crossing point.

In 1690 Henry Kelsey, an employee of the Hudson's Bay Company, set out on a mission to encourage trade with the Indians living to the west of Hudson Bay. Kelsey left the Company's post at York Factory in June 1690 and, travelling to the southwest by water, reached the present site of The Pas in July.[3] The following year he travelled south to the vicinity of the present town of Swan River, thus becoming the first European to see the Canadian prairies.

Probably the first permanent settlement at The Pas was "Fort Paskoyac" built by the Vérendrye brothers soon after 1741.[4] These two men, sons of the noted explorer Sieur de la Vérendrye, explored Lake Winnipegosis in 1741 and travelled up the Saskatchewan River to the site of The Pas. With the establishment of this post the French entered into active competition for the fur trade of the northwest and traders at Fort Paskoyac began to intercept the furs moving, via the Churchill and Nelson Rivers, to the British posts at York Factory and Fort Churchill. In 1754 when Anthony Hendry of the Hudson's Bay Company passed Fort Paskoyac on his explorations to the west he noted that the post had expanded considerably.

[1] Victor W. Sim, B.A., McMaster. Member of Geographical Branch party to northern Manitoba, 1951.
[2] Robinson, M.E., and A.C.: The Pas—Crossroads of the New North; Can. Geog. J., vol. XLV, 1952, p. 55.
[3] Pratt, A.M., and Archer J. H.: The Hudson's Bay Route; Govts. of Manitoba and Saskatchewan, 1953, p. 25.
[4] Ibid, p. 31.

Figure 1. Location map.

For almost a hundred years thereafter The Pas remained an important fur-trading post on the banks of the Saskatchewan River. In 1840 settlement on a more permanent basis began when the Reverend Henry Budd,

the first Cree convert to Christianity, founded an Anglican Mission on Mission Island.[1] The mission grew rapidly and a new church was built in 1847 by the men of the Franklin Relief Expedition under Sir John Richardson. The party wintered at The Pas before setting out in search of the missing arctic explorer. The hand-carved pulpit, baptismal font, pews, and chancel chairs are preserved in the present Christ Church, erected in 1896.

By 1900 the town was still little more than a fur post and mission. The growth of population in Western Canada, however, soon resulted in a tremendous increase in agricultural production. As wheat production on the prairies increased so did the need for an export outlet on Hudson Bay. In preparation for this, The Pas was connected by rail to Hudson Bay Junction in Saskatchewan in 1908 and became the southern terminus of the projected Hudson Bay Railway to Fort Churchill 510 miles to the northeast.

The arrival of the railway from the south established The Pas as the supply and service centre for the north. Throughout the period of the construction of the Hudson Bay Railway the town increased in size and importance. Business boomed and the number and type of services increased.

The Hudson Bay Railway was finally completed to Fort Churchill in 1929 and added impetus to the growth of the town was given by the development of the rich mining area at Flin Flon. In 1929 also, a railroad was constructed to the mines 90 miles north of The Pas.

Until 1906 the townsite was a Cree Indian reserve. In that year the Indians surrendered their right to the land and, in 1910, moved to the present Indian reserve on the north bank of the Saskatchewan River. The site was surveyed in 1911 and the following year The Pas was incorporated as a town.

The white population of The Pas originated in practically every European country. Settlers from the United Kingdom and Central European countries form the largest groups but Scandinavians, French-Canadians, and Eastern Europeans are also represented. Comparatively few Indians now live in the town itself. Most are concentrated in the village across the river or live in isolated cabins in the Saskatchewan delta east of the town.

The population increased steadily as the town developed. By 1931, with development as the supply centre for railway construction, the population had increased to just over 4,000. Thereafter the number declined to 3,181 in 1941.[2] The increased importance of the town as an administrative centre and the continuing economic development of the north has raised the population to 3,900 at the present time.

[1] It is of interest to note that the area now known as Devon Park was an island (Mission Island) in the Saskatchewan River until the last decade of the 19th century. The deposition of river sediments has since linked the island to the shore and the area is now used as a playing field.

[2] Census of Canada, 1951, vol. I; Queen's Printer, Ottawa, 1953, Table 9-23.

SITUATION AND SITE

The Pas is situated at the one good natural crossing on the Saskatchewan River in Manitoba (Figure 2). Only at the site of the town is there to be found a narrow ford which is free from an annual danger of flooding and where the surface material of the river banks provides a suitable

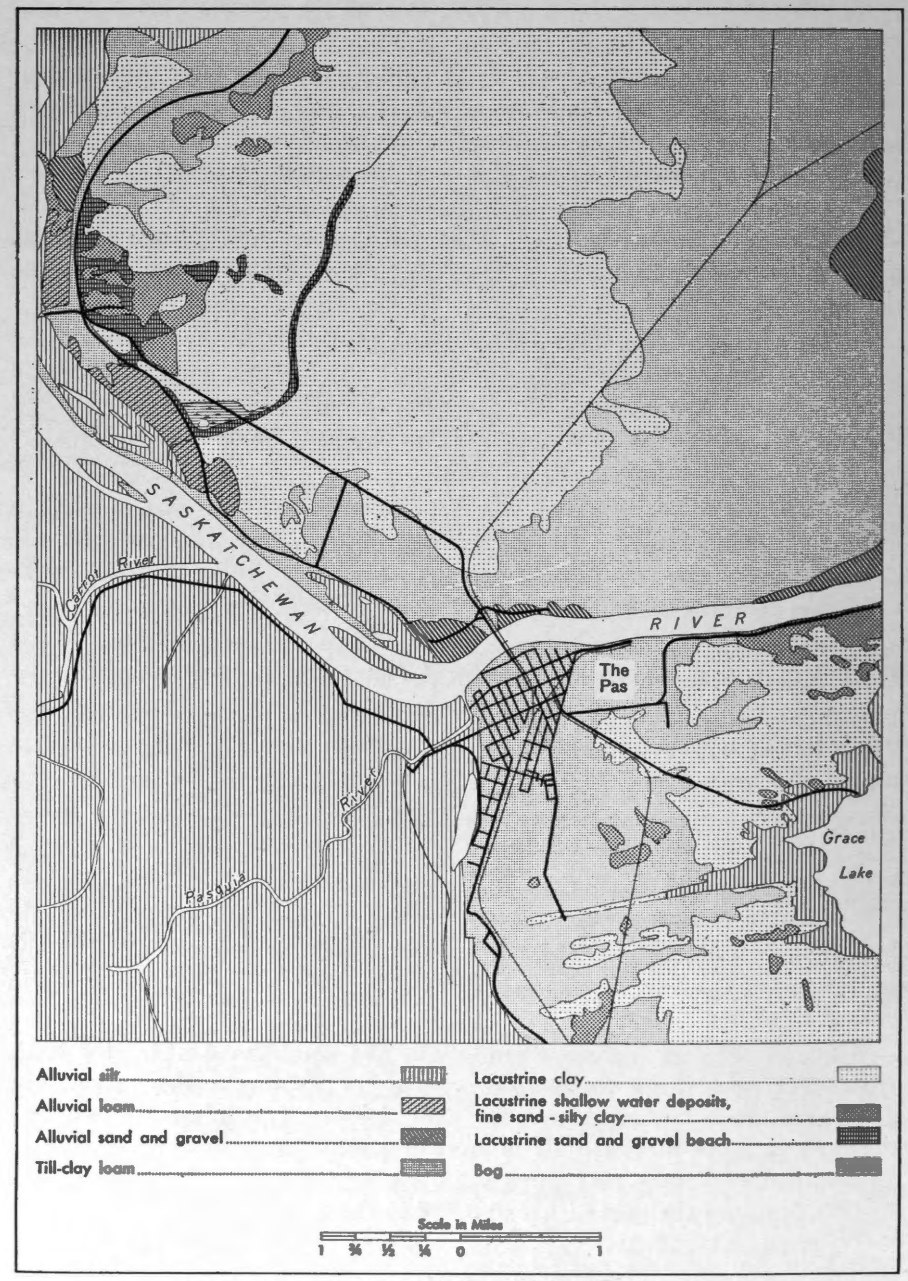

Figure 2. Surface material map of the The Pas area.

foundation for the construction of a bridge. East of The Pas the Saskatchewan branches into a maze of channels. This broad marshy delta emptying into Cedar Lake is difficult to traverse in all seasons and almost impenetrable in the period of high water during early summer. West of the town the river flows between low banks through a broad alluvial lowland where floods occur in most years.

At the site of The Pas the river has cut a narrow straight channel through a low moraine. The glacial material of which the moraine is composed is well drained and stands at a sufficient elevation to avoid flooding. The actual townsite is located on the triangularly shaped portion of the moraine on the south bank of the Saskatchewan River immediately east of the Pasquia River valley. East of the town the moraine, composed of light-textured till, merges gradually into a gently rolling till plain and this in turn gives way to the marshy, alluvial deposits around the shores of Grace Lake. Large portions of this area have remained under a natural forest vegetation of black spruce, tamarack, and willow.

Figure 3. View of the Saskatchewan River valley a few miles west of The Pas.

At the western edge of The Pas the moraine drops abruptly 20 feet to the alluvial lowland of the Pasquia and Carrot Rivers. In spite of the spring flooding hazard these lands have been partly cleared for agriculture (Figure 4). The floods are not caused directly by the high waters of the Saskatchewan River but by the spring run-off from the Pasquia Hills, 60 miles southwest of the town. In May and June, because of the high water level of the Saskatchewan River, the control dams on the Pasquia and Carrot Rivers must be kept closed to prevent

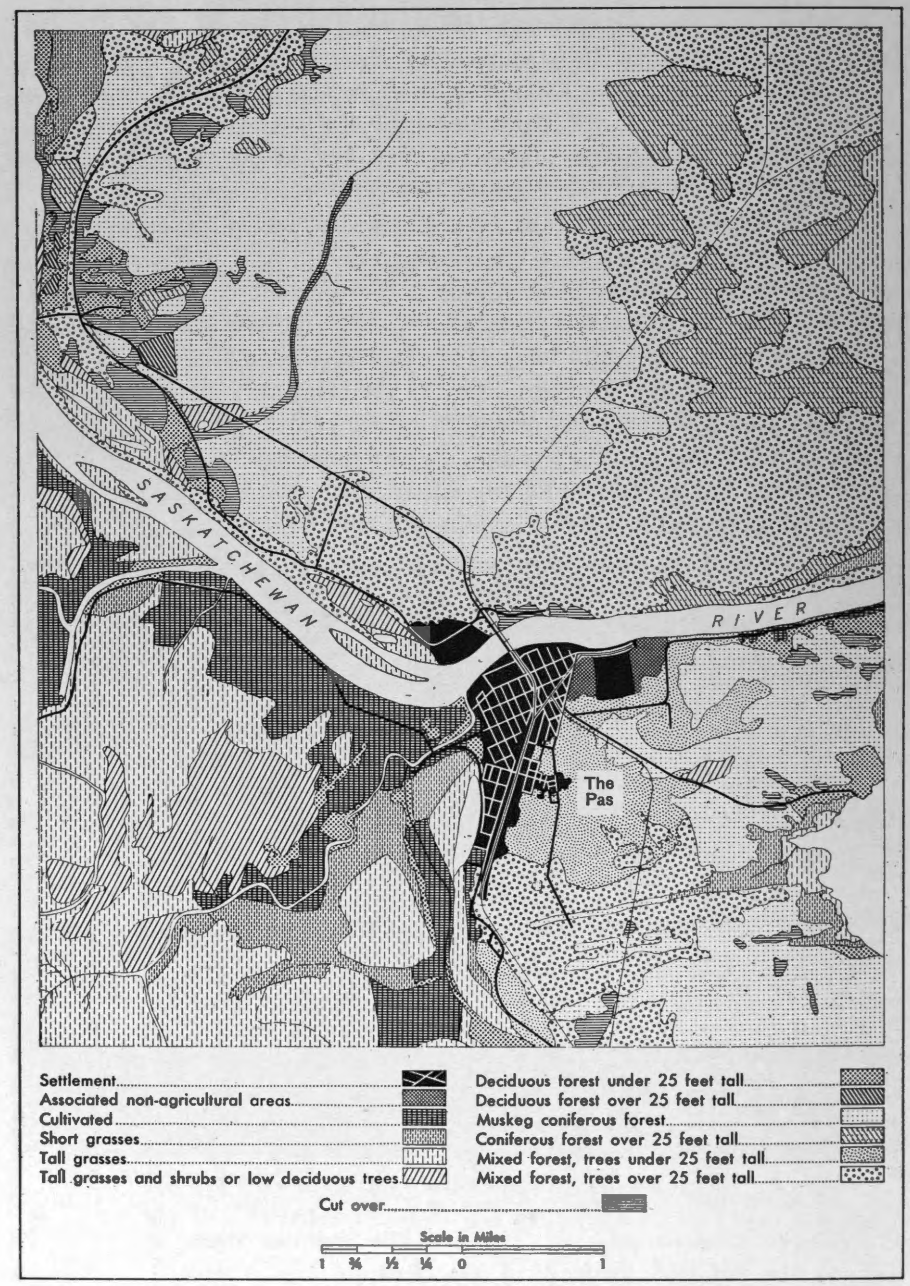

Figure 4. Vegetation map of the The Pas area.

the water of the larger stream from backing up in the tributary streams. This causes the Pasquia and Carrot Rivers to overflow onto the low-lying farm land. An extensive diking and reclamation program, begun in 1954, will reduce this danger considerably.

On the north bank of the river the overburden consists of deep deposits of comparatively light-textured till with a level to very gently rolling surface. Locally the till deposits are overlain by beach ridges of sand and fine gravel deposited along the margin of glacial Lake Agassiz during the late Pleistocene period. Elsewhere on the north bank extensive areas are covered by lacustrine silty clays. Well-developed spruce and tamarack forest predominates in the vegetation of this area.

Figure 5. A newly built road in the lowland of the Pasquia and Carrot Rivers. Note the low relief, absence of trees or shrubs, and abundance of water.

FORM

The townsite of The Pas was first surveyed in 1911. In 1929, in anticipation of rapid growth following the completion of the railroad to Fort Churchill, an extensive pattern of streets and building lots was laid out in the southeastern portion of the town. The expected development never occurred and the present built-up area is confined to the flat-topped, well-drained moraine described above (Figure 6).

In the northern and older portion of the town the streets, roughly running parallel and at right angles to the river, have assumed the familiar grid or rectilinear pattern of Canadian prairie towns. In the southern section the streets follow the trend of the moraine, which becomes progressively narrower and eventually disappears towards the south. The railway and main highway enter the town from that direction and follow the axis of the moraine for a short distance before curving through the centre of the town and crossing the Saskatchewan River.

To the west, the occupied area is rigidly controlled by the sloping edge of the moraine. No urban development is found west of a line joining the north end of Halcrow Lake with the mouth of the Pasquia River. Along this line the land slopes abruptly to the poorly drained lowland of the Pasquia and Carrot Rivers.

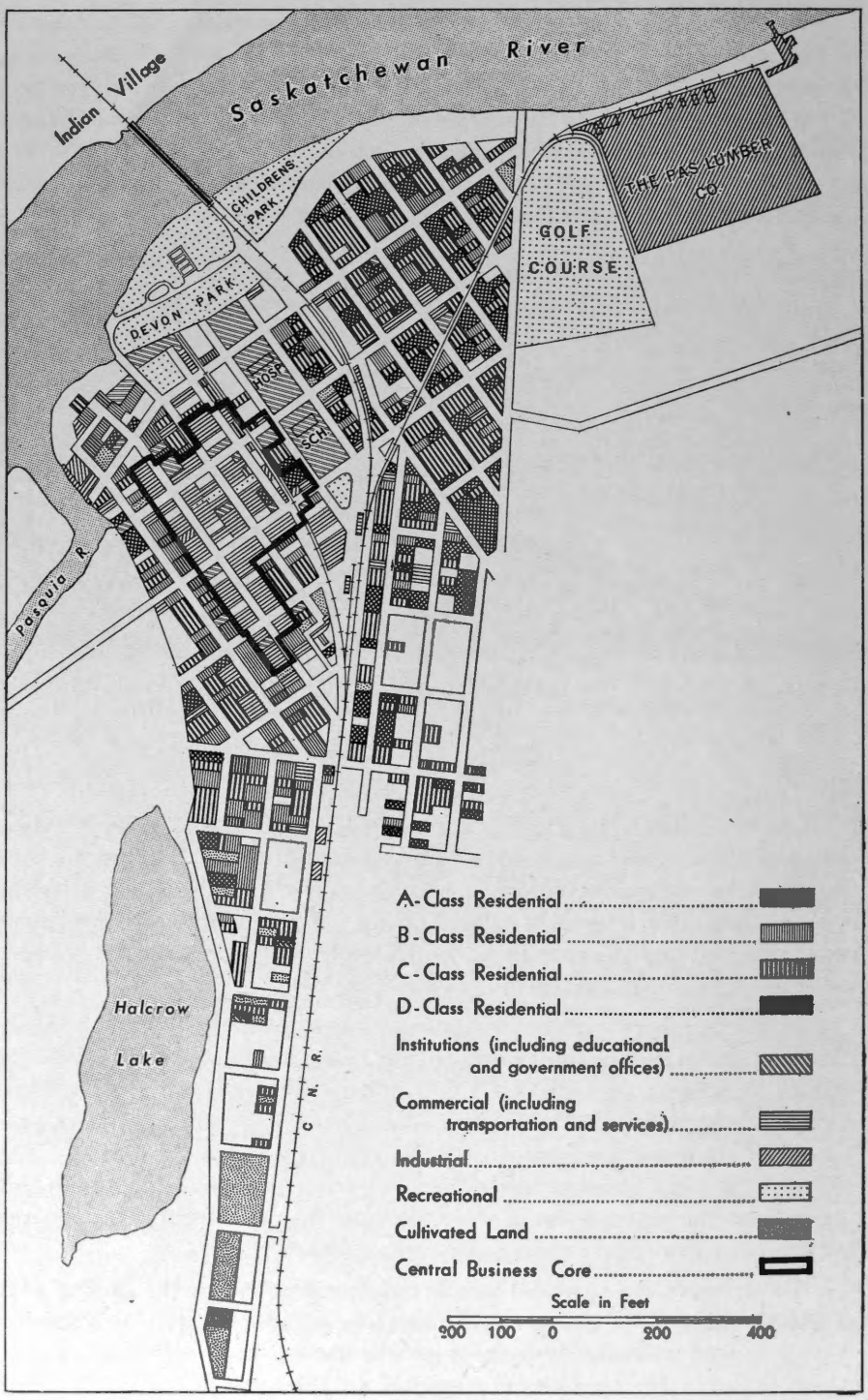

Figure 6. Urban land use in The Pas.

Development of the town has been less rigidly controlled by artificial barriers in the east. The land occupied by The Pas Lumber Company mill has effectively blocked any growth along the river. A limited number of new homes are, however, being built east of the railway and immediately south of the lumber company.

Several distinct functional zones have developed within The Pas since the northward projection of the railway spurred growth. As the town assumed the character of an administrative and commercial centre, a substantial central business core developed between the waterfront and the railway. Within this rectangular district, which covers approximately six blocks, are located most of the important retail and commercial establishments, the federal and local administrative buildings, the banks, larger hotels, and service stations. Buildings in the business core range widely from false-fronted frame buildings reminiscent of a pioneer background to modern, substantial, and well-designed brick and stucco structures.

An unusual number of vacant building lots are scattered throughout the central business district. Several choice corner lots are vacant and not a few stores and small shops are unoccupied. This situation is in contrast to the 236 per cent increase in retail trade in The Pas during the past ten years, reported by the 1951 Canadian Census.[1] It would seem that a static number of retail establishments have been able to handle the increased trade of the town.

Figure 7. Court house and community building at The Pas. Several provincial government offices are located in this building.

[1] Census of Canada, 1951, vol. VII; Queen's Printer, Ottawa, 1954, Table 5-14.

A second functional area, which may be termed a warehouse zone, is located along the main line of the Canadian National Railways, beginning in the southern section of the town and continuing along the spur track past the eastern edge of the central business district. The Imperial and British American Oil storage tanks, the Searle Company grain elevator, and the railway roundhouse and repair shops are located south of the railway station. North of the station the warehouses of a number of the larger business establishments have been built immediately east of the business core. The Monarch and Beaver Lumber Companies, Western Grocers, Keystone and Booth Fisheries, and National Fruit Company are all served by railway. A second spur line serves the plant of The Pas Lumber Company in the northeast section of the town.

Figure 8. British American and Imperial Oil storage tanks at The Pas, Manitoba. Note the Searle Company grain elevator in the background.

Immediately east of the warehouse spur line is the medical and educational area. The public elementary school and the modern collegiate occupy an entire block. North of the schools stands St. Anthony's hospital, a Roman Catholic institution operated by the Grey Nuns. The hospital has 150 beds, an affiliated nursing school, and a medical staff of 5 doctors and 23 registered nurses. It serves the vast area of northern Manitoba as well as the town. A Roman Catholic church, boarding and day school, and administration buildings complete the facilities in this zone.

Residential land comprises most of the remainder of the occupied area of The Pas. East of the medical-educational zone an area of lower-class housing extends to the edge of the property owned by The Pas Lumber Company. Homes in this area have been generally included in the C and

D classification of Table I. Many fine A and B class homes are concentrated in the oldest part of the settlement west of the central business core. These structures are usually substantial brick or frame buildings on paved streets. Several have been recently converted for use as offices by both provincial and federal departments.

During the last several years residential development has taken place in the southern section of the town between the railway and Halcrow Lake. Neat, well-kept homes, fronted by lawns and sidewalks have made this area the most attractive in the town. At the southern fringe of this residential zone, market gardening replaces urban land use. New homes alternate with vegetable gardens supplying the town with fresh produce.

Located in the northern waterfront area, Devon Park provides a considerable area of recreational land within the town. This is further augmented by a small golf course and by several children's playgrounds scattered about the town.

TABLE I

House Types in The Pas

House Types	Characteristics
A	1 or 2 storeys, brick or painted frame construction, cement cellar, well maintained with neat lawn.
B	1 and 1½ storeys, usually frame construction, no cellar, neat and well kept.
C	1 storey, frame construction, usually unpainted, considerable neglect, little improvement to lawn, untidy.
D	Unpainted frame or log shack, badly constructed and poorly maintained, no attempt at improvement to house or lot.

ECONOMY OF THE PAS AREA

The Pas is the centre of a diversified economy based on the utilization of the natural resources of northern Manitoba. The town fulfils the function of a wholesale collecting and distributing point for the many companies with headquarters there. At least six activities in the area tributary to the town contribute to its present importance as an entrepôt and administrative point.

FISHING

The fishing industry of northern Manitoba is an important source of income to many people. Each year more than 4,000,000 lbs. of jackfish (northern pike), pickerel, whitefish, and trout are taken from over 40 lakes on the Canadian Shield north and northeast of The Pas. In 1953 these had a market value of $788,000.

Figure 9. A class A dwelling. Houses of this type are characteristic of the expanding residential area in the southern part of The Pas.

Figure 10. A typical class B dwelling. Although smaller than class A, houses of this type are neat and well kept.

Figure 11. A class C house. A poorly constructed frame building covered with brick siding.

Figure 12. A class D house. Homes of this type are little more than shacks. They are generally small, unpainted frame structures, badly built and poorly maintained.

Commercial fishing in Manitoba began in 1885 on Lakes Winnipeg, Winnipegosis, and Manitoba and has been moving steadily northward since the beginning of the 20th century (Figure 1). With the completion of the railway to the mining town of Lynn Lake in 1953, it has become economically sound to take fish from previously unfished lakes in the extreme northern portion of the province, such as Lakes Nueltin and Egenolf.

Fishing operations are carried on in both winter and summer by independent, licensed fishermen who deliver their catches daily to the agents of several fish-buying companies. The fish are collected at central points near the lakes where they are caught. They are packed in ice and are either flown directly to The Pas by chartered plane or are taken to the railhead for shipment to the town. During the winter season fish are often collected and transported by snowmobiles. At The Pas the fish are graded and repacked for shipment to processing plants in Winnipeg, where they are filleted and frozen. The two major fish-processing companies that operate collecting and transhipment plants in the town are Keystone Fisheries and Booth Fisheries.

The winter catch is largely exported to the United States, where markets are found on the Atlantic and Pacific seaboards as well as in the mid-western states. A large part of the summer catch is sent to the prairie provinces directly from The Pas.

The market price for fish is a significant factor in the production scheme. The fish buyers of The Pas have calculated precisely the costs involved in catching and transporting fish to the town from every regularly fished northern lake. A drop in the market value of only a cent or two per pound on the Winnipeg market is frequently sufficient to wipe out all profit from fish taken in such remote lakes as South Indian and Etawney.

A strict control on the lakes available for fishing is maintained by the Game and Fisheries Branch of the Manitoba Department of Mines and Natural Resources. Frequent surveys are made to determine whether a lake is being depleted by over-fishing. Such lakes are periodically closed to commercial activity while they are restocked by natural increase.

Even with the improved transportation facilities provided by the C.N.R. to Lynn Lake, it is doubtful if fish production will increase by any considerable amount, although it is probable that the present catch will be able to compete much more favourably with other fishing areas.

TRAPPING

Fur trapping north of The Pas is carried on primarily by the Cree Indians. On registered traplines in the forest land north of the town these men trap beaver, mink, skunk, squirrel, fox, and bear. The pelts are collected by fur buyers from The Pas and are shipped to Winnipeg for sale by public auction.

Muskrat trapping in the marshy delta at the mouth of the Saskatchewan River has been developed on a commercial scale under provincial government supervision (Figure 1). Thirty miles southeast of The Pas this area, known as the Summerberry Fur Rehabilitation Block, has become a prosperous trapping ground. By the construction of a system of canals and dams, water levels have been controlled so as to provide a habitat favourable to the muskrat population. Each year between 300 and 800 white and native trappers are licensed and assigned to a zone in the delta. There, under the supervision of a head trapper, they are permitted to trap a predetermined quota of skins.

Provincial government mammalogists maintain a careful record of the number of muskrat houses in the area and are then able to decide the number of trappers to be licensed and the quota of fur to be allowed each man. In 1953, 200,000 muskrats were trapped in the Summerberry area. These are collected and taken to The Pas by snowmobile, tractor, and boat, and are graded there before being sent to Winnipeg for sale. The proceeds of the sale are distributed in equal monthly payments to the trappers. Careful conservation practices have made it possible to remove a substantial annual "crop" of pelts from the delta. Wise administration of the proceeds has made benefits available to the trappers throughout the year.

LUMBERING

Since 1911, when the Finger Lumber Company commenced operations in the Carrot River valley, lumbering has been an important part of the economy of the town. Today The Pas Lumber Company, which replaced the Finger Lumber Company in 1919, operates a sawmill and planing mill that has 115 permanent employees and produces annually approximately 18,000,000 board feet of lumber.

Until the winter of 1951-52, most of the logging done by the Company was concentrated in the valley of the Carrot River in Saskatchewan, 70 miles west of the town. During this winter, operations commenced on Moose and Talbot Lakes 30 miles east of the town. From this area a winter tractor road has been built to The Pas and logs are now moved by tractor and sleigh-haul during the winter. Logs are cut at a maximum distance of 50 miles from the town.

Cutting of timber, chiefly spruce, is carried out during the winter months either by independent loggers working on a contract basis or by men operating from company camps. While many bush employees live in The Pas, a considerable number are Saskatchewan farmers who travel to the northern logging camps for the winter months. Logs are stacked on the banks of rivers during the winter and are floated downstream to The Pas after spring break-up.

The finished lumber is marketed almost entirely in the mid-western states of Iowa, Illinois, and Michigan. The Company, however, supplies a number of small subsidiary wood-using industries in the town. Among

them is Branner's woodworking and machine shop, making canoes, toboggans, and fish boxes. Several other companies sell dressed lumber through retail outlets.

FARMING

Land was first cleared for farming in The Pas in 1753. In that year Louis de la Corne, Governor of Fort Paskoyac, planted grain in the lowland of the Carrot and Pasquia Rivers. Since that time agriculture has been concentrated on this flat alluvial flood plain to a distance of 30 miles southwest of the town.

The agricultural soils have developed on a parent material of fine alluvial sand and silty sand and are usually immature in profile development.[1] Frequently the soils are covered with a thick accumulation of peat and have a good natural fertility. With an average growing season of 108 days and an annual precipitation of 18 to 20 inches, barley and oats are the chief grain crops of the area. Smaller quantities of wheat and flax are also grown and market gardening and hay cultivation have met with considerable success.

A major problem in the development of the Carrot River Triangle (the land between the Carrot and Pasquia Rivers) has been the danger of periodic flooding. In many years flood waters in the Saskatchewan River cause the waters of the two smaller rivers to back up and overflow their banks, flooding the adjacent agricultural land. Frequently standing water remains on the land until late June, thus delaying seeding operations. Because of extremely poor drainage conditions the ripe grain has a high moisture content and is of inferior quality.

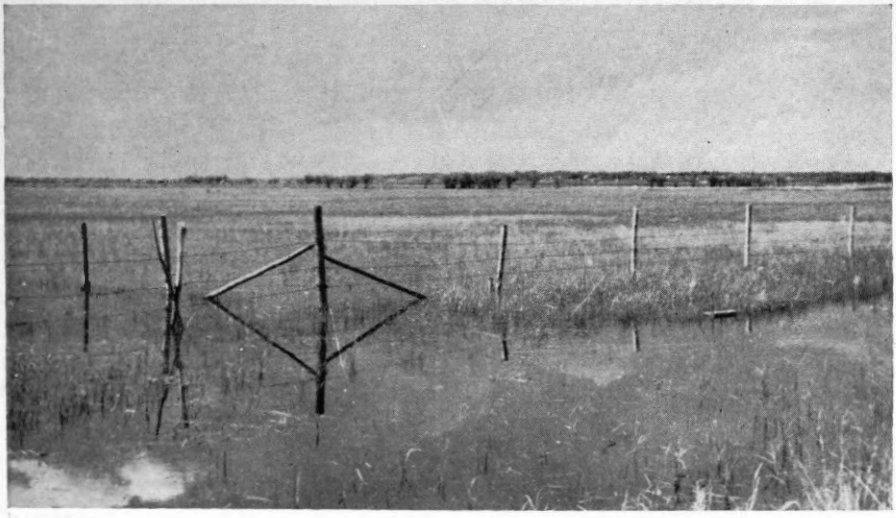

Figure 13. A view of the farm land in the lowland of the Pasquia and Carrot Rivers. Note the general flooding over the whole area.

[1] Manitoba Soil Survey, Carrot River Relocation Project, mimeo., no date, p. 9. Dept. of Agriculture, Winnipeg.

Under the Prairie Farm Rehabilitation Act an ambitious program of improvement is under way. The water of the Pasquia River is to be diverted to the Carrot River and dikes will be built along the latter stream. It is expected that artificial drainage of the reclaimed land will provide 100,000 acres of land suitable for agriculture. Three hundred farm families from depressed areas of Saskatchewan will be settled on the lowland under P.F.R.A. sponsorship.

The need for dairy products in The Pas has resulted in a considerable specialization in dairying in the lowland. Several large dairy herds supply two local dairies with 1,000 quarts of milk per day and a small surplus is shipped to Flin Flon. Approximately 500 head of beef cattle are raised. These animals are shipped to the southern part of the province for slaughtering. Pigs, sheep, and poultry are kept in small numbers and are killed for local use.

A further agricultural development has taken place on river-front lots east of The Pas. Here farms on well-drained till soils are strung out along the road which parallels the south bank of the Saskatchewan River. Although smaller (usually under 50 acres) than those in the lowland these farms appear more prosperous; this may be partly due to freedom from periodic flooding. However, the stoniness of the till soils in some cases impedes cultivation.

Successful mixed farming seems to be entirely feasible near The Pas. With the arrival of new settlers from the south, the diked and drained farm lands will come under more intensive cultivation. The area will then be in a position to supply the market for agricultural produce in the mining towns and lumber camps of the north.

TOURISM

Each year the tourist industry in The Pas assumes a greater importance. It now ranks as one of the more important aspects of the economy. During the last three years an impressive number of tourist camps and hunting and fishing lodges have been opened along the highway to Flin Flon.

The marshy region around The Pas offers excellent facilities for duck shooting in the autumn, while fishing in the lakes of the Canadian Shield and game hunting are also important attractions. Each year considerable numbers of American tourists from the states of Minnesota, North and South Dakota, and Montana make the town their headquarters. Not a few tourists have been arriving at The Pas airport by private plane, while others reach the town by train and automobile. The week-long Northern Manitoba Trappers Festival during the winter, featuring sled-dog races and the election of a Fur Queen, attracts many American and Canadian visitors.

TRANSPORTATION AND TRADE

Since The Pas became the focal point in the life of northern Manitoba, an extensive transportation system has developed. By road, rail, and air, The Pas maintains a liaison between the southern part of the province and the vast area of the north.

By rail the town is served daily except Sunday by the Canadian National Railways from Winnipeg. Over this line travels the bulk of the freight consigned to the town and to the north including all freight for Flin Flon and Lynn Lake. The Hudson Bay Railway provides tri-weekly freight and passenger service to Fort Churchill. Each year an increased quantity of western wheat is being exported from Canada over the Hudson Bay route via The Pas. The Hudson Bay Railway is also the only dependable means of supply for the many small communities along the 510 miles of track to Churchill.

Number 10 Highway is a well built gravel road linking The Pas with Swan River 140 miles to the south and with Flin Flon 90 miles to the north. This road was completed to The Pas in 1939 and to Flin Flon in 1948. Although comparatively little commercial freight enters the town by this route, a regular bus service is now provided between Winnipeg and Flin Flon by Canadian National Transportation, a subsidiary of the Canadian National Railways. A small local bus company operates regularly between the town and the airport.

It is air transport that has, however, shown the most significant expansion in recent years. Air service is provided daily between Winnipeg, The Pas, and Flin Flon and three times weekly to Lynn Lake and Fort Churchill. The airport, 20 miles north of the town, was built during World War II as a military base, but is now operated by Canadian Pacific Airways. Lamb Airways, a local company, provides charter freight service "anywhere in the north". The Manitoba Government Air Service, using Beaver and Norseman aircraft, operates an air transport service for government agencies located in The Pas.

During the winter, tractor-drawn sleds supply isolated mining communities and towns along the Hudson Bay Railway. These "cat swings" supplement snowmobiles and dog sleds as means of communication. In summer, fishing and trading communities on the Saskatchewan waterway communicate with The Pas by boat. Motor launches and auxiliary craft carry freight and passengers on the river.

The trade area of The Pas could be described as the entire area of northern Manitoba. In wholesale trade, particularly, the town is the redistribution centre for all northern communities except Flin Flon, Lynn Lake, and the military camp at Fort Churchill. Two large wholesale fruit and grocery firms supply the many small businesses in outlying communities along the Hudson Bay Railway. Wholesale supplies are received in the town by rail directly from Winnipeg.

Retail trade is limited by the undeveloped nature of the area surrounding the town. Beyond the agricultural lands in the valley of the Pasquia and Carrot Rivers, retail trade is maintained only along the route of the Hudson Bay Railway. Many isolated-section families on the railway prefer to deal directly with retail outlets in The Pas even though a store is located at some closer railway town. Slightly lower prices and free freighting privileges appear to be the determining factors.

SERVICES

Since The Pas has become the administrative centre for the unorganized northern portion of the province, many branches of the provincial and federal governments have opened offices in the town. Among the federal services are the offices of the Prairie Farm Rehabilitation Act (Department of Agriculture), Indian Affairs Branch and Indian Health Service, (Department of Citizenship and Immigration), and Royal Canadian Mounted Police. The R.C.M.P. have jurisdiction over the entire area of northern Manitoba, but The Pas has its own police force.

The provincial department of Mines and Natural Resources is represented by the offices of the Mining Recorder, the Manitoba Forest Service, and the Water Resources and Lands Branch. Although no mining is done in the immediate area of The Pas, all claims in the north are recorded there. The Manitoba Sanitorium Board maintains a 100-bed tuberculosis hospital at Clearwater Lake, near the municipal airport.

Figure 14. Power house and pumping station at The Pas, Manitoba.

The Pas generates its own electricity. Using diesel electric power, the plant develops a maximum of 450 kilowatts for use by subscribers within the town. A municipally owned water-pumping plant and central sewage system is also in operation. An exchange of the Manitoba Telephone System and a local volunteer fire brigade serve the town and adjacent rural area.

Other service facilities include two primary schools: a public and a separate, and a modern collegiate. Many children from outlying communities attend these schools and board in town during the school year. Churches of the Roman Catholic, Anglican, United, Presbyterian, and Lutheran faiths have been established.

NATIVE POPULATION

No account of The Pas would be complete without some discussion of the native population. The Indians of The Pas band are members of the Cree nation and have maintained a tribal organization among their 618 members. Under the guidance of the Indian Affairs Branch of the Department of Citizenship and Immigration, an elected chief and six councillors govern the band.

Early in the present century the native population was removed to an extensive reserve on the north side of the river opposite the town and the band was recompensed for the land they relinquished. Even today the sale of land near the town still owned by the natives is a valuable source of income.

Two elementary schools and three churches have been established on the Indian reserve. Those Indian children who complete their elementary education may attend the collegiate in town. More frequently, however, they attend a secondary boarding school operated by the Indian Affairs Branch in Prince Albert, Saskatchewan.

Most Indians in The Pas band have little difficulty in finding profitable employment. Many trap during the winter months on registered traplines in the north and on the government-controlled Summerberry River muskrat area in the Saskatchewan delta. Others are occupied in cutting pulpwood either on the timber reserve owned by the band in Saskatchewan or on tracts being cut by The Pas Lumber Company. In the former case a portion of the money received from the proceeds of the sale is turned over to the band fund for the benefit of those who are unable to work. A certain number of members find permanent employment with The Pas Lumber Company at the plant in town while the Hudson Bay Railway employs considerable numbers as section hands and day labourers.

The band has, for a number of years, cultivated a community garden on 600 acres of cleared land in the Carrot River valley. The produce is sold to other native groups in northern Manitoba and the proceeds are

turned over to the fund. The addition of mechanized equipment during the past two years has increased the agricultural efficiency.

The future of The Pas band appears to be promising. It is one of the most prosperous native groups in Canada, having amassed total assets of between $60,000 and $70,000, largely by the sale of land to the town.

SUMMARY

The Pas, strategically located at the focus of northern transportation routes, is situated at a convenient crossing place on the Saskatchewan River. Until the beginning of the present century, the town existed only as a fur-trading and missionary centre. With the coming of the railway, however, The Pas became the northern terminus of the Canadian National Railways and later the supply centre for the building of the Hudson Bay Railway to the north. The continued development of the resources of the northern part of the province has made The Pas a logical administration centre.

Appendix A[1, 2, 3]

In recent years there has been considerable discussion of the origin of the name "The Pas". One point of views holds that the name is of Cree Indian derivation while another favours a pure French origin.

When the first French fort was built at the site of the town in 1741 by the sons of La Vérendrye it became known as Fort Paskoyac. This name appears to have been a derivation of the Cree word "Opasquaow" meaning "narrows between wooded banks" and refers to the natural route across the Saskatchewan at the site of the town. It has been alternatively suggested that the name of the French fort might possibly have been a corruption of a proper name for the Cree encampment near the site.

In any event the name was thereafter variously spelled Paskoya (Niverville, 1751), Paskoyat (Carleton, 1768), Basquia (Cocking, 1772), and Basquiau (Franklin, 1819). Evidence of the original name is retained to-day in "Pasquia River", the stream which joins the Saskatchewan at The Pas.

It seems likely that the early French voyageurs would apply the term "le pas" (strait, passage, as in the phrase "Le Pas de Calais") to the narrow, straight stretch of the river at the town. In 1883 McLean referred to the site as "La Rivière du Pas" and in 1840 Budd used "Le Pas de la Rivière". Thereafter the town became known alternatively as Le Pas (Darveau, 1843) or The Pas (Young, 1840; Hind, 1858). English-speaking users of the name appear to have substituted the English article "the" for the French "le" while retaining the French pronunciation of "pas".

[1] Place Names of Manitoba; King's Printer, Ottawa, 1933, pp. 86-7.
[2] Historic Forts and Trading Posts, Canada; Dept. of the Interior, Ottawa, 1930, p. 134.
[3] The Pas: Encyclopedia of Canada, vol. VI, University Associates of Canada Ltd., Toronto, 1937, p. 136.

The town was officially incorporated as "The Pas" on the 15 May, 1912. The local post office, however, still uses both "Le Pas" and "The Pas" on the stamp cancelling machine. Both names are used by townspeople.

It would seem, then, that the town has had two not dissimilar names, one of Cree and one of French origin, and both deriving from the natural crossing of the river in the area.

RÉSUMÉ

Le Pas, centre administratif et économique du nord manitobain, est située au confluent des rivières Saskatchewan et Pasquia. Un fort avait été érigé en 1741, sur le site actuel de la ville, par les fils du Sieur de La Vérendrye. Dans la suite, cet établissement devint un important poste pour la traite des fourrures.

Avec l'arrivée du chemin de fer en 1908, Le Pas devint, pour le Nord, le centre des services et des approvisionnements. En 1929, l'inauguration du chemin de fer de la baie d'Hudson et la découverte d'une riche région minière à Flin Flon marquèrent un nouvel essor de la ville.

Le Pas est bâtie sur une basse moraine de la rive sud de la rivière Saskatchewan et est dotée d'un plan rectiligne, caractéristique des villes de la prairie canadienne. Les quartiers ayant une fonction propre ont été cartographiés: le centre des affaires et des entrepôts, le district médical et scolaire et le quartier résidentiel. Le Pas a une population de 3,900 blancs. En outre, 600 indiens Cree occupent un village sur la rive nord de la rivière Saskatchewan.

Le Pas est le centre d'attraction et de rayonnement de toutes les activités économiques de la région. Ces activités comprennent la pêche commerciale des lacs du bouclier canadien, la chasse des animaux à fourrures dans le delta marécageaux de la rivière Saskatchewan, la coupe du bois dans la vallée de la rivière Carrot et l'agriculture sur les sols alluviaux s'étendant à l'est de la ville.

Les communications terrestres et aériennes furent améliorées au cours des toutes dernières années; ce fut là un facteur important du développement de l'industrie touristique.

SEA ICE CONDITIONS ALONG THE HUDSON BAY ROUTE[1]

Charles N. Forward

As a shipping lane the Hudson Bay route is open to traffic for about two and a half months each year and the present navigation season, when marine insurance rates are at a minimum, extends from July 23 to October 10.[2] During the rest of the year sea ice conditions prevent navigation. Although Hudson Bay and Strait have been navigated by small vessels in the brief open season for over two centuries, [3] it was not until the Hudson Bay Railroad was completed and terminal facilities were built at Churchill that the route was opened to general trade. The number of commercial cargo vessels using the route increased from two in 1931 to thirty-one in 1953. The main attraction of the route for grain shippers is the relatively short rail haul from the wheat-growing areas of the Prairies to Churchill. From this point grain shipments can be loaded on ocean-going steamers and carried to world markets (Figure 1).

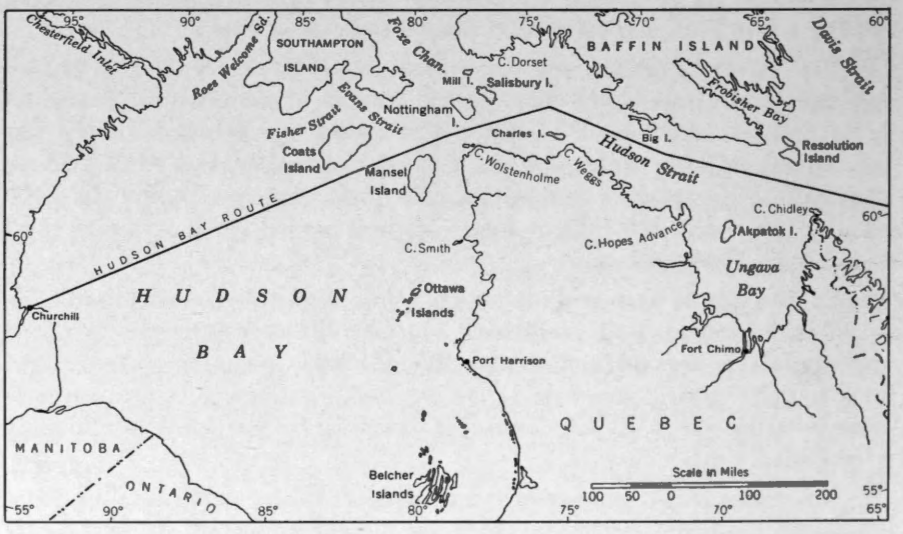

Figure 1. The Hudson Bay shipping route.

In view of the importance of this shipping route it is unfortunate that the navigation season is so brief. A better understanding of the ice conditions along the route would improve the possibility of extending the navigation period. The present study is an attempt to bring together

[1] This study is based on the files of the Canadian Ice Distribution survey in the Geographical Branch. These files are made up of extracts concerning sea ice taken from historical records, such as explorers' journals, and modern scientific reports, such as the reports of *Navigation Conditions on the Hudson Bay Route* published annually by the Department of Transport. All the information gathered was plotted on maps by J-P. St. Pierre, who, while a geographer with the Branch, produced the basic interpretion of ice distribution in the area.

[2] Shipping Operations in Hudson Bay; Marine Observer, vol. 22, No. 158, 1952, pp. 219-222.

[3] For a concise survey of the development of the route see Nicholson, N. L.: The Hudson Bay Route; Twenty-Fifth Ann. Rep. on Navigation Conditions on the Hudson Bay Route etc., Dept. of Transport, Ottawa, 1954, pp. 11-12.

in a concise form the information available concerning ice conditions in the area. Ice conditions throughout the year are outlined against the background of the physical environment and the accompanying maps depict ice conditions during the transitional periods when the break-up and freeze-up are in progress. The influence on ice behaviour of certain controlling factors is also indicated.

PHYSICAL SETTING

BATHYMETRY[1]

The bottom contours of Hudson Bay show that only a few areas in the central portion are below the 100-fathom level (Figure 2). This level is generally regarded as marking the edge of the continental shelf. It is noteworthy, also, that the 50-fathom contour lies well offshore in Hudson Bay. Such a large, shallow sea covering an area of about 290,000 square miles, considerably more than the area of Alberta, is bound to produce large quantities of winter ice. The severe climate is conducive to ice formation and the shallow water is quickly cooled in the fall in spite of convection currents.

On the north Hudson Bay is connected with Foxe Basin by Roes Welcome Sound and Foxe Channel, which lie on either side of Southampton Island. These areas are even shallower than Hudson Bay, the greater part of Foxe Basin being less than 50 fathoms deep. Both Foxe Basin and Hudson Bay are joined to the open Atlantic by Hudson Strait.

Somewhat deeper than the Bay, Hudson Strait has a depth of more than 100 fathoms for the most part and several depressions reaching depths of more than 200 fathoms. At the western end of the Strait, the lack of sufficient soundings makes it difficult to complete the contours. Around the shores of Hudson Strait the bottom slopes down fairly steeply to the 100-fathom level, leaving only a narrow strip of shallow water in contrast to the broad expanse around the edge of Hudson Bay. Ungava Bay is shallower in its western and southern sections than elsewhere. In fact, much of the area west and southwest of Akpatok Island is less than 25 fathoms deep.

WATER MOVEMENTS AND PROPERTIES[2]

Physical Properties. The water of Hudson Bay is chiefly of Arctic, rather than Atlantic origin, whereas the water of Hudson Strait is more of a mixture. Surface temperatures in Hudson Bay are probably raised by the large inflow of fresh water from its drainage basin. In any case, the water surface temperatures are higher in Hudson Bay, especially in the southwestern part, than elsewhere during August and September when the area is essentially ice-free. At this time of year the surface

[1] Dunbar, M. J.: Eastern Arctic Waters; Bull. 88, Fisheries Research Board of Canada, Ottawa, 1951.
[2] Ibid.

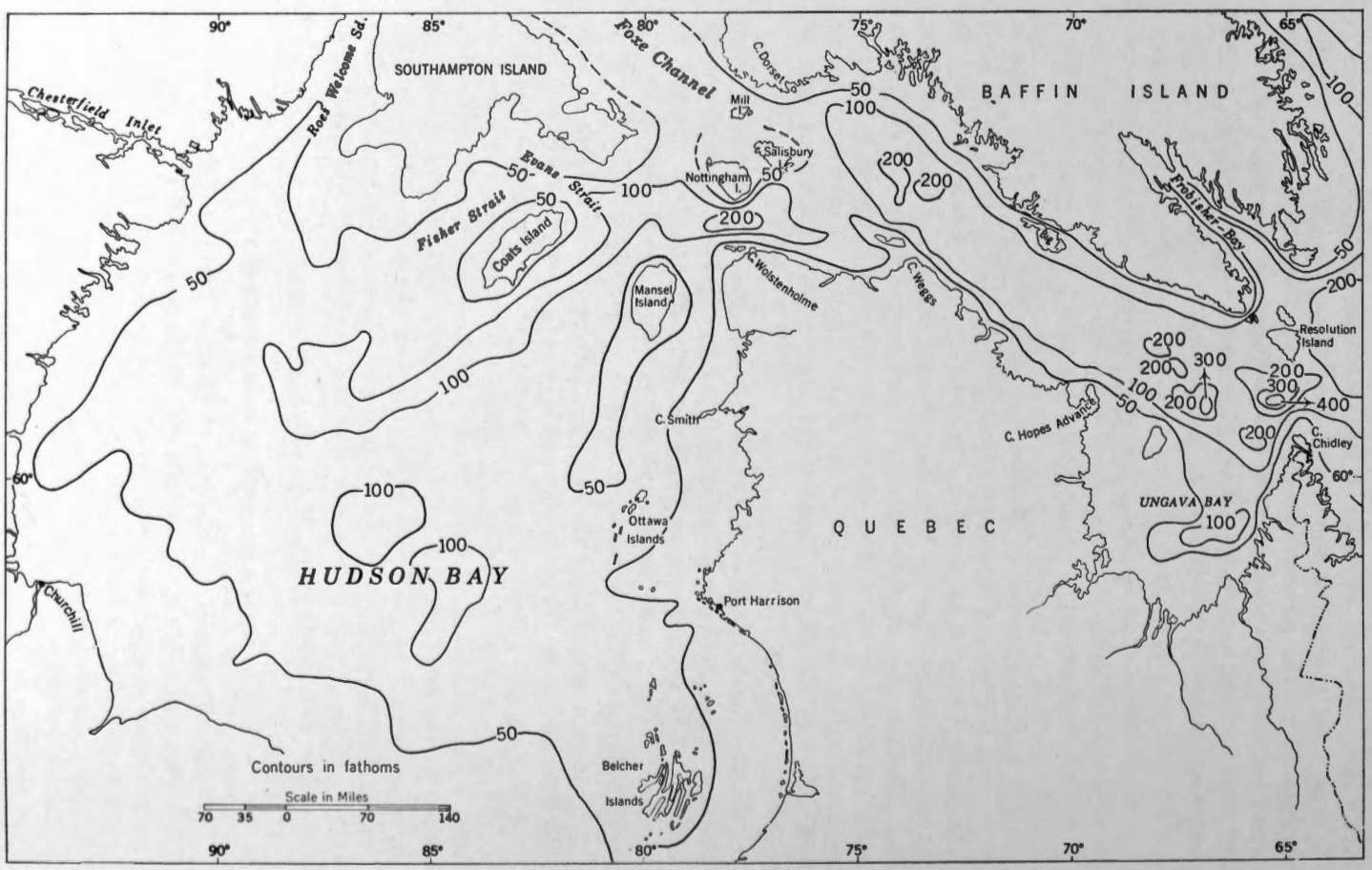

Figure 2. Bathymetric map of Hudson Bay and Strait (after M. J. Dunbar).

temperatures become progressively lower toward the northeastern part of the Bay and eastward through Hudson Strait. The salinity of Hudson Bay water is relatively low compared with that of Davis Strait or Hudson Strait. The large quantity of fresh water entering Hudson Bay from the drainage area is a main factor causing the reduced salinity. The region of lowest salinity is in the southern part of the Bay. Water of low salinity is more susceptible to ice formation. For this reason, and owing to the fact that there are large stretches of shallow water, Hudson Bay is an especially favourable area for ice formation.

Tides.[1] Unusually high tidal ranges are recorded in Hudson Strait and Ungava Bay. The range reaches its maximum of 54 feet in Ungava Bay. In Hudson Strait proper the range of tide is greater on the northern than on the southern side. At Ashe Inlet, in the central part of the Strait, the range is 31 feet at spring tides and 15 feet at neap tides. Outside the eastern entrance to Hudson Strait the range is much lower, being only three or four feet along the northern Labrador coast. Similarly, the tidal range drops at the junction of Hudson Strait and Hudson Bay. Tidal fluctuations of considerable magnitude tend to retard the formation of landfast ice in the freeze-up period.

In spring, tides contribute to the breaking up of large floes as they become weaker with rising temperatures.

Currents. The main circulation in Hudson Bay is in a counterclockwise direction (Figure 3). Water from Foxe Channel enters Hudson Bay through Roes Welcome Sound and perhaps through Evans and Fisher Straits. The water drifts down the west side of Hudson Bay and then flows eastward to move up the east side. This general flow curves eastward again, passing into Hudson Strait between Nottingham Island and Cape Wolstenholme. The velocity of this circulation is quite low, however, and the waters of Hudson Bay have a remarkable vertical stability. Definite stratification of the upper layers, due to the addition of fresh water drainage, which raises the temperature and lowers the salinity, is mainly responsible for the vertical stability. Early freezing is encouraged by this condition.

At the western end of Hudson Strait there is a movement of polar water into the Strait from both Foxe Channel and Hudson Bay. The drift continues eastward along the south side of Hudson Strait. This current is supplemented in the vicinity of Big Island by a current of Davis Strait water that enters on either side of Resolution Island and flows along the north side of the Strait before curving eastward again. In Ungava Bay there is a surface current that enters between Akpatok Island and the mainland and drifts across to the eastern side, where it rejoins the outgoing current of Hudson Strait.

[1] Atlantic Coast Tide and Current Tables; Canadian Hydrographic Service, Dept. of Mines and Tech. Surv., Ottawa, 1955.

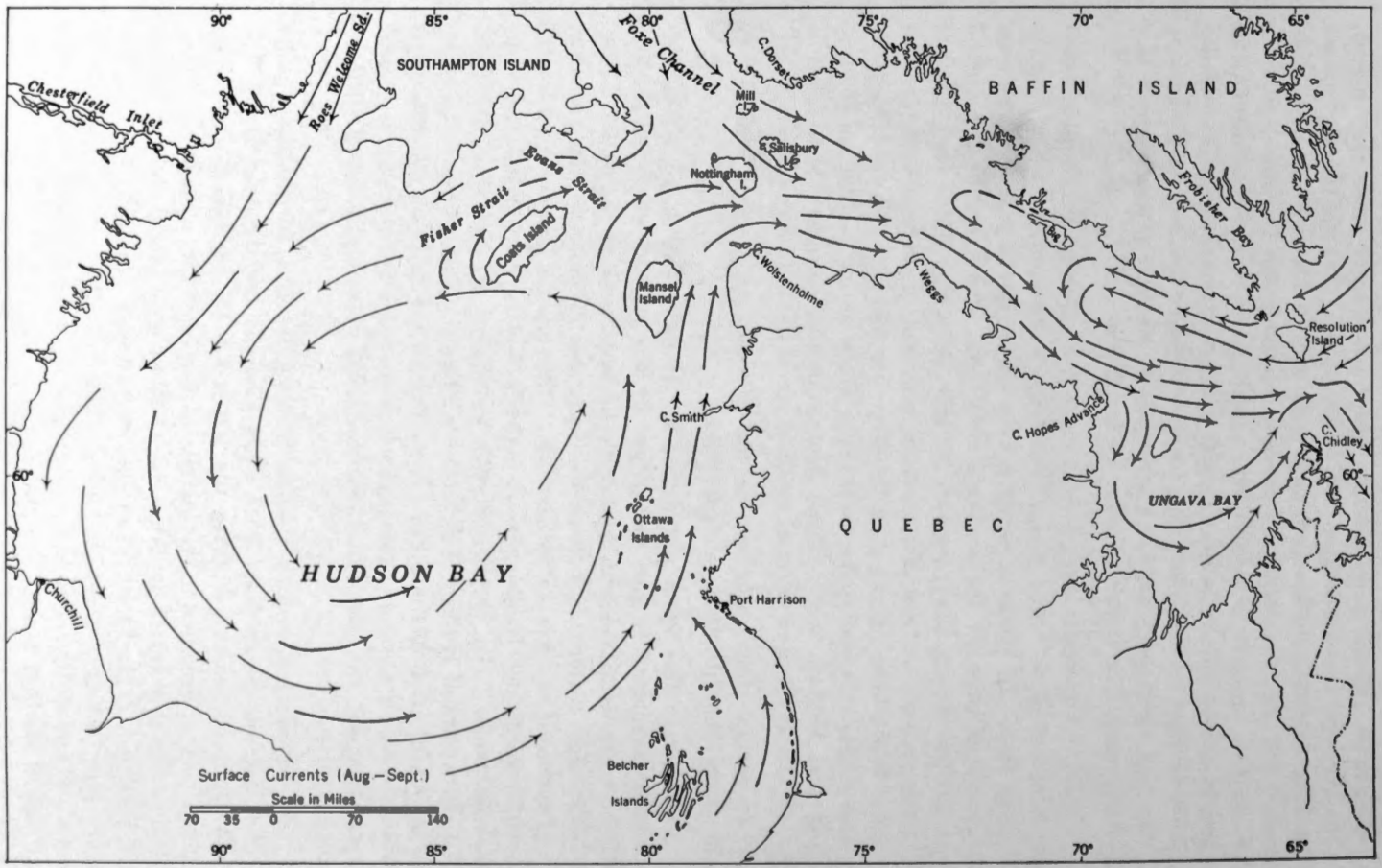

Figure 3. Surface currents in Hudson Bay and Strait during August and September (after M. J. Dunbar).

The velocities of these currents are obscured by the strong tidal movements in Hudson Strait and Ungava Bay.[1] Tidal currents of four to five knots are common in many parts of Ungava Bay, but the velocities of the constant currents are very much less than this. The outgoing current of Hudson Strait has been estimated at about 0·18 knots. Considerable vertical mixing of the water takes place in Hudson Strait. This lack of stability, in direct contrast to the condition of Hudson Bay, arises partly from the mingling of the Hudson Bay, Foxe Channel, and Davis Strait waters. Hudson Strait, therefore, is a body of water less favourable for ice formation than Hudson Bay.

The currents throughout Hudson Bay and Strait indicate the general direction of drift of floating sea ice, although winds and tidal currents cause movements of greater magnitude locally in time and place.

CLIMATE[2]

The climate of the Hudson Bay-Hudson Strait area is an Arctic type. Its main characteristics are a long, cold winter and a short, cool summer, and a low total precipitation.

Temperature. During January the moderating effect of open water is confined to the Hudson Strait area because Hudson Bay is mostly ice-covered, except for a broad offshore lead. Consequently, the mean January temperature at Resolution Island is higher than that of even the most southerly part of Hudson Bay. The ice-covered Hudson Bay has mean January temperatures of −20°F. and −30°F. as compared with −10°F. at the western end of Hudson Strait and 0°F. at the eastern end. In February, temperatures are slightly lower along Hudson Strait, but little changed elsewhere. During March, mean temperatures are about 10°F. higher than in February; in spite of this, winter conditions still prevail, with average temperatures ranging from −15°F. to 5°F. Mean temperatures rise another 10°F. in April, but it is not until May that winter loosens its grasp on the area.

The ice pack in Hudson Bay begins to break up in May and melting progresses everywhere with mean temperatures between 20°F. and 30°F. The gradual rise in temperatures continues through June and July. At this time the more continental stations report higher temperatures than the more maritime stations at the eastern end of Hudson Strait. At Churchill the July mean temperature is 54°F., while at Resolution Island it is 38°F. During August a decline of mean temperatures begins in all areas except those most subject to maritime influence, such as Resolution Island. Here the August mean temperature is slightly higher than the July mean. In September, mean temperatures are still above freezing

[1] *See* Prior, L., and Drinnan, R. H.: Physical Characteristics of the Ungava Bay Area; Geographical Bulletin No. 7, 1955, pp. 17-37.

[2] Rae, R. W.: Climate of the Canadian Arctic Archipelago; Meteorological Division, Dept. of Transport, Toronto, 1951. Meteorology of the Canadian Arctic; Meteorological Division, Dept. of Transport, Ottawa, 1944.

throughout Hudson Bay and Strait. The figures for Churchill and Resolution Island are 42°F. and 35°F. respectively. The decrease in temperatures continues in October and ice begins to form in sheltered bays during the latter half of the month. During November the warming effect of the open-water area of Hudson Bay is most pronounced.[1] While Port Harrison, situated on the east side of the Bay, has a mean temperature of 17°F., Churchill on the west side has a mean temperature of only 6°F. The ice cover forms over the surface of Hudson Bay in late December and average temperatures are mostly below 0°F., except in the vicinity of Resolution Island.

Precipitation. Most stations in the Hudson Bay and Strait area report mean annual precipitation totals falling within the range of 10 to 15 inches. About half of the precipitation falls as rain during the brief summer and the rest falls as snow. In October and November slush frequently forms during snowfalls and leads to the formation of young ice. Throughout the winter the depth of snow cover controls the ice thickness attained. Lack of data concerning snow depths and ice thicknesses prevented full consideration of this factor in the present study.

Wind. The predominant wind direction in Hudson Bay and Strait in winter is westerly as a result of the pressure distribution at that time. West of Hudson Bay there is an area of high pressure which falls eastward to a low-pressure area over Davis Strait. Average wind speeds are not so high in winter as they are in the fall (owing to the stable stratification of the air). March and April are generally months with light winds and clear skies. During the summer winds are more variable, with a greater frequency of easterly winds than in winter. A weak low-pressure system lying over the whole area permits the increased influence of land and sea breezes and travelling depressions. The fall ushers in the stormiest period of the year. Wind velocities are highest in September and October.

ICE DISTRIBUTION

ICE TYPES

The two main types of ice occurring along the Hudson Bay route are sea ice and glacier ice. Sea ice is found throughout the area during the winter, but glacier ice in the form of icebergs and 'growlers' (small pieces of glacier ice barely showing above the water) is mainly concentrated in the eastern part of Hudson Strait, east of Charles Island.

Most of the glacier ice in this vicinity originates along the Greenland coast and moves south into Davis Strait from Baffin Bay. Some enters Hudson Strait through the channels north and south of Resolution Island and moves westward along the north side of the Strait under the influence of water currents. In the vicinity of Big Island the icebergs, following

[1] Burbidge, F. E.: The Modification of Continental Polar Air Over Hudson Bay; Quart. Jour. Roy. Met. Soc., vol. 77, No. 333, 1951, pp. 365-374.

the currents, tend to drift across the Strait, then along the south side, and finally out into the open ocean south of Resolution Island. As a rule, icebergs do not penetrate farther west than Charles Island and only on rare occasions do any of them move into Hudson Bay. Some icebergs and growlers do enter Ungava Bay off Cape Hopes Advance. Although icebergs are present all year, they are most numerous in July, August, and September. It is at this season, when sea ice virtually disappears, that navigation is possible. With the use of radar, however, icebergs can generally be detected long enough in advance to avoid collision. Moreover, the menace to shipping is localized because icebergs do not cover the large areas of water surface that sea ice frequently occupies.

The sea ice encountered in Hudson Bay and Strait in winter comes from several different sources. Within Hudson Bay the bulk of the ice is of local origin, except for small quantities that penetrate into the Bay from the north through Roes Welcome Sound and Foxe Channel. The ice formed in Hudson Bay is winter ice, usually about three feet thick, while ice entering from the north is considerably thicker. As a result of rafting and ridging due to pressure, ice of thicknesses up to 30 feet may be encountered in certain areas.

Hudson Strait has more of a mixture of ice types than Hudson Bay. Locally formed winter ice constitutes only part of the sea ice in the Strait. Large quantities of winter ice drift into the Strait from Foxe Channel and small quantities from Hudson Bay. The Foxe Channel ice is the more formidable, being six or seven feet thick. Another source of sea ice is the Baffin Bay-Davis Strait area. Sea ice comparable in thickness with that from Foxe Channel enters Hudson Strait at the eastern end and mingles with the pack ice of other origins. The movement of this ice is similar to that of icebergs, which also enter from Davis Strait.

While the sea ice in Hudson Bay is essentially homogeneous in type and chiefly of local origin, the ice in Hudson Strait is a mixture of types from various sources. In addition, icebergs and growlers are common in the eastern part of Hudson Strait, but very rare in the Bay.

ICE CONDITIONS THROUGHOUT THE YEAR

Ice is encountered throughout the year along the Hudson Bay route. Its presence is noticeable in certain sections even in summer. The last lingering floes disappear but a short time before new ice forms, and icebergs and growlers persist in numbers during the brief summer interval.

January, February, March, and April.[1] Although Hudson Strait does not freeze over during the winter, it becomes mostly covered with shifting pack ice and is unnavigable throughout this period. Around the shore a shelf of landfast ice forms a strip varying in width from a mile to 6 miles. In Ungava Bay the landfast ice is broader, reaching 10 or

[1] Hare, F. K., and Montgomery, M. R.: Ice, Open Water and Winter Climate in the Eastern Arctic of North America, *Arctic*, vol. 2, 1949, pp. 79-89 and 149-164.

12 miles in width in some areas. Outside this strip lies the pack ice. Because the pack ice is constantly shifted in position under the influence of currents, tides, and winds, leads open frequently. Ice coverage is usually greatest at the western end of the Strait, where it averages eight to nine tenths from February to May. The central and eastern sections of Hudson Strait are generally more open, with a coverage of six to eight tenths. Also, a stream of pack ice escapes into the open Atlantic through the channel south of Resolution Island and joins the main flow of ice along the Labrador coast.

A different situation exists in Hudson Bay, where the pack ice is much more concentrated. Several years ago it was thought that the central part of Hudson Bay was open all winter, but recent meteorological studies and observation flights have shown that this is not the case. Around the edge of the Bay there forms a strip of landfast ice similar to the shelf ice in Hudson Strait. Beyond this strip lies a stretch of open water varying in width from a mile to 40 miles. This shore lead varies in width considerably from time to time under the influence of changing tides and winds. The expanse of ice beyond the shore lead extends all the way across the Bay, covering a high percentage of the total area.

By early January the ice concentration reaches about nine tenths and remains between nine and ten tenths until May. The surfaces of the floes exhibit many refrozen cracks and ridges that have resulted from thermal changes and pressures exerted by wind and tide action. Within the pack the sizes of floes are quite large, with giant floes and field ice predominating. At times, a shore lead may become completely covered with ice driven onshore by strong, persistent winds. This situation occurred in early May, 1948, when sustained easterly winds pushed the ice westward, sealing off the shore lead along the west coast of the Bay.[1] At the same time the shore lead on the east side was opened considerably.

May and June. During May the ice begins to show signs of weakening. Melting and refreezing of ice takes place as a result of the changing temperatures, and giant floes and field ice tend to break up more readily than previously. Tides cause dislocations of landfast ice that has remained immobile all winter. The surface of this ice is sometimes flooded by spring tides, which aids the process of decay. In late May the ice begins breaking up at the mouths of rivers, uncovering patches of open water. The concentration of ice is less in both Hudson Bay and Strait in May than during the previous four months.

It is not until June, however, that the main pack of Hudson Bay becomes completely broken up into small and medium floes and the concentration is greatly reduced. At this time the landfast ice in Hudson Bay and Strait breaks up and floats freely as part of the large body of

[1] Mackay, G. A.: The Effect of Protracted Spring Thaws on Ice Conditions in Hudson Bay; Bull. Amer. Met. Soc., vol. 33, 1952, pp. 101-106.

pack ice. Towards the end of the month shore leads along the coasts are common and ice concentration varies considerably throughout the pack.

July. By the beginning of July the break-up is well advanced, and it is during this month that conditions improve sufficiently to permit navigation. Information concerning ice conditions at this time of year is available from the Department of Transport icebreaker and from the direction-finding and meteorological stations that begin observations on July 1.

The accompanying maps are based on ice distribution data over a 24-year period. The limits of the main ice areas at specific dates were mapped for each year from 1929 to 1953. Then the ice boundaries, on July 1 for example, in each of the 24 years were plotted on a single map. The zone where a large number of boundary lines coincided roughly was interpreted as indicating an average limit, while lines most removed on either side indicated opposite extremes. Thus Figures 4 to 16 give a visual impression of the average, the best, and the worst ice conditions that may be expected in the area.

These boundaries cannot be taken as definite limits, because the information on which they are based was very incomplete and considerable interpolation was therefore necessary. Within the limits shown the ice varies greatly in density. The term "main ice areas" includes all concentrations of sea ice that could impede navigation by ordinary ships. The term does not include icebergs and growlers. Outside the areas for which ice distribution has been mapped, insufficient data concerning ice distribution were available.

The average condition on July 1 is one with extensive ice areas (Figure 4). Shore leads exist along the southern shore of Hudson Strait and along the western shore of Hudson Bay and leads are found over the central part of the Bay. These open areas are broader in favourable years, but much reduced in unfavourable seasons. During the worst years the ice is onshore in most areas and leads are quite restricted. Owing to the fact that the pack ice is constantly changing position, ice may be onshore along one section of the coast and offshore along another section at the same time. The north side of the Strait usually remains blocked with ice longer than the opposite side.

By July 10 the ice areas have contracted and have become separated by large stretches of open water (Figure 5). The shore lead in Hudson Strait is fairly broad, although the ice area is continuous and the ice is still close to shore on the northern side. In favourable years the ice is less extensive and on certain occasions ships could locate a passable route through the ice areas. The shore lead is reduced in width in unfavourable years when ice is present over most of the area. By July 15 the ice areas are more confined, with broad stretches of open water between (Figure 6). The ice is offshore in most sections except along the northwestern shore of Hudson Strait. In favourable years the ice areas are sufficiently localized to permit navigation.

65270—3½

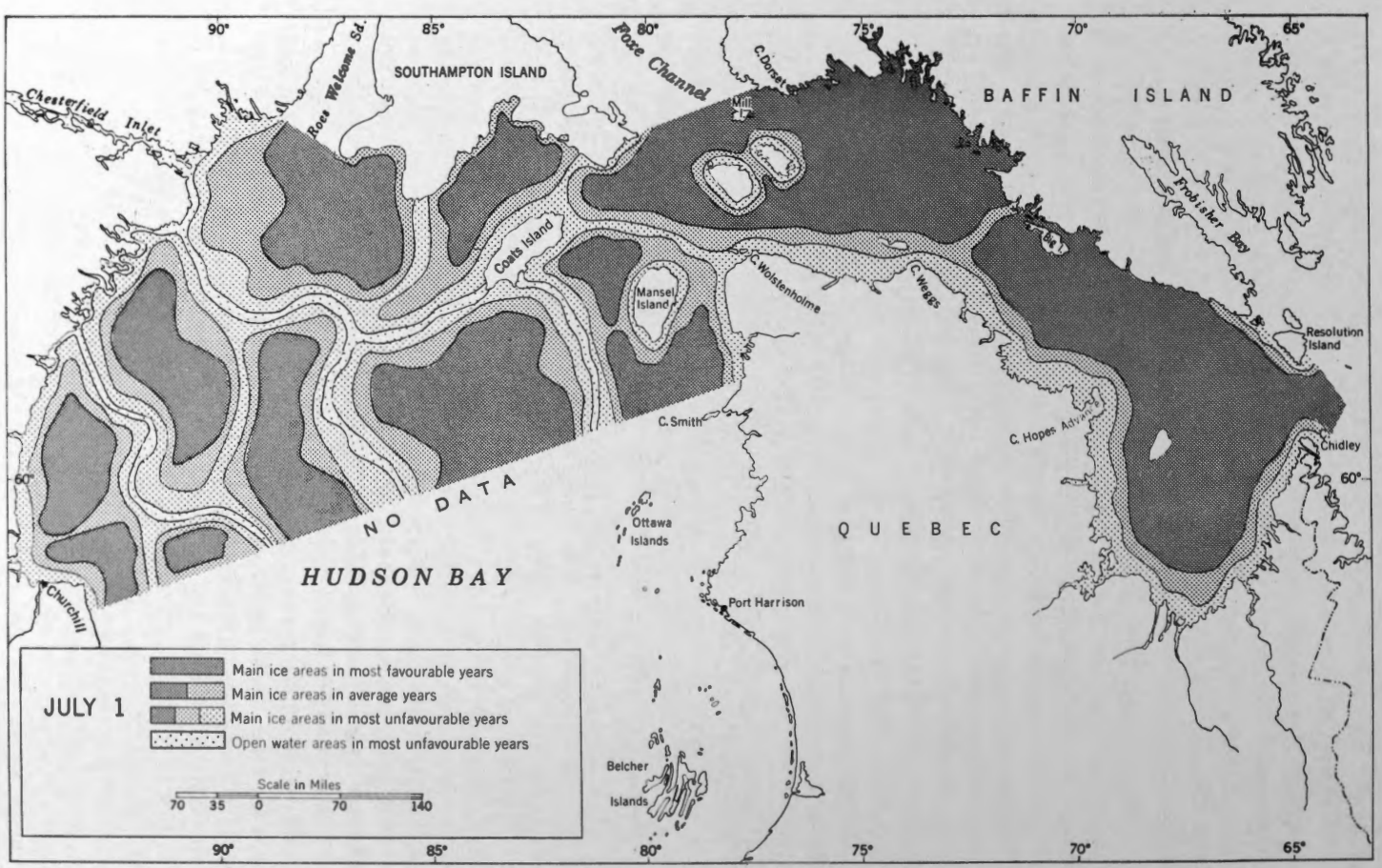

Figure 4. Limits of main ice areas along the Hudson Bay route on July 1.

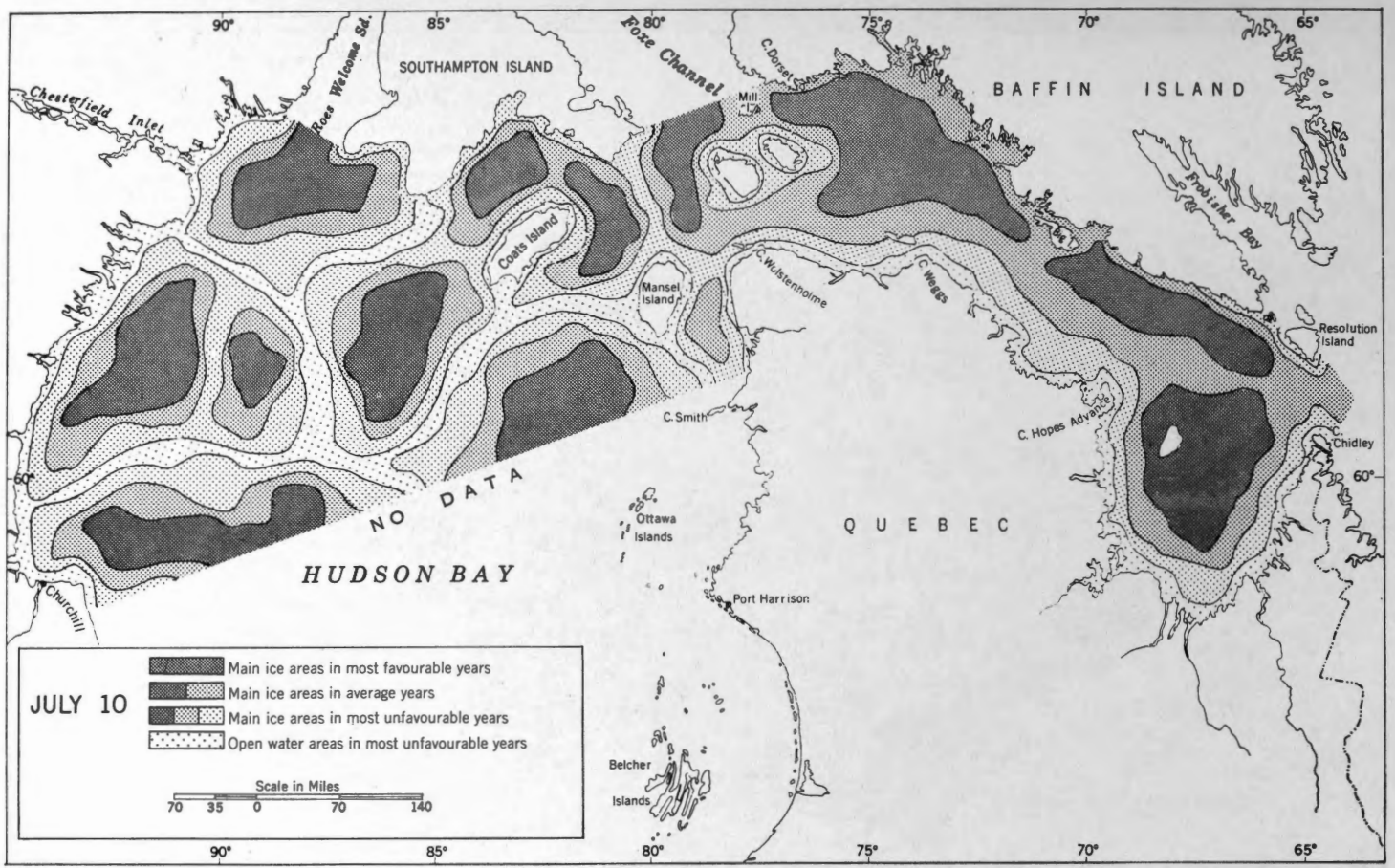

Figure 5. Limits of main ice areas along the Hudson Bay route on July 10.

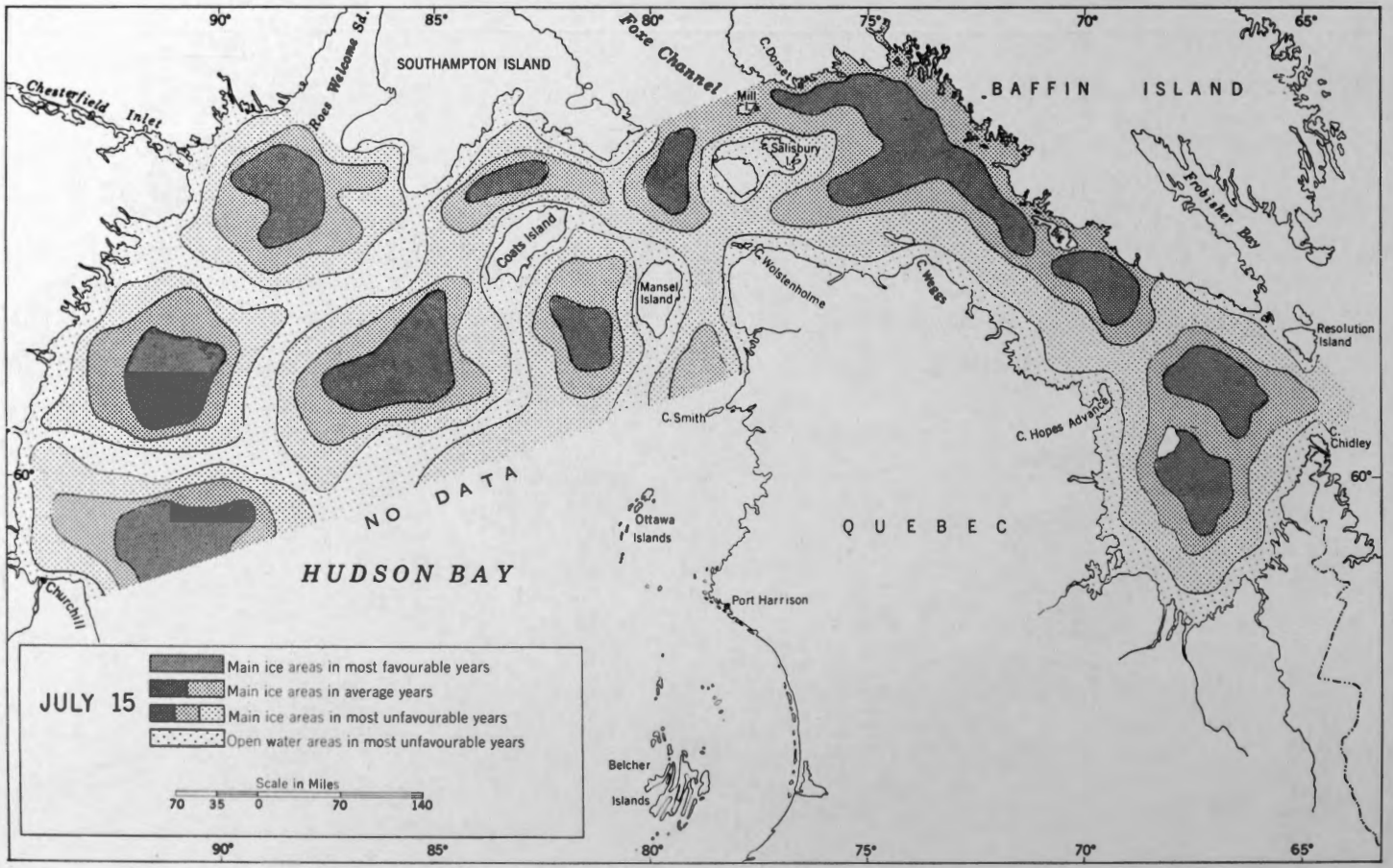

Figure 6. Limits of main ice areas along the Hudson Bay route on July 15.

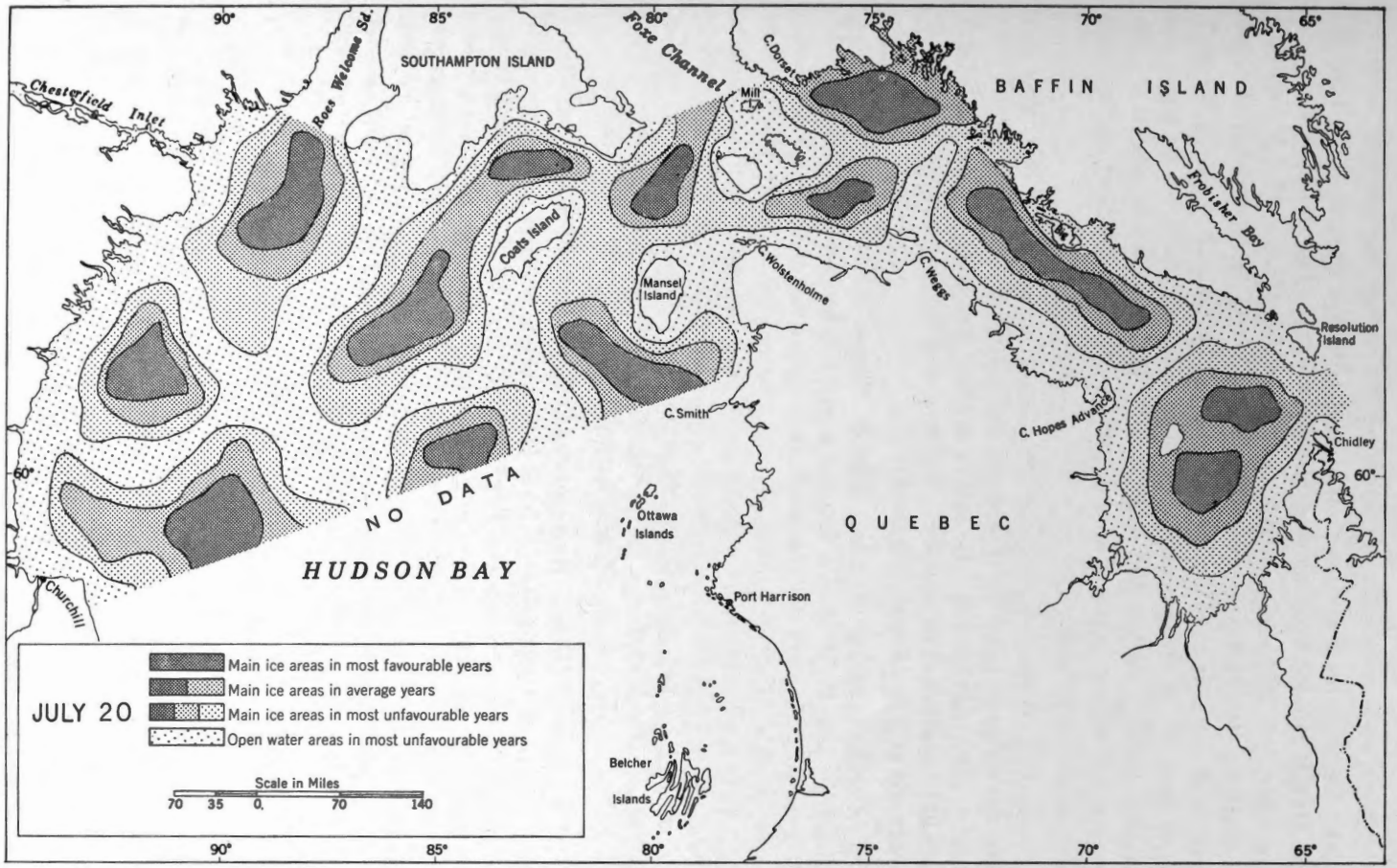

Figure 7. Limits of main ice areas along the Hudson Bay route on July 20.

Navigation conditions improve greatly during the last half of July, while the dwindling ice areas constitute less of a menace. By July 20 the ice has receded from most of the coastal areas and the concentrations are separated by large stretches of open water (Figure 7). Navigation is possible, although care must be taken to avoid patches of heavily concentrated ice that may lie on the steamer track, and steaming through open pack ice is often necessary. In favourable years the ice areas are smaller and can be avoided more easily. During a severe season the ice may prove almost impenetrable in certain areas at this time and is more abundant everywhere.

Further dissipation of the ice areas has occurred by July 25 (Figure 8). For the most part the ice is offshore and scattered enough to permit relatively easy navigation. In unfavourable years, however, navigation would be somewhat more risky. By August 1 the ice areas become widely scattered and more open (Figure 9).

August. During the early part of August the ice areas continue to shrink in size until only a few scattered patches remain by August 15 (Figure 10). In unfavourable years large quantities of pack ice may persist even at this date, presenting obstacles to navigation. At this date in especially favourable years, there is practically no ice danger to navigation. Towards the end of the month the sea ice disappears completely in some years while in others small patches remain all summer. However, as indicated above, icebergs and growlers are present all summer in considerable numbers in the eastern half of Hudson Strait.

September. Hudson Bay and Strait are relatively free of ice during the month of September (Figure 11). A few patches of ice, generally harmless to ships, may linger in widely separated areas as remnants of the spring break-up. Also, ice from Foxe Channel sometimes drifts southward toward Nottingham Island in September. As a rule, this ice does not appear in any quantity until late October. When Foxe Channel ice does enter Hudson Strait during September, it usually does not penetrate far enough south to block the steamer track. This has occurred on only one occasion during the last 25 years.

October. It is during the month of October that the present navigation season comes to an end. The main obstacle to continuance of navigation until the end of October is the ice conditions at Churchill. Here slush forms in the river and harbour during early snowfalls about the middle of October. At the same time, young ice that forms on the tidal flats is broken up by high tides and carried through the harbour, where it constitutes a menace to ships. In unfavourable years ice forms in small, protected coves all along the western shore of Hudson Bay during October (Figure 12). Most of this ice is broken up repeatedly by tide and wind action before the landfast shelf of ice becomes established.

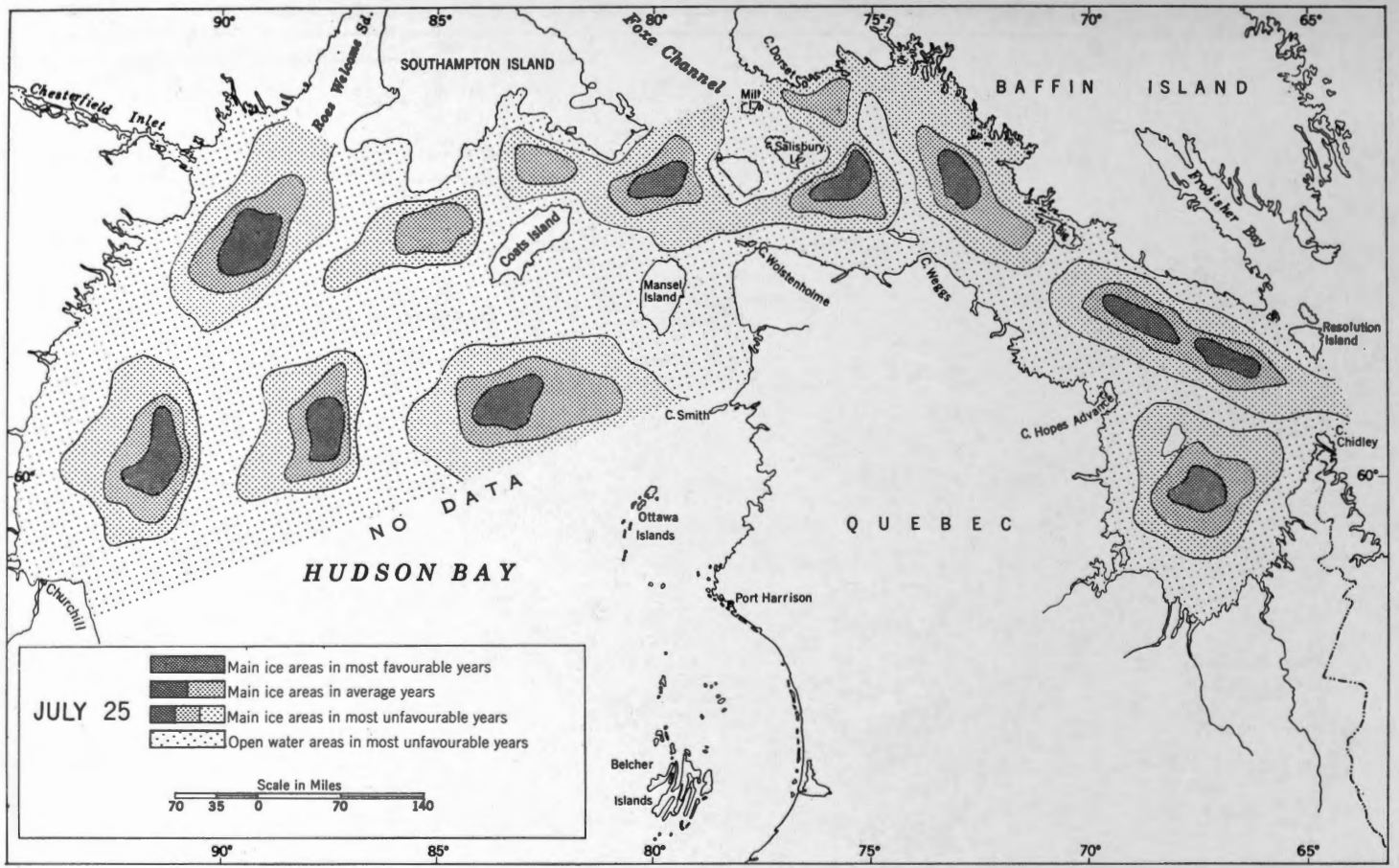

Figure 8. Limits of main ice areas along the Hudson Bay route on July 25.

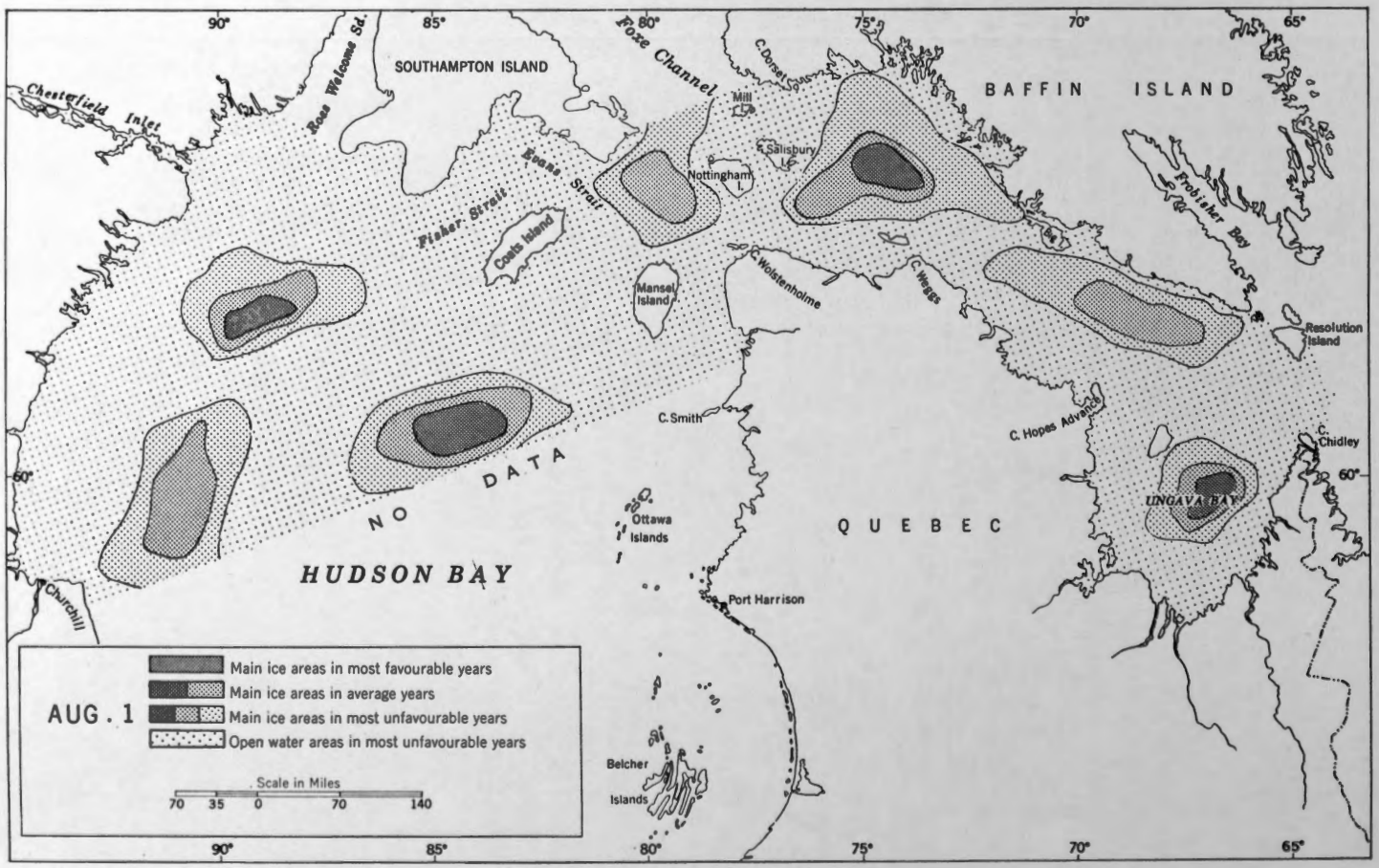

Figure 9. Limits of main ice areas along the Hudson Bay route on August 1.

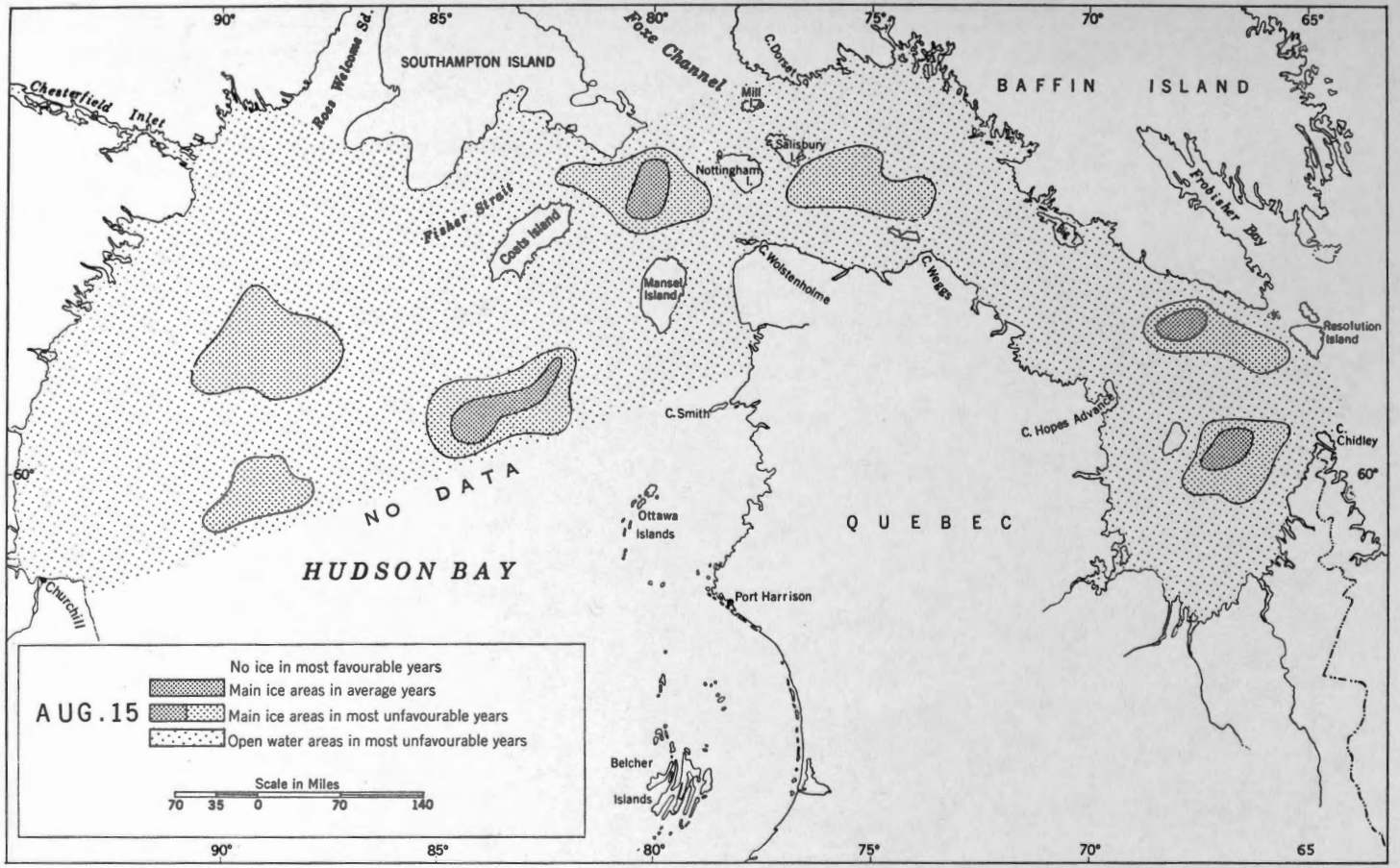

Figure 10. Limits of main ice areas along the Hudson Bay route on August 15.

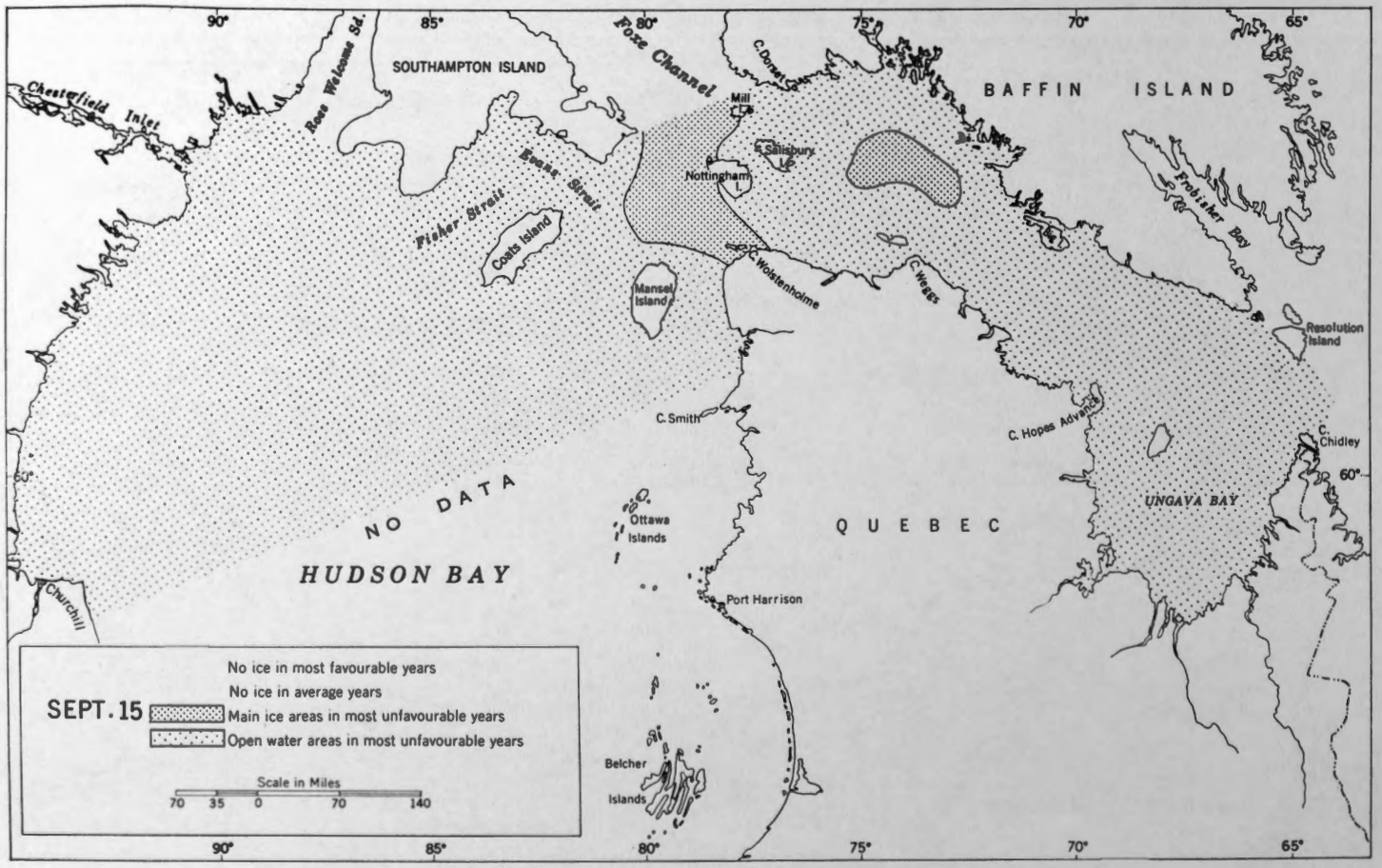

Figure 11. Limits of main ice areas along the Hudson Bay route on September 15.

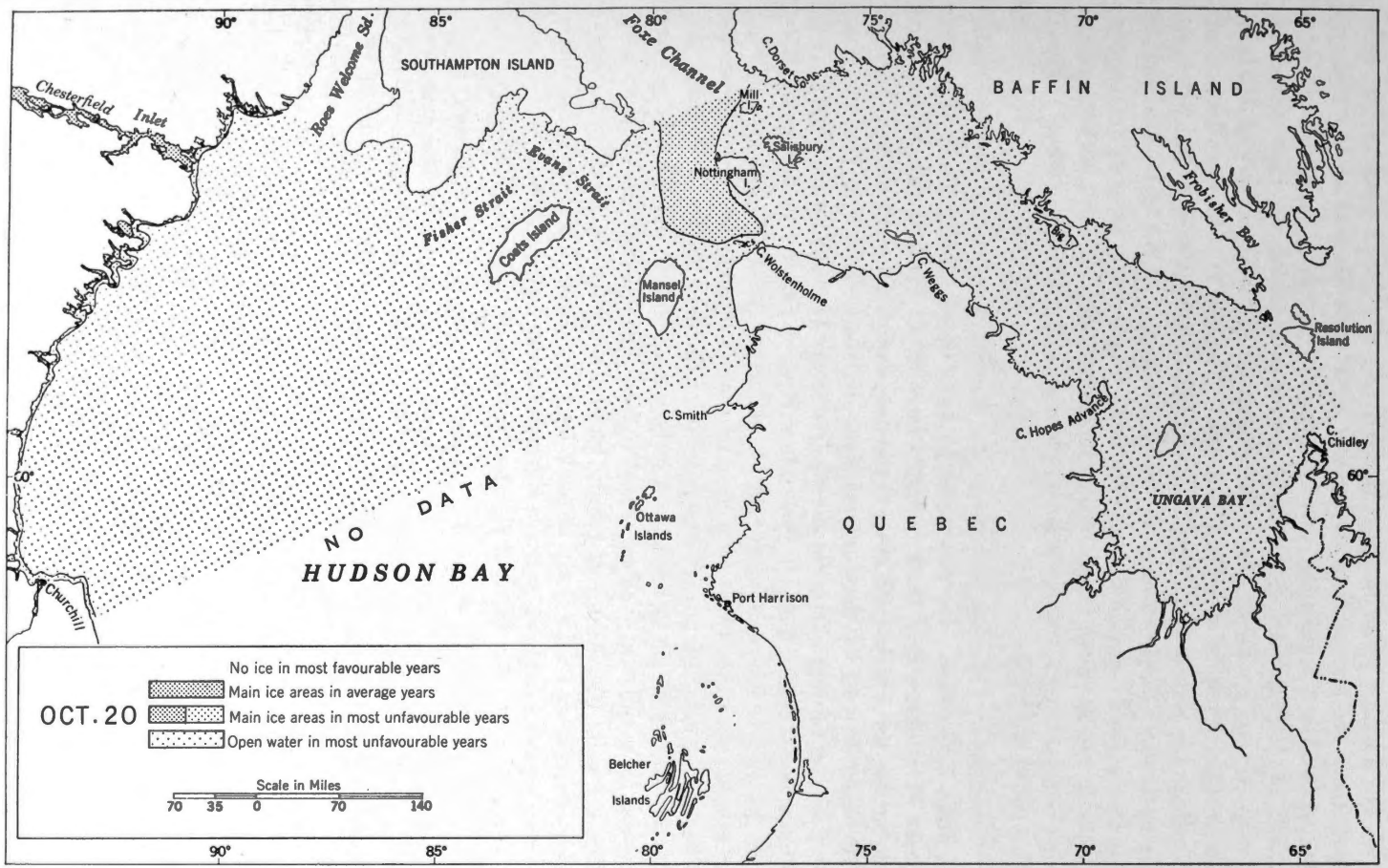

Figure 12. Limits of main ice areas along the Hudson Bay route on October 20.

The steamer route through Hudson Bay and Strait generally remains open until the end of October, except when it is blocked at Nottingham Island by Foxe Channel ice. As in September this ice is frequently present north of Nottingham Island and moves southward on rare occasions only. Young ice forms along the shores at the western end of Hudson Strait later than in the Churchill area (Figure 13). In the vicinity of Nottingham Island and Cape Wolstenholme there is seldom much young ice until the end of the month. East of Charles Island in Hudson Strait the formation of ice is still more retarded. Here young ice does not appear until November, even in the most adverse seasons. In fact, under favourable circumstances, young ice is completely lacking along the whole Hudson Bay route in October.

November. During November the transition to winter ice conditions is most noticeable. Ice continues to form more rapidly along the west coast of Hudson Bay than further eastward in Hudson Strait, and the formation of ice is delayed most in the neighbourhood of Resolution Island. By November 10 ice floes extend some distance offshore in Hudson Bay and ice has formed along the shores in western Hudson Strait (Figure 14). In average years ice forms in the eastern Hudson Strait area before November 20, but is less extensive than it is farther west (Figure 15). Even in favourable years there is a strip of shore ice along the coasts west of Charles Island. In unfavourable seasons there is considerable pack ice outside the shore ice in both Hudson Bay and Strait. As the month progresses large quantities of ice enter Hudson Strait from Foxe Channel and Davis Strait; the freeing of locally formed shore ice by tidal movements also contributes to the body of pack ice. By the end of November there are widespread fields of pack ice throughout the Bay and Strait, and shore ice has become established along most sections of the coast (Figure 16).

December. Throughout December shifting pack ice covers large areas in Hudson Bay and Strait. Open-water areas become less extensive as the month progresses, especially in Hudson Bay, where the pack becomes heavily concentrated with only occasional leads towards the end of the month. Around the shores the strip of landfast ice broadens to a width of several miles in some cases. Concentrations of pack ice in Hudson Strait become denser, particularly at the western end. By January 1 the pattern of winter ice conditions that will dominate the area for the next five months is established.

VARIABILITY OF ICE CONDITIONS

Ice conditions vary considerably from year to year as a result of variations in certain controlling factors. Among the many factors that influence ice conditions there are several that affect ice in essentially the same manner each year, and others that affect it differently.

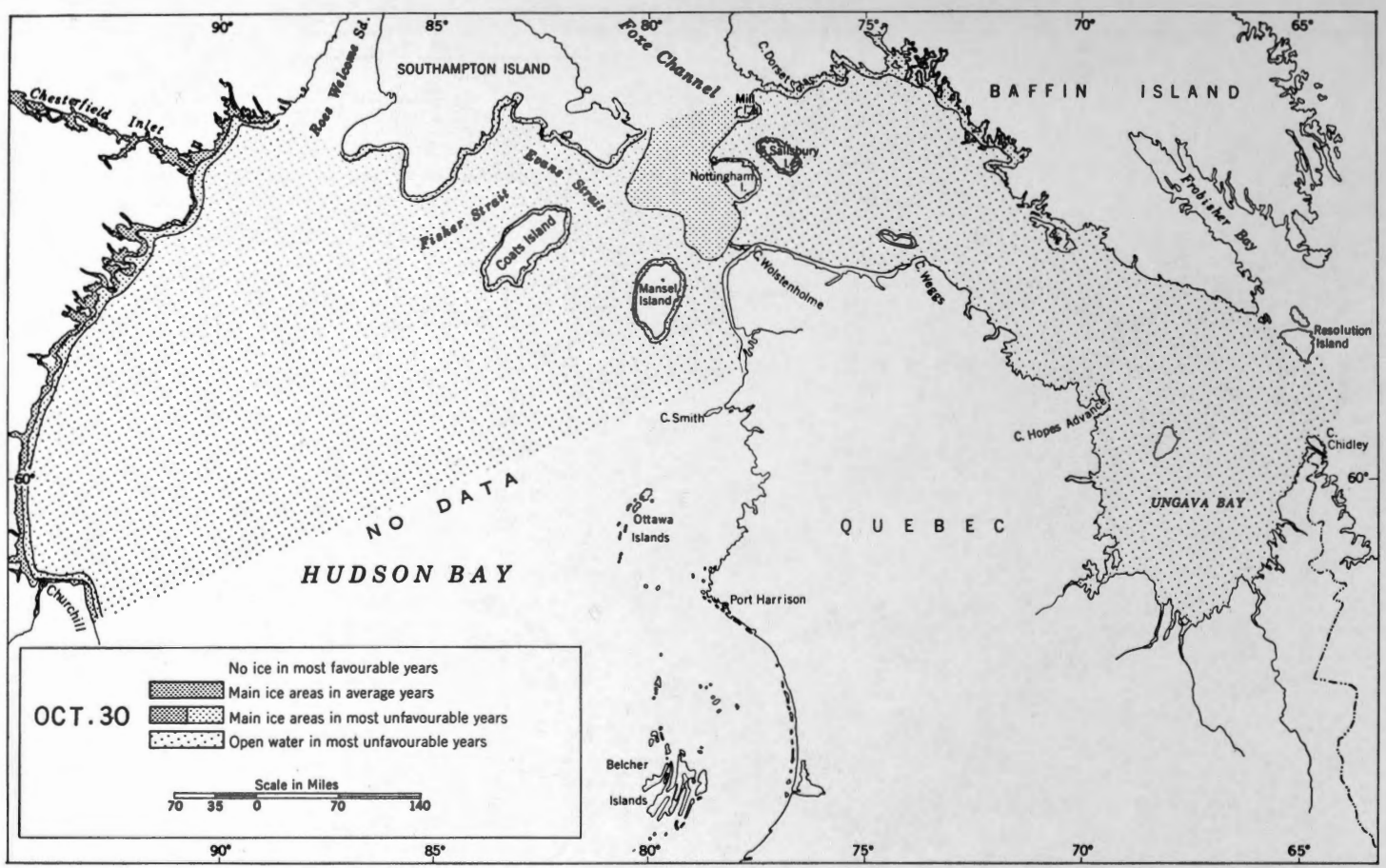

Figure 13. Limits of main ice areas along the Hudson Bay route on October 30.

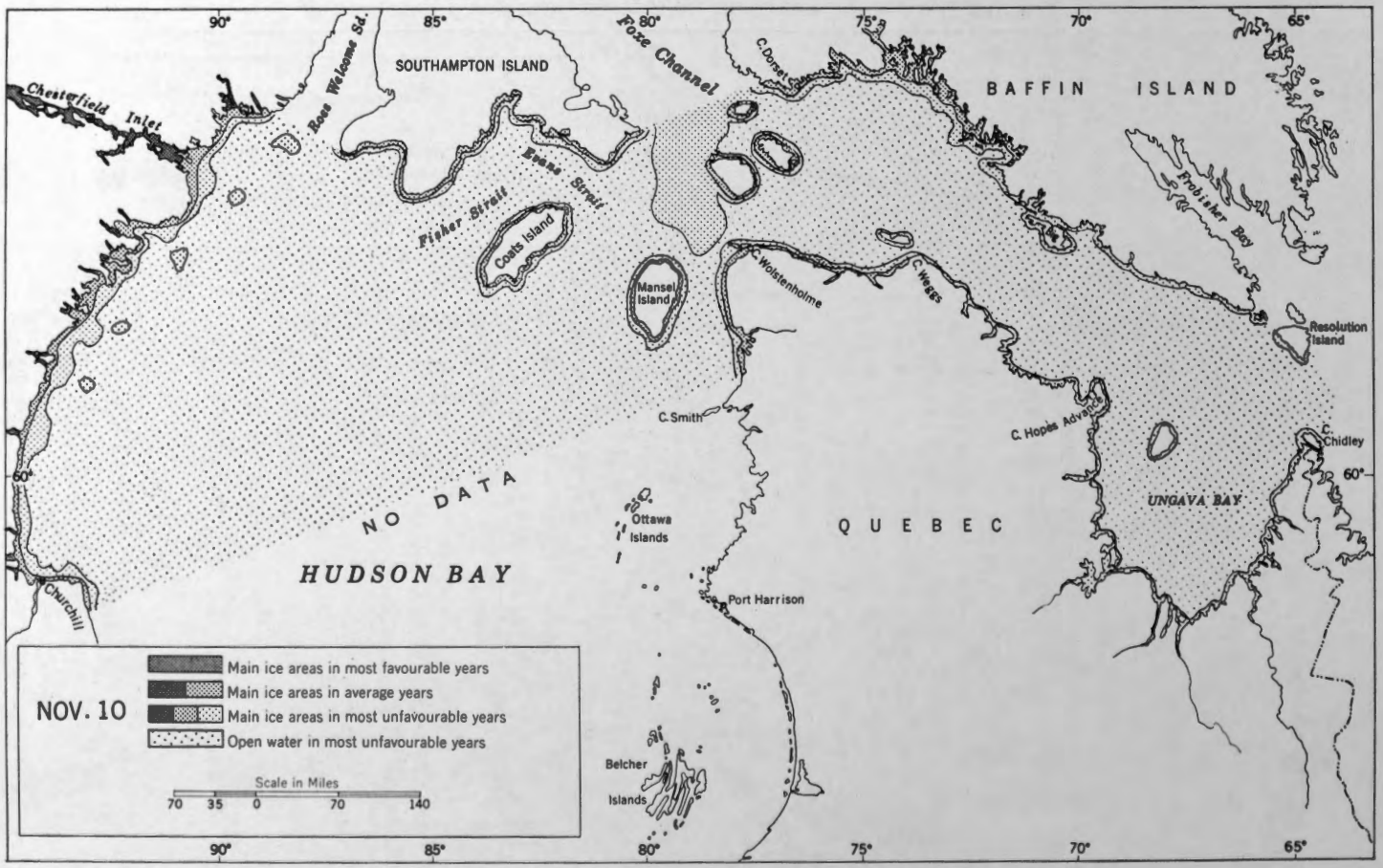

Figure 14. Limits of main ice areas along the Hudson Bay route on November 10.

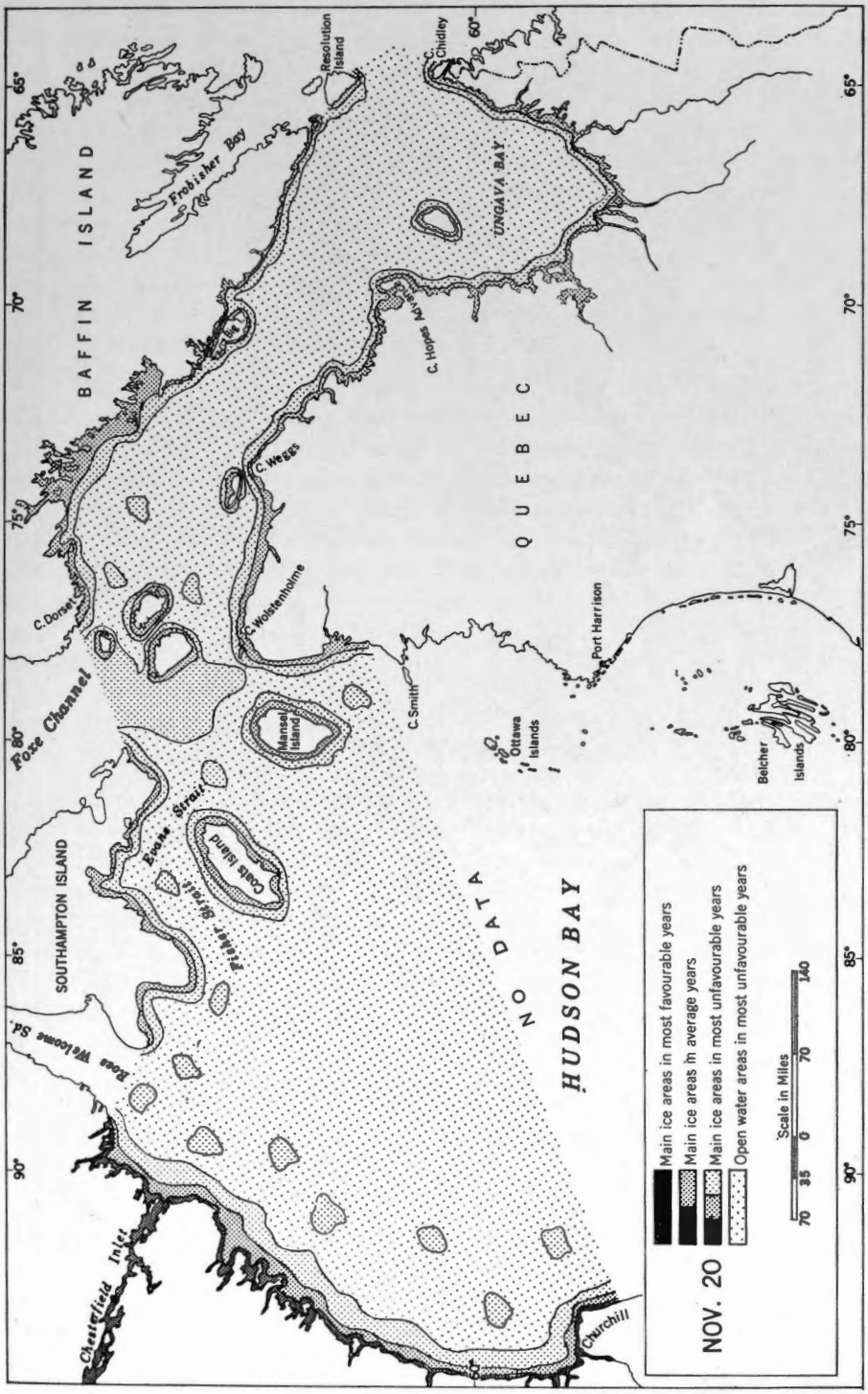

Figure 15. Limits of main ice areas along the Hudson Bay route on November 20.

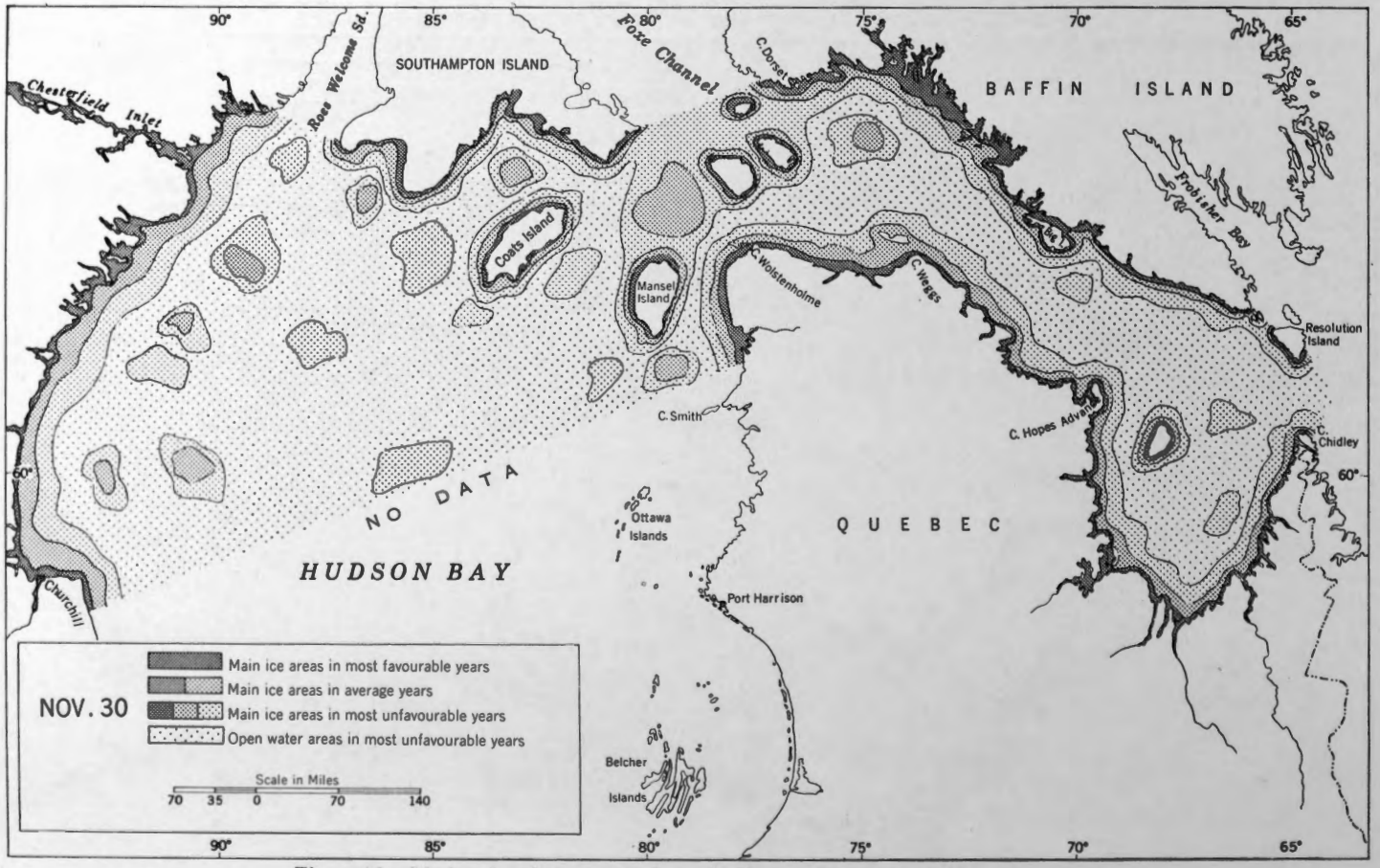

Figure 16. Limits of main ice areas along the Hudson Bay route on November 30.

The configuration of the land areas and the bathymetry do not change. These physical conditions impose a certain pattern of behaviour on the sea ice. The relatively narrow entrances to Hudson Strait and Hudson Bay do not permit large quantities of pack ice to gain exit during the spring break-up period. Consequently, the bulk of the ice, in Hudson Bay especially, remains until it melts and dissipates within the area. For practical purposes, the physical characteristics of the water, the tides and currents may also be considered as non-variable factors. One notable feature of the water currents in Hudson Bay and Strait is that they are not strongly defined flows with great velocity. Although the pack ice is carried slowly in certain directions by these currents, it does not travel as quickly as ice in the Gulf of St. Lawrence.[1]

The meteorological factors, particularly temperature and wind, do cause annual variations in ice conditions. The temperature and wind records of the 26-year period 1929 to 1953 were compared with the ice observations during the same period. The records of wind observations for several stations are published in the annual reports of navigation conditions along the Hudson Bay route. In the case of temperature the statistics published in the Monthly Record[2] were used as a basis for the construction of graphs. The difference from average of the mean monthly temperature at each of seven stations was plotted graphically for each month of the 26-year period. In this manner it was possible to determine whether a particular month was warmer or colder than average throughout the whole Hudson Bay and Strait area. A comparison with the maps of ice conditions in each year revealed certain relationships.

Influence of Temperature on Ice Conditions. Temperature deviations from average are a strong determining factor in the timing of ice break-up and freeze-up in the area. Brief periods of higher or lower than average temperature do not have nearly as significant an effect as longer periods of a month or more in duration. Also, localized temperature fluctuations do not affect the over-all ice conditions in the area to any great extent. For this reason the temperature conditions were generalized graphically to apply to the whole area in question.

In years when the break-up or clearing of ice from the area occurred at a relatively early date, it was found that temperatures were higher than average during several winter and spring months. Among the years of early break-up were 1937, 1942, 1945, 1947, 1948, and 1949. In all of these years winter temperatures were above average or approximately average. On the other hand, those years when the final clearing of ice occurred relatively late were characterized by lower than average temperatures in some months. Among the years of late break-up are 1932, 1933, 1936, 1939, 1946, and 1950. In most cases, the temperatures during the actual break-up season in May, June, and July were below average. These

[1] Forward, C. N.: The Gulf of St. Lawrence During the Break-up Season; Geographical Bulletin, No. 6, 1954, pp. 45-84.

[2] Monthly Record; Meteorological Div., Dept. of Transport, Toronto.

results coincide with the findings of G. A. Mackay, who was concerned with Hudson Bay alone.[1] The remaining years of the twenty-six under consideration lay between these extremes in time of ice clearance. An examination of conditions in the fall indicated that the freeze-up was delayed by above average October and November temperatures. Among the years in which this condition occurred were 1931, 1944, 1947, and 1948.

The chief difficulty preventing the determination of more detailed and significant relationships between air temperature and the general pattern of ice behaviour is the lack of specific data concerning ice distribution over the whole area. The situation is the same with respect to the influence of wind.

Influence of Wind on Ice Conditions. The wind is an important factor in determining directions of movement of pack ice. In Hudson Strait the ice is constantly shifted about in position by changing winds. Leads are opened and closed periodically as the ice areas are successively compacted and scattered. A long period of sustained wind of moderate velocity from one direction has a greater effect on the ice than a short period of wind of high velocity. In Hudson Bay, where ice concentrations are higher than in the Strait, long sections of the shore lead are frequently narrowed or completely closed by wind action. In some areas ridged or rafted ice is produced when sea ice is buckled or floes are overridden by other floes under pressures that are often caused by wind. Many of the changes in ice distribution resulting from wind action are most apparent locally rather than throughout the whole area.

During the season when the ice is clearing away, the wind frequently causes adverse navigation conditions by pushing heavily concentrated pack ice across the steamer track. Conversely, the track is sometimes cleared unexpectedly by wind action. In 1932 northeasterly winds in July, especially at the eastern end of Hudson Strait, pushed the ice to the southern side. But in 1935 westerly winds and high temperatures along the south side of Hudson Strait caused the ice to break up and move out long before the northern side of the Strait cleared. On the whole, westerly and southerly winds encourage the flow of pack ice into the open Atlantic through the eastern entrance of Hudson Strait. The extent to which Foxe Channel ice enters Hudson Strait is chiefly dependent upon the wind. Northwesterly winds tend to drive this ice into the Strait in the autumn, as occurred in early September 1952.

CONCLUSION

The menace of sea ice along the Hudson Bay route is one that can be minimized by greater knowledge of the distribution and behaviour of ice in that area. At the present stage the gaps in this knowledge are tremendous and this study marks but a tentative beginning in the analysis of ice conditions along the route.

[1] Mackay, G. A., op. cit.

An attempt is made to show cartographically the distribution of ice at specific dates during the navigation season. Although the areas outlined are somewhat arbitrarily drawn, they are based on all the information available. It is apparent that ice is more abundant during the break-up season than during the freeze-up. It would seem that navigation by ordinary vessels, especially in favourable years, could begin earlier in July than at present if definite information concerning immediate ice distribution throughout the area were available. Such information cannot be provided by icebreaker reconnaissance alone, but only by frequent aerial reconnaissance. Although icebergs are present throughout the summer in Hudson Strait they can be detected by each vessel itself with the aid of radar. In the fall the main obstacle to navigation is the new ice that forms around the shores, blocking the port of Churchill as well as other points. If this shore ice could be controlled the season of navigation could probably be lengthened. Through November and December the strip of shore ice gradually broadens and floes break loose to float freely over the open-water areas. At the same time ice begins to enter the area from outside sources, particularly from Foxe Channel. Pack ice from this source occasionally blocks the steamer track in the vicinity of Nottingham Island during the early fall.

In comparison with the Gulf of St. Lawrence, ice conditions are somewhat different. The concentration of ice in the Hudson Bay pack is usually greater than that in the Gulf pack. On the other hand, conditions in Hudson Strait are similar to those in the Gulf in winter. During the break-up season a large quantity of ice in the Gulf streams through Cabot Strait into the open Atlantic, instead of remaining in the area until it melts. This movement is aided by strong water currents. In Hudson Bay and Strait only a relatively small quantity of ice escapes from the area in this manner. The bulk of the ice dissipates within the area.

As a result of the daily aerial ice reconnaissance survey conducted each year in the Gulf of St. Lawrence, a valuable record of ice information has been collected. These data have made possible a better understanding of the behaviour of ice in that region. A similar aerial survey along the Hudson Bay route, somewhat modified because of the great distances involved, would greatly augment the present knowledge of ice conditions.

RÉSUMÉ

La route maritime de la baie d'Hudson n'est ouverte à la navigation que pendant deux mois et demi chaque année. Toutefois, une meilleure connaissance des conditions de la glace permettrait peut-être de prolonger cette période. La présente étude vise à rassembler brièvement les renseignements disponibles sur les conditions de la glace dans la région, et à représenter cartographiquement les limites des principales étendues de glace aux dates critiques pour la navigation. Certains facteurs agissant

sur les comportements de la glace, comme les mouvements et propriétés de l'eau, la bathymétrie et les conditions atmosphériques, sont aussi considérés.

On trouve, le long de la route maritime de la baie d'Hudson, deux principaux types de glace: la glace de mer et les icebergs. La glace de mer se rencontre dans toute la région durant l'hiver, tandis que les icebergs sont confinés principalements dans la partie orientale du détroit d'Hudson. La plus grande partie de la glace de la baie d'Hudson est d'origine locale. Dans le détroit d'Hudson, cependant, celle-ci se mélange à la glace dérivant du canal de Foxe et du détroit de Davis.

Même si le détroit d'Hudson ne gèle pas complètement durant l'hiver, il se couvre en grande partie de morceaux de banquise. La baie d'Hudson, au contraire, gèle presque totalement. En mai, la glace commence à faiblir et, en juin, le champ principal de glace de la baie d'Hudson se disloque. Le dégel étant déjà avancé, au début de juillet, la navigation peut reprendre. La baie et le détroit d'Hudson sont à peu près libres de glace en août, septembre et octobre. C'est en novembre que la glace recommence à se former. Enfin, en décembre, les apports extérieurs déterminent un état caractéristique de la glace d'hiver, laquelle couvrira la région pendant les cinq mois suivants.

D'une année à l'autre, les conditions des glaces dépendent de certains facteurs. Quelques-uns, comme la bathymétrie, les propriétés physiques de l'eau, les courants et les marées, ont une action constante. D'autres, tels que le vent et la température, causent des variantes annuelles aux conditions de la glace. Il fut vérifié que les écarts thermiques exercent bien une influence au moment précis de la débâcle et de l'embâcle et que le vent est un facteur important du mouvement des glaces.

THE POSITION OF CERTAIN FOREST BOUNDARIES IN SOUTHERN LABRADOR-UNGAVA[1]

F. Kenneth Hare and Reginald G. Taylor[2]

Considerable attention has been given in recent years to the zonal subdivisions of the great belt of conifer-dominated forest that stretches across northern North America. Interest has been displayed in this problem by foresters[3], botanists[4,5],and geographers[6]. As the number of published studies has multiplied, a wide diversity of opinion has become visible; a casual reader comparing the works of the writers just cited might despair of finding common ground between them, because of the discrepancies in terminology and interpretation. The diversity arises from differences of objective on the one hand, and from the lack of accurate observational evidence on the other.

This impression of discordance, however, is very largely misleading. It has become apparent to those most intimately concerned that a large measure of agreement underlies these studies. Hare, Hustich, and Rousseau have directed their energies primarily towards peninsular Labrador-Ungava, and it is obvious from a comparison of their published maps that there is reasonable agreement as to the position of the principal zonal boundaries; divergences of language cannot hide the similarity of Rousseau's map of the biological zones of Quebec[7], Hustich's map of phytogeographical and forest regions[8], and Hare's proposed forest regions[9]. This similarity was achieved in spite of the fact that all three workers had access to very sparse data only.

In the present paper the authors discuss the position of certain forest boundaries within southern Labrador-Ungava. This discussion is based on a recently completed program of aerial photographic interpretation at McGill University. They attempt to define the meaning of these boundaries in physiognomic terms, which do not involve the prior adoption of any particular ecological system. The boundaries so treated are (i) the forest/woodland or forest/parkland boundary, and (ii) the inner margin of the "coastal tundra" of eastern Quebec and Labrador. Both boundaries are of fundamental importance to the ecologist, forester, and physical geographer, a fact well recognized in all the papers previously cited. The authors hope that they have avoided errors or confusion in interpretation, and have consistently attempted to maintain an empirical approach.

---

[1] Paper presented to Section V, Royal Society of Canada, at its meeting in Winnipeg, Manitoba, on June 2, 1954.

[2] Dr. Hare is Professor and Chairman of the Department of Geography, McGill University. Reginald G. Taylor, B.A. (Cambridge), research department, Canadian Industries Limited.

[3] Halliday, W. E. D.: A Forest Classification for Canada; Ottawa, King's Printer, 1937.

[4] Rousseau, J.: Les Zones Biologiques de la péninsule Québec-Labrador et Hemiartique; Can. Jour. Bot., vol. 30, 1952, pp. 436-474.

[5] Hustich, I.: On the Forest Geography of the Labrador Peninsula; Acta Geographica, vol. 10, 1949, 63 pp

[6] Hare, F. K.: Climate and Zonal Divisions of the Boreal Forest Formation in Eastern Canada; Geographical Review, vol. 40, 1950, pp. 615-635.

[7] Rousseau: op. cit., Fig. 2.

[8] Hustich: op. cit., Fig. 19.

[9] Hare: op. cit., Fig. 4.

METHOD OF INVESTIGATION

In 1948, a group at McGill University (under the general direction of the senior author of this paper) set out to map the vegetation of the Labrador-Ungava peninsula by means of the vertical aerial photographs then being taken by the Federal Government. This work has progressed to the point where all areas for which vertical photographs exist have been mapped on the scale of 8 miles to the inch (1:500,000 approx.). This work has required the following steps:

(i) the establishment of an adequate *physiognomic* classification of vegetation types (for it is physiognomy, not flora and ecology, that one sees from the air);

(ii) the construction of interpretation keys, enabling the laboratory workers to identify the established classes on the vertical photographs (most of which are on scales between 1:30,000 and 1:70,000);

(iii) the development of laboratory techniques whereby the photographic coverage could be used to construct accurate reconnaissance maps on scales appropriate to the size of the region.

The methods by which these steps have been achieved have been described elsewhere[1,2,3] and will not be treated here.

The physiognomic classes (or *cover-types*) employed derive from a system first established by Hustich[4] and subsequently found admirably suited to the work of the McGill group. Hustich's classification is especially valuable because it begs no ecological questions by referring the classes to particular stages in hypothetical successions; moreover, he has cross-referenced his classes with their physiognomic equivalents in other parts of North America and Eurasia. It has been necessary to add other types to his list: he does not recognize the widespread lichen-heath and lichen-scrub types of rocky outcrops, which are very extensive in certain districts; he also does inadequate justice to the birch stands that cover very considerable areas in the southern part of the peninsula. Nevertheless, the classification itself, and the physiognomic method it exemplifies, have both proved invaluable to the McGill group.

The maps so far completed have been drawn on scales that do not permit a detailed identification of cover-types. On the main working scale of approximately 1:500,000, it has been found possible to identify only four principal cover-types, corresponding roughly with Hustich's *series*. The types identified are tabulated below:

[1] Drummond, N.: A Traverse of the Romaine River; unpublished M.Sc. Thesis, McGill University, 1949.

[2] Drummond, N., Mackay, I. A., and Hare F. K.: Investigations in the Boreal Forest of Labrador-Ungava, 1948-1951. Paper presented before the Sixteenth International Geographical Congress, Washington, 1952.

[3] Hare, F. K.: Mapping of Physiography and Vegetation in Labrador-Ungava, A review of Reconnaissance Methods; Can. Geographer, 5, 1955, pp. 17-28.

[4] Hustich: op. cit., p. 36.

TABLE 1

Hustich's series	*Forest-types included*	*McGill group's cover-types*
	Bare rock Lichen scrub	1. Bare rock, etc. (red on maps)
A. Dry series	Conifer lichen forest Conifer dwarf-shrub lichen forest Conifer blueberry forest	2. Lichen woodlands, etc. (yellow on maps)
B. Moist series	Conifer feather-moss forest Conifer bunchberry forest Rich conifer forest Mixed groves	3. Closed-crown forests (green on maps)
	Birch stands	
C. Wet series	Open bog forest Black spruce muskeg Rich swamp forest	4. Bog and muskeg (brown on maps)
	Treeless bog	

The four cover-types listed on the right are clearly composites, but it has not been found possible to separate them into components in small-scale mapping. Their distribution has been determined over the whole area of vertical photography in southern Labrador-Ungava on the 1:500,000 scale, and this in turn has been simplified to the 1:1,000,000 scale, so as to comply with the world mapping program of the International Botanical Union. In the present paper, their distribution is shown by means of isopleth maps originally drawn on the scale of 35 miles to 1 inch, or 1:2,217,600. These maps show the percentage of the land area (i.e., exclusive of lakes) covered by each type *within unit areas averaging 280 square miles in extent.* The statistics from which these maps were drawn were computed by the laboratory analysts by the direct visual appraisal of the vertical photographs.

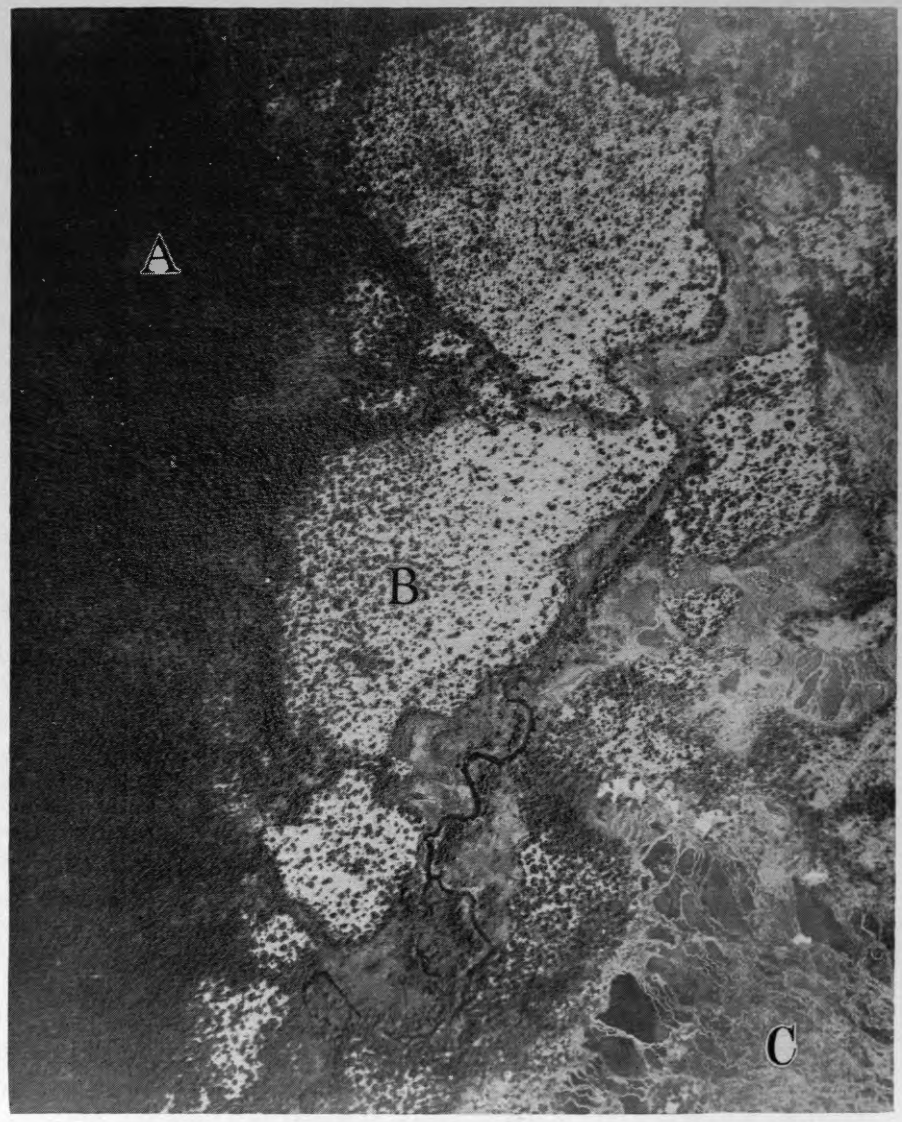

Figure 1. The cover types from approximately 5,000 feet. A—closed-crown forest; B—lichen woodland (the black dots are trees); C—floating sphagnum-dominated strings of vegetation ("string bog").

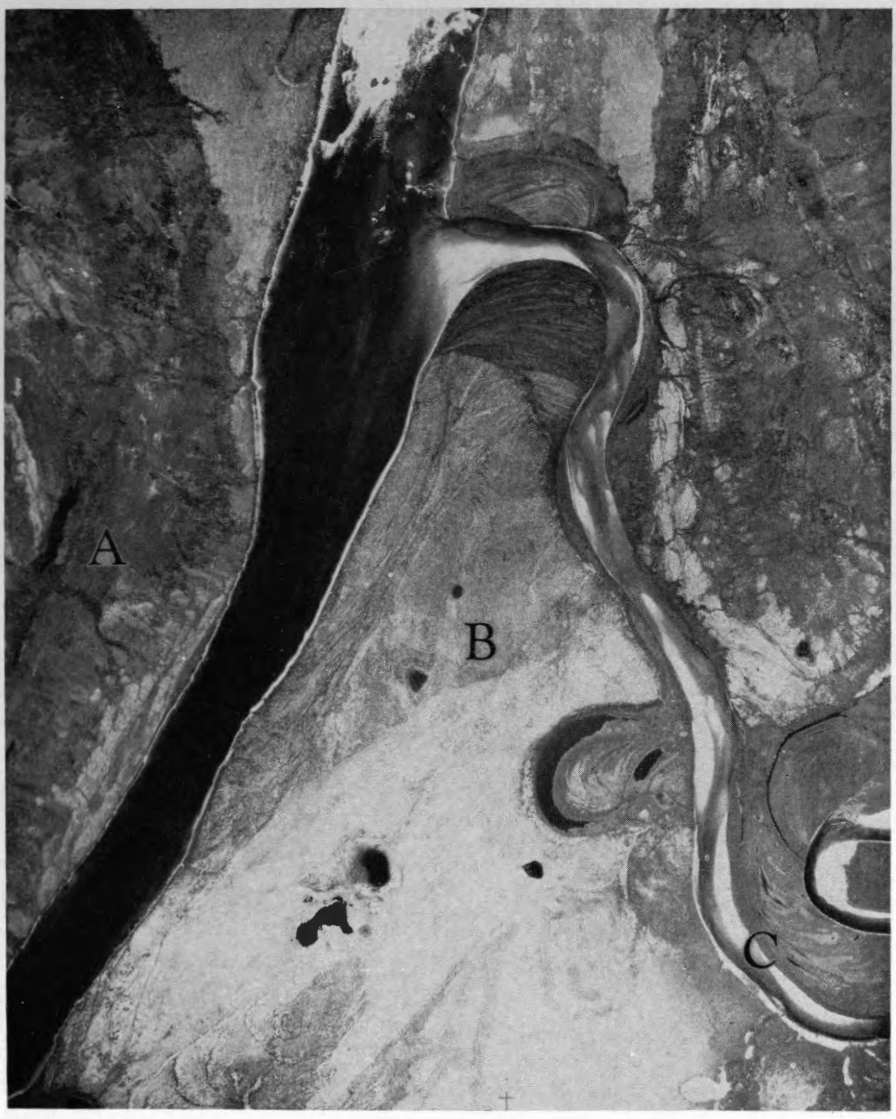

Figure 2. The cover types from approximately 17,000 feet. A—burnt-over area re-vegetated by alders; B—lichen woodland; C—alder thickets (smooth dark tone) extending along river. (RCAF photo).

THE DISTRIBUTION MAPS

I. *Closed-crown Forests (Figure 3)*

All forest types having a closed-crown layer that totally obscures the ground surface and any lower layers have been grouped together in Figure 3. The cover-type consists primarily of dense, well-developed coniferous forest, with black spruce (*Picea mariana* (Mill.) BSP) the overwhelming dominant. White spruce (*Picea glauca* (Moench) Voss) and balsam fir (*Abies balsamea* (L.) Mill.) are numerically significant in certain areas, but these facts cannot be ascertained on photographs of this scale, except in minutely detailed work. Over large areas, however, a considerable admixture of white birch (*Betula papyrifera* (Marsh.)) occurs in crown layer, and on steep valley sides there are areas of apparently pure birch, which is a far more extensive type in southern Labrador-Ungava than is normally believed. Nevertheless, on the scale of the present mapping, it has not been found feasible to distinguish these sub-types, and all three are grouped together under the heading of "closed-crown forest".

The continuous stands of the mountainous southern edges of the interior plateau are very evident on this map. In this belt, the forest cloaks almost the whole surface. A considerable percentage of closed-crown forest also occurs, however, farther north on the plateau itself. Typically, about 30 per cent of the ground—chiefly the steep, rock-controlled slopes—remains under closed forest. Extensive outliers of predominantly closed-crown structure cover the middle Hamilton Valley, the Lake Melville district, and the remote, little-explored southeastern peninsula south of Mealy Mountains.

II. *Lichen Woodland (Figure 4)*

A characteristic physiognomic type on all except waterlogged sites of interior Labrador-Ungava (and of the corresponding parts of northern Eurasia and western North America) is an open-crowned forest with a brightly illuminated floor. There may be an abundant shrub-layer, notably of *Vaccinium* spp. or of dwarf birch, and the floor is characteristically rich in lichens, especially the three common species of *Cladonia*. These open-crowned forests present difficulties of nomenclature. Hustich[1] called them conifer lichen forest, conifer blueberry forest, and conifer dwarf-shrub lichen forest. The senior author of the present paper suggested *lichen woodland* as a collective term for the open-structured forests of the Labrador-Ungava peninsula, for the lichen floor is almost always present, and the word "woodland" seemed to convey a less dense stand of trees than "forest". Hustich[2] adopted this usage, but Rousseau[3] objected on the ground that "woodland" did not necessarily convey low

[1] Hustich: op. cit., p. 36.
[2] Hustich, I.: The Lichen Woodlands in Labrador and their Importance as Winter Pastures for Domesticated Reindeer; Acta Geographica, vol. 12, 1951, 48 pp.
[3] Rousseau: op. cit., p. 444.

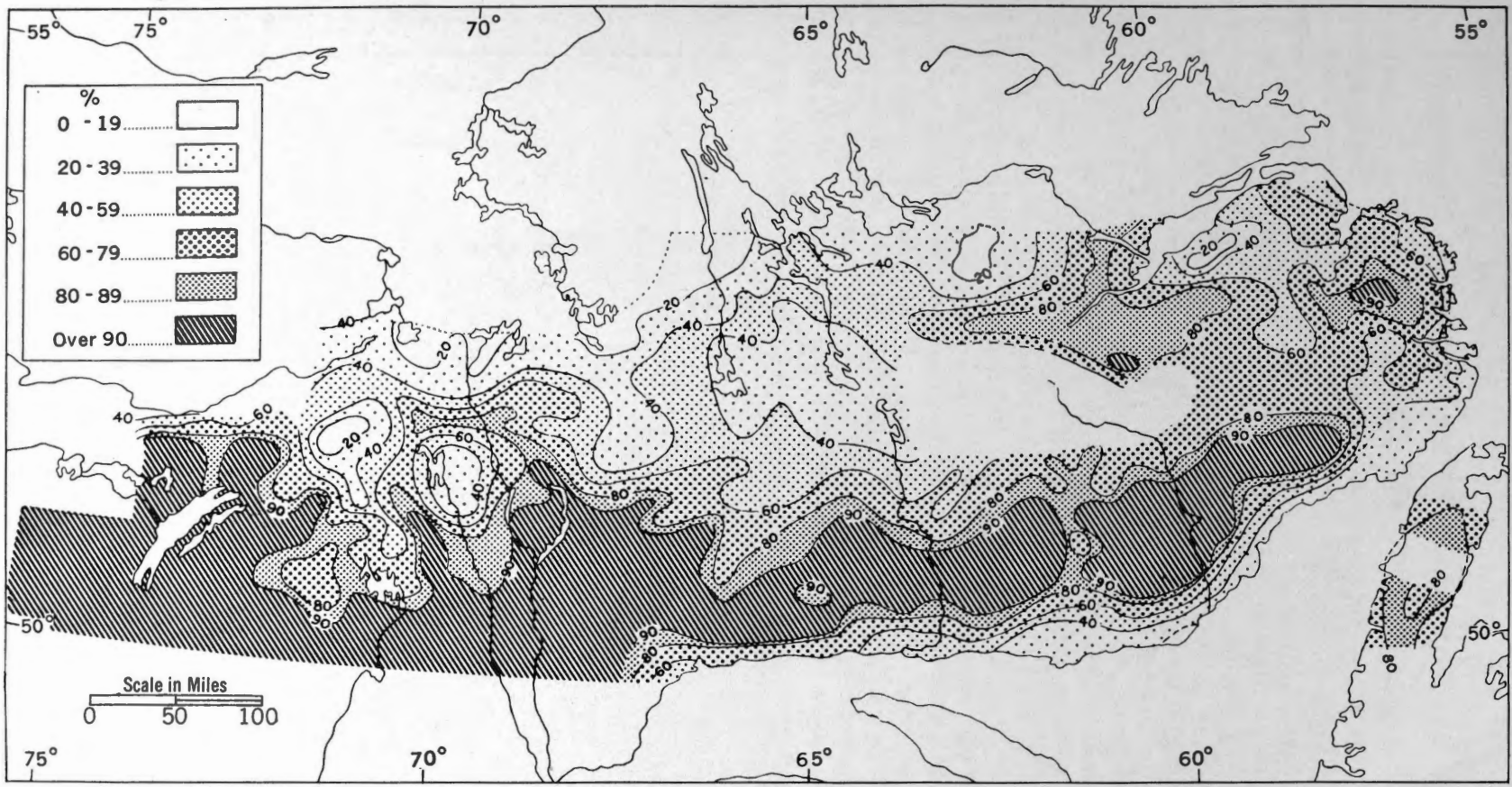

Figure 3. The distribution of closed-crown forest in southern Labrador-Ungava and part of the island of Newfoundland. Isopleths indicate the percentage fraction of the surface occupied by the cover-type concerned, based on rectangular unit areas averaging 280 square miles.

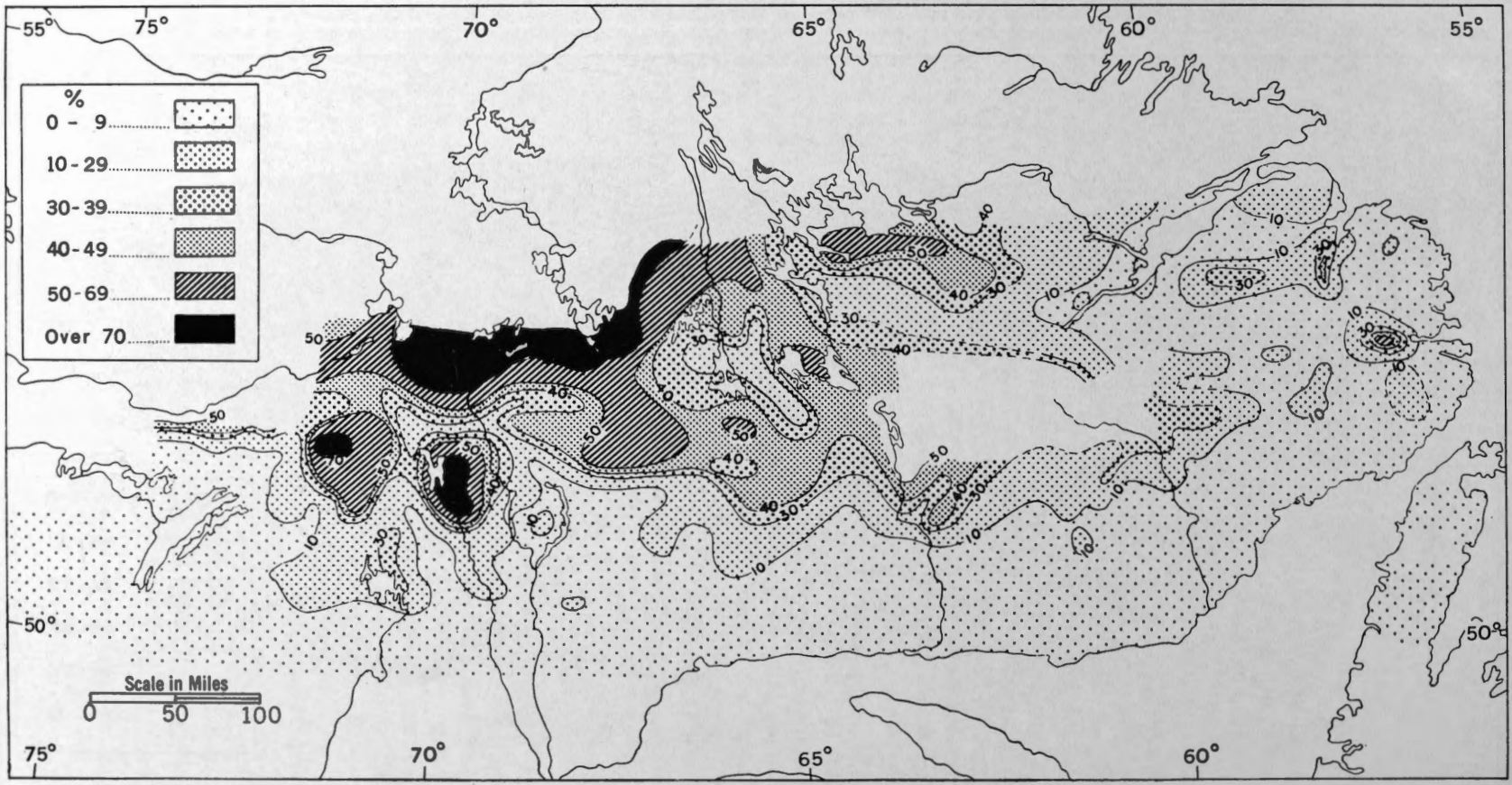

Figure 4. The distribution of lichen woodlands in southern Labrador-Ungava and part of the island of Newfoundland.

tree-density. He, himself, prefers "parkland", a term suggestive to one of English birth of country estates and deliberate plantations rich in exotics. For lack of a better term the present authors have adhered to lichen woodland.

Physiognomically, the lichen woodlands consist of open stands of coniferous species, usually black spruce, white spruce, or jack pine (*Pinus Banksiana* Lamb.) with occasional larch (*Larix laricina* (DuRoi) K. Koch) and white birch. The trees stand anywhere from 2 to 100 yards or more apart. The floor is normally thickly covered by a *Cladonia* carpet that may or may not be interrupted by clumps of dwarf birch, *Vaccinium*, *Kalmia*, and *Empetrum*. Though the composition of the type is variable, its chief physiognomic characteristics are fairly consistently maintained; a complete stranger to the area has no difficulty in identifying "lichen woodland" in any one of its several guises.

The distribution shown in Figure 4 needs little comment. In the south, the proportion of lichen woodland is everywhere below 10 per cent. In this thickly forested area, the type is virtually confined to sand plains and gravel spreads, that is, to dry sites. Farther north, however, the proportion rapidly rises, exceeding 40 per cent on most parts of the interior plateau. In the southeastern peninsula (between Lake Melville and the

Figure 5. A low oblique photograph of open and close lichen woodland. Lakes and open areas are snow covered. (RCAF photo).

Strait of Belle Isle), the distribution is curiously patchy, small areas of lichen woodland lying isolated in the surrounding ocean of closed-crown forest and spruce muskeg.

It is worthy of mention that although lichen woodland is confined to xeric sites, especially flat sand plains, in the south and in the Lake Melville district, it extends over all types of soil and all conditions of drainage except the wettest on the interior plateau. It conspicuously avoids steep, rocky slopes.

III. *Bog and Muskeg* (*Figure 6*)

The cover-types typical of normally drained sites having been considered, the areas of extreme drainage must now be described. Figure 6, showing the proportion of bog and muskeg, shows the effects of poor drainage, a characteristic feature of glaciated terrain.

As in all other cases, a wide range of sub-types is subsumed under this general heading. At the "wet" end of the spectrum, there is the fringe of aquatic, semi-aquatic, and moisture-tolerant species that make up the characteristic hydrosere along the margins of ponds and lakes (of which there are tens of thousands). Also excessively wet are the vast areas of "string bog", in which half-floating, *sphagnum*-dominated strings of vegetation criss-cross shallow pools of dark brown water over a peaty base. Drier types include the spruce muskegs and swamp forests in which black spruce and sometimes larch have begun the slow process of colonizing the bog. There are also considerable areas of sedge-fens and, in the north, the so-called palsa bogs of the Finnish ecologists.

Figure 6 shows very clearly the effect of relief. The hilly Laurentide rim everywhere has less than 5 per cent of the type, dispersed in small, rock-enclosed basins and along the banks of the large lakes and streams. Extensive bogs occur, however, on the deltaic coast-plain fragments of the St. Lawrence shore, and again southwest of Lake Mistassini. But the greatest extent of bog occurs on the interior plateau, and in the Lake Melville and southeast peninsula districts.

These bogs occur in distinct regional concentrations. The largest occupies the so-called Lake Plateau;[1] the whole district has more than 10 per cent of its surface under bog and muskeg, the highest concentrations extending in a great crescentic arc from Lake Ashuanipi past Lakes Joseph and Atikonak to Lake Gabbro-Ossokmanuan. Over this entire arc, bog occupies more than 25 per cent of the surface. A much smaller but similar area lies across the middle stretches of the Goose, Susan, and Red Wine Rivers. This is separated by the well-drained land along the Hamilton from a further vast bog area in the unmapped area about the headwaters

[1] Tanner, V.: Outline of the Geography, Life and Customs of Newfoundland-Labrador; Cambridge University Press, 1947, p. 218.

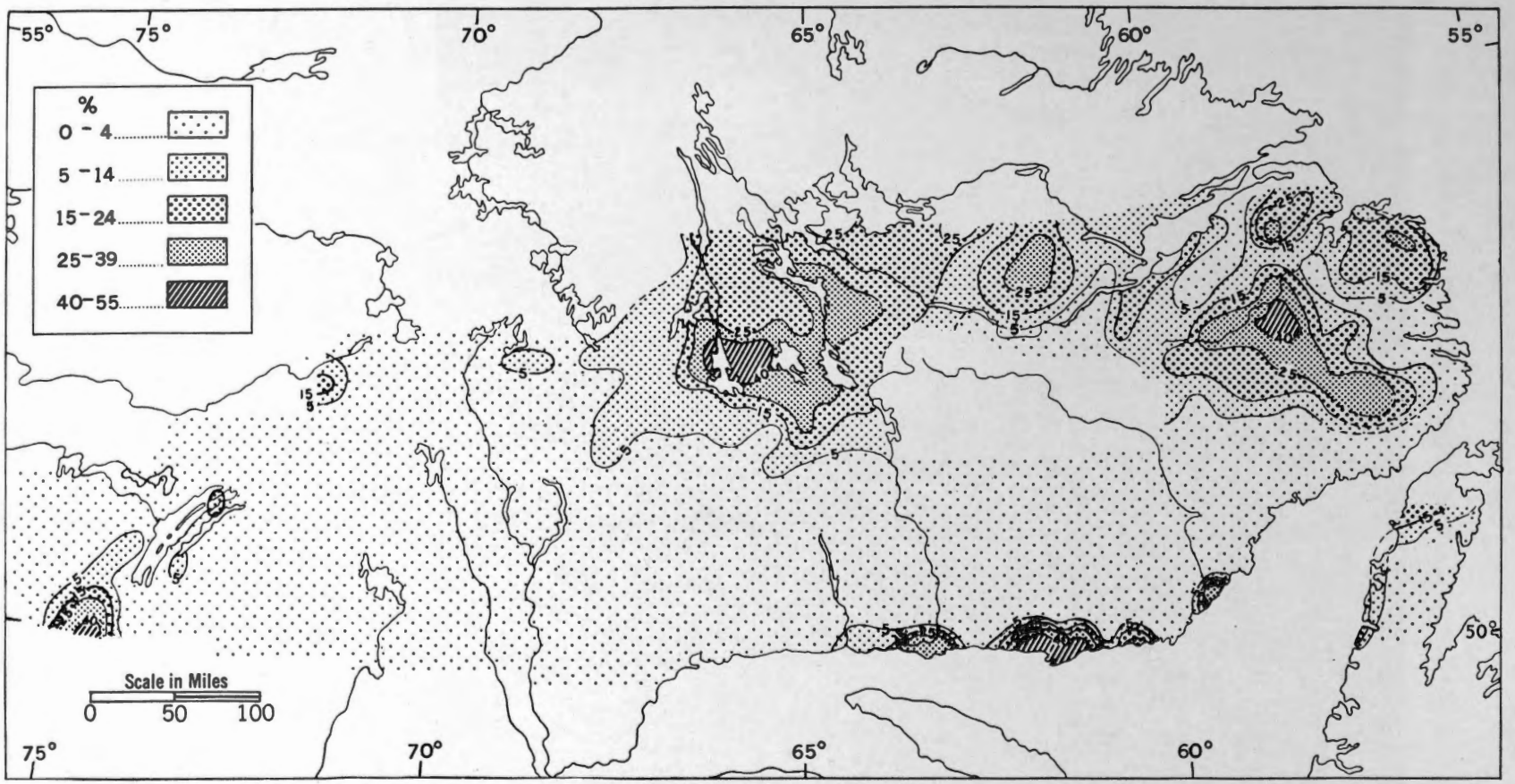

Figure 6. The distribution of bog and muskeg in southern Labrador-Ungava and part of the island of Newfoundland.

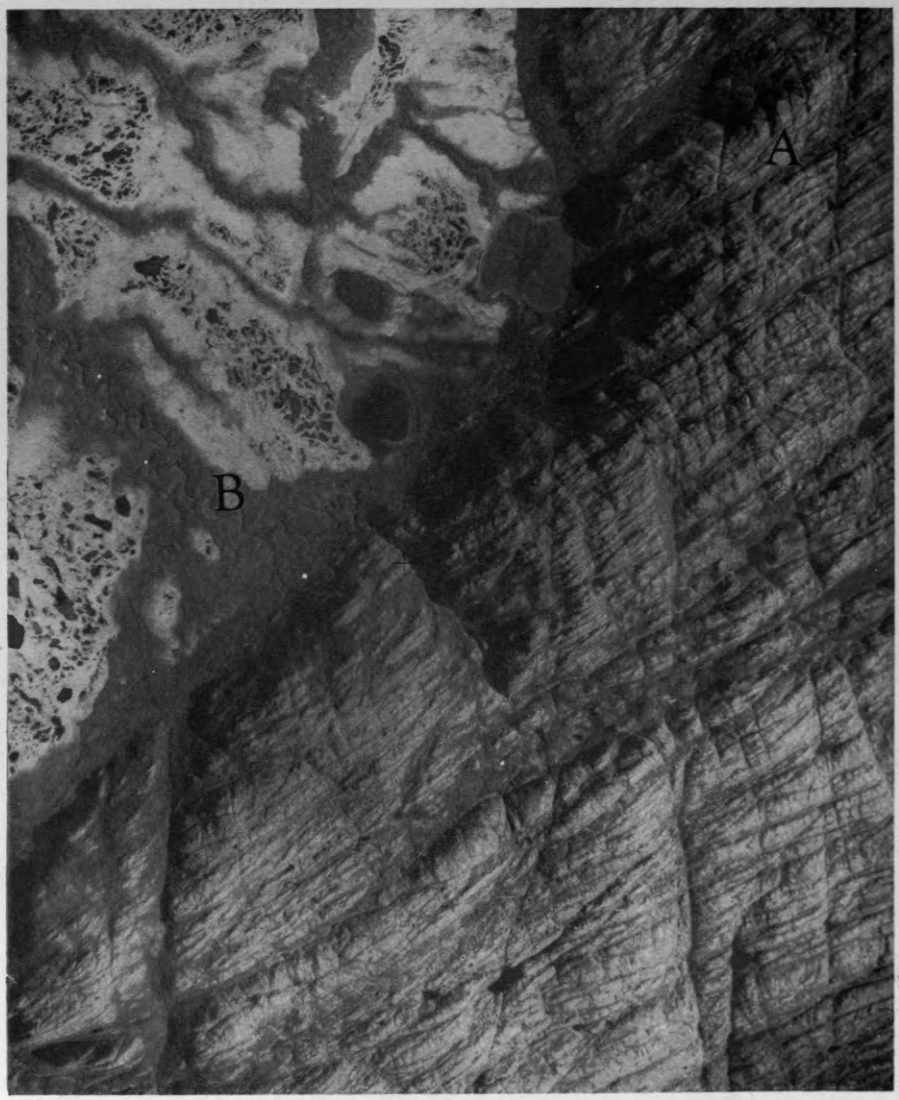

Figure 7. Mealy Mountains; bare rock and scrub cover (A) form an abrupt contact edge with "string bog" (B) along Lake Melville lowlands. (RCAF photo).

of the Little Mecatina and Natashquan Rivers (where the authors have examined it by trimetrogon photography). The final concentration occurs along and near the shores of Lake Melville, especially at its southwestern end and in the Traverspine Valley. All these areas are marked by the predominance of *sphagnum*-rich string-bog.

The great wet areas of the southeast peninsula (an almost untravelled wilderness) are strikingly different. Spruce muskeg appears to be the dominant type, and string-bog is much less common than on the Lake Plateau.

IV. *Bare Rock and Scrub (Figure 8)*

At the opposite end of the series of site-types—the ecologically very dry—comes a group of types linked only by the factor of extremely unfavourable ground conditions. Extensive bare-rock outcrops, supporting only a few crustose lichens, represent the driest type; lichen-scrub, with a fairly continuous lichen cover and with a poor, unusually stunted growth of herbs, shrubs, and trees in the more favoured crannies, represents the most favourable type. Contrary to common report, these types are by no means common in southern parts of the peninsula.

Figure 8 shows the distribution. Isolated areas of high concentration occur near the summits of the higher hill masses of the interior, notably in the Laurentide rim, on the Red Wine Mountains, and on the great rocky plateau west of the Menihek Lakes. The summits of the Mealy Mountains are by far the most striking of these montane areas. But over most of the interior, whether the land is hilly or flat, the type is virtually absent.

The striking feature of Figure 8 is undoubtedly the great belt of "coastal tundra", as it is usually called. It stretches from Mingan around to Sandwich Bay, though isolated areas of bare rock and scrub occur as far west as the Ste. Marguerite River. This sterile coastal area is evident, most continuous and most shocking to the eye, from just west of Cape Whittle to just beyond Battle Harbour. The north shore of the Strait of Belle Isle belongs in this belt; its grim, rocky aspect has been immortalized by Cartier's famous obloquy

> "J'estime, mieulx que aultrement, que c'est la terre que Dieu donna à Cayn,"

which he uttered after inspecting the coast near Blanc Sablon.

V. *Some Miscellaneous Maps (Figures 9 and 10)*

Figures 9 and 10 complete the mapping by showing the proportion of open water (lakes, rivers, etc.) exclusive of boggy openings, and the proportion of burned land.

The burnt-over areas (Figure 9) are widely distributed, and afford melancholy testimony to the effectiveness of fire as an ecological agent. The proportion burnt is lowest in the southeast but is fairly high even there. Especially severe destruction has occurred along well-known Indian hunting and canoe routes. Nevertheless, the widespread occurrence of sporadic small burns in areas, never travelled to the authors' knowledge, proves that natural causes—notably lightning—are also at work.

THE SIGNIFICANT BOUNDARIES

All authorities on the region agree that one must separate the southern, densely forested districts from the more open landscape of the interior plateau. This *forest/woodland boundary*, or whatever one may call it, is clearly a major division whether one takes the point of view of the ecolo-

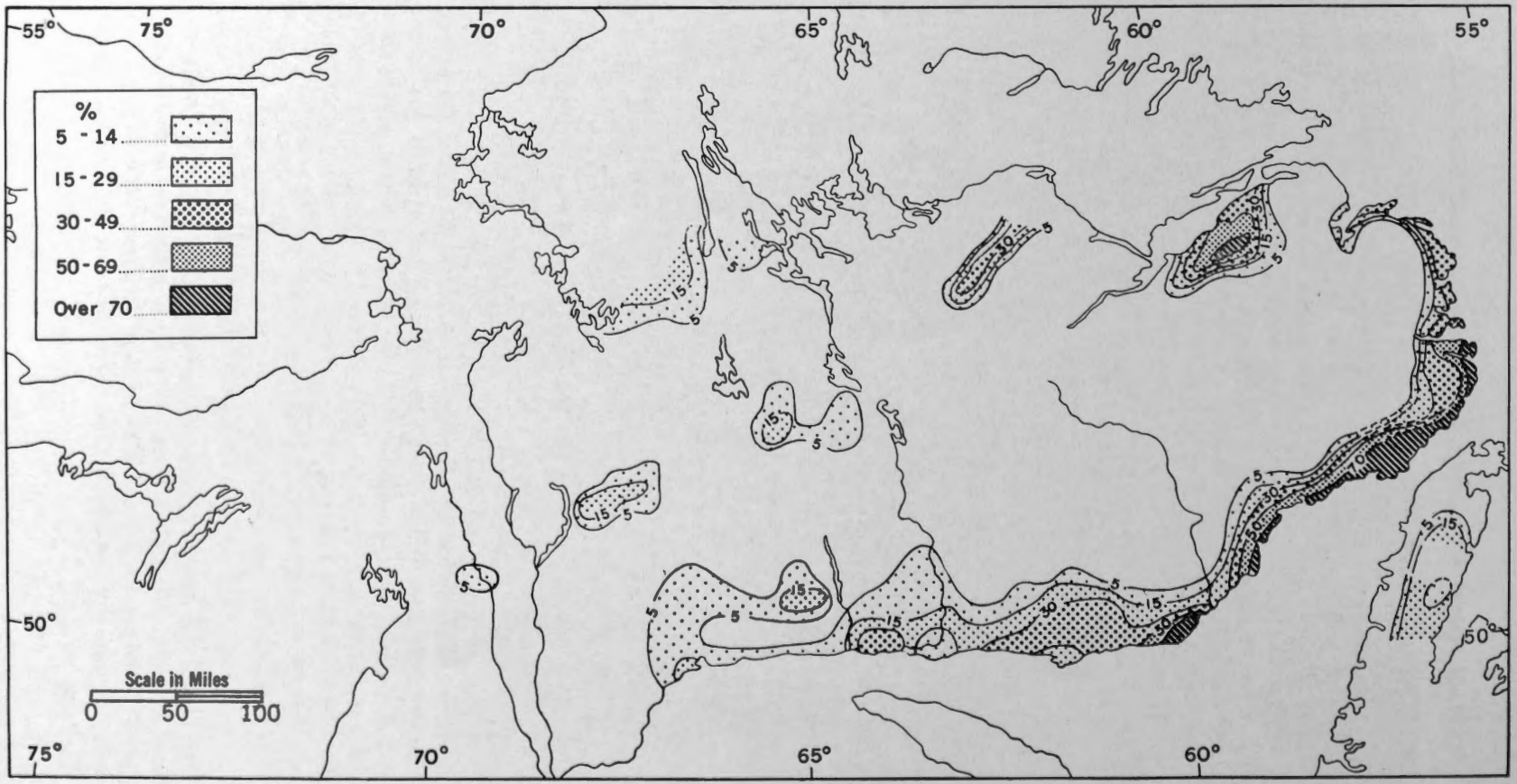

Figure 8. The distribution of bare rock and scrub in southern Labrador-Ungava and part of the island of Newfoundland.

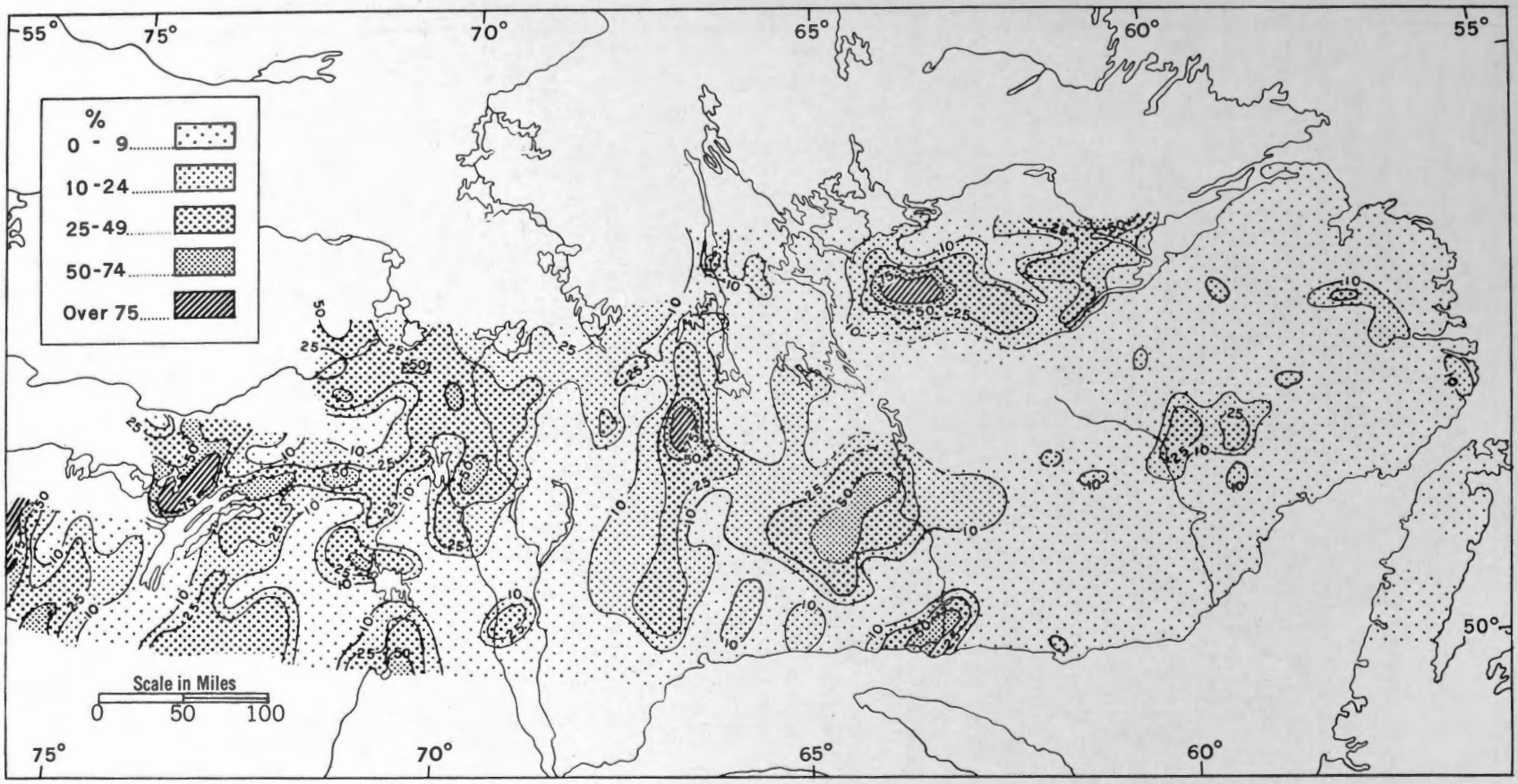

Figure 9. The distribution of burnt-over areas in southern Labrador-Ungava and part of the island of Newfoundland.

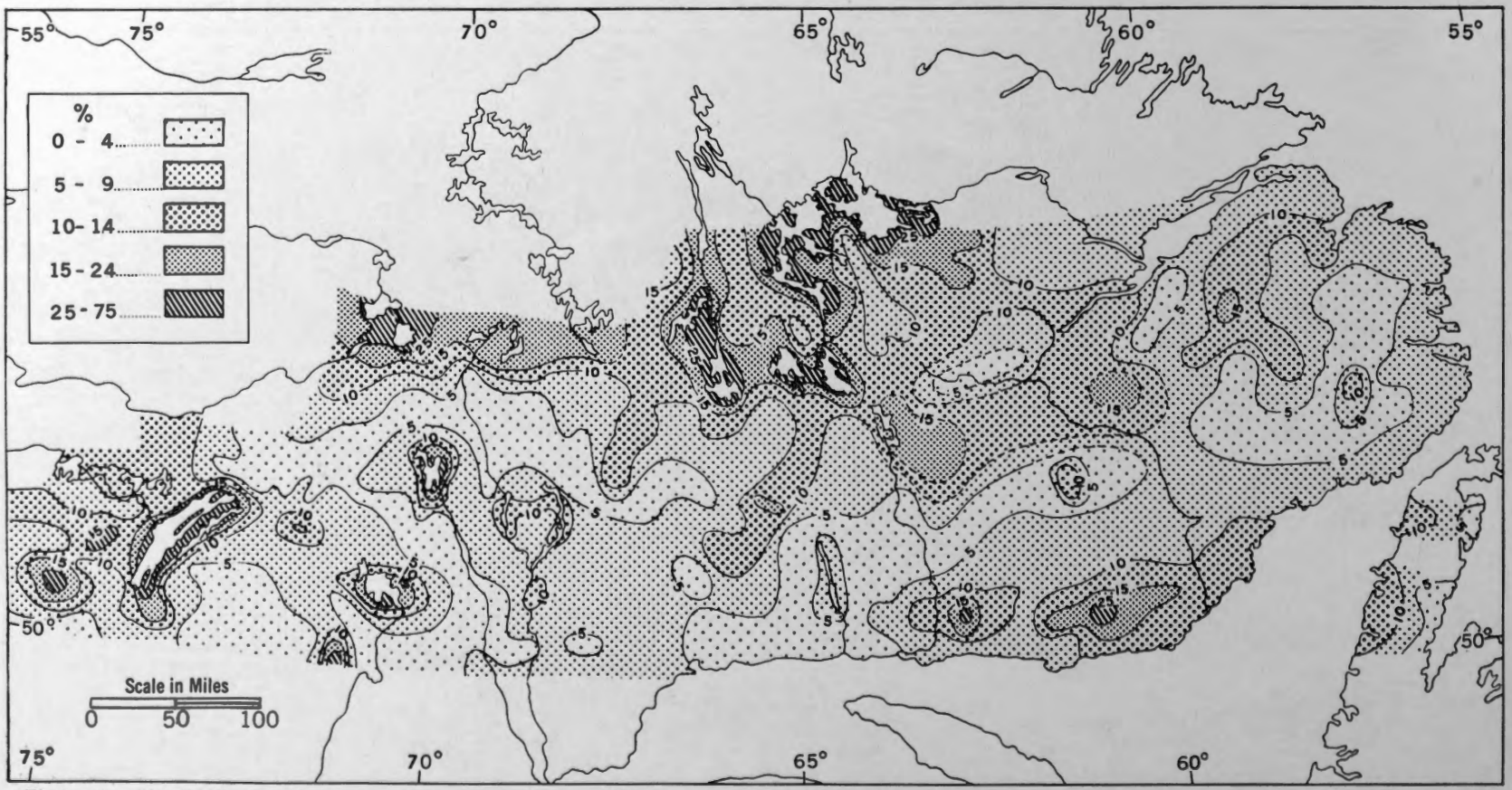

Figure 10. The distribution of open water in southern Labrador-Ungava and part of the island of Newfoundland. Embayments are not included in this analysis.

gist, the forester, or the geographer. Rousseau,[1] for example, regards the coniferous forests south of this boundary as belonging to the temperate biological zone, whereas the open "parklands" (to use his term) to the north constitute the sub-arctic zone. Hustich similarly distinguishes a northern *taiga* from the southern spruce forests, and Halliday distinguishes, on his well-known forest map of Canada (1937),[2] a northern transition zone from the main forests to the south. Hare, in recognizing the separate existence of a woodland sub-zone and a close-forest sub-zone throughout the Boreal Forest of North America and Eurasia, has defined the boundary as that line "on which close-forest stands occupy at least 50 per cent of the mesic sites".[3]

The present writers suggest, on the basis of the quantitative evidence presented in this paper, that two alternative definitions may be defended. The positions of both are indicated on Figure 13, which shows the extent of lichen woodland as a percentage fraction of all forested ground (i.e., lichen woodland plus closed-crown forest, excluding bog, muskeg, bare rock, etc.):

(i) one may take Hare's suggestion just cited, which in effect constitutes the line along which lichen woodland and closed-crown forest are equally extensive. On Figure 13, this is the 50 per cent isopleth;

(ii) on the other hand, it may prove more logical to take a much lower value of the ratio as the boundary. Experience has shown—and Figure 13 confirms—that the forest/woodland boundary is very sharp; the ratio of lichen woodland to total forest rises very abruptly from 10 per cent to above 30 per cent in a short distance—ordinarily no more than 20 miles. The isopleth of 10 per cent on Figure 13 marks the line along which this abrupt change occurs.

Of the alternatives, the writers prefer the second. The forest zone then becomes that over which closed-crown forest is present in virtually all sites except those of bog and bare rock. In any case, because of the abruptness of the boundary, the 10 per cent and 20 per cent lines are everywhere close together and even the 50 per cent is only a little farther north.

This quantitatively determined boundary confirms to a remarkable degree the position postulated by Rousseau[4] except near Lake Mistassini—where the McGill group's interpretation was in any case rendered difficult by snow-cover—and east of the Natashquan. The large outlier of closed-crown forest in the Lake Melville basin and lower Hamilton Valley is not, as Rousseau suggests, an area of "forêts à sous-bois de *Cladonia*, caractéristique de forêts subarctiques";[5] the closed-crown forests of the district are nine times as abundant as lichen woodlands, and their floor is carpeted by the feather-mosses, by *Cornus canadensis* (L.), and by the other character-

[1] Rousseau: op. cit., pp. 438-441.
[2] This was reprinted in revised form in Native Trees of Canada (4th Ed.), Ottawa, King's Printer, 1949.
[3] Hare, F. K.: The Boreal Conifer Zone; Geographical Studies, vol. 1, 1954, pp. 7-9.
[4] Rousseau: op. cit., pp. 439-440, Fig. 2.
[5] loc. cit.

Figure 11. Coastal lowland north of Blanc Sablon—an area of bare rock, scattered bogs and very sparse vegetation.

istic site indicators of more southerly deep-shade forests. Moreover, this outlier is partly joined to the main area of close-forest west of the Natashquan by the fairly dense forest cover of the southeast peninsula of Labrador between Lake Melville and the Gulf. This last area, though liberally spotted with vast muskegs, has far more closed-crown forest than open woodland, as Figure 13 suggests; in effect, the whole peninsula lies just on the "forest" side of the forest/woodland boundary. Otherwise, however, the writers agree very closely with Rousseau's view.

The second principal boundary defined in this paper is the inner margin of the so-called coastal tundra. The writers consider that this expression does in fact beg many ecological questions, but its wide use renders any substitution hopeless. In this second case, as with the forest/woodland boundary, two quantitative limits suggest themselves to the authors; both are indicated on Figure 8:

(i) the isopleth of 15 per cent bare rock and scrub effectively delimits the coastal area where these elements are conspicuous. This reaches the coast near Magpie River (though the rocky areas near the mouth of the Ste. Marguerite also exceed this figure),

and then runs parallel with the St. Lawrence, Belle Isle, and Atlantic coasts around to Sandwich Bay. It usually lies about 25 miles inland, but in a few areas reaches 40 miles. Deep indentations like Alexis Bay extend well inland to the forest zone.

(ii) the areas of very barren coastal tundra, in which forest types are very subdued, and are usually confined to sheltered hollows, is well defined by the isopleth of 50 per cent which includes within its course the Cape Whittle promontory and a wide belt along the shores of the Strait of Belle Isle.

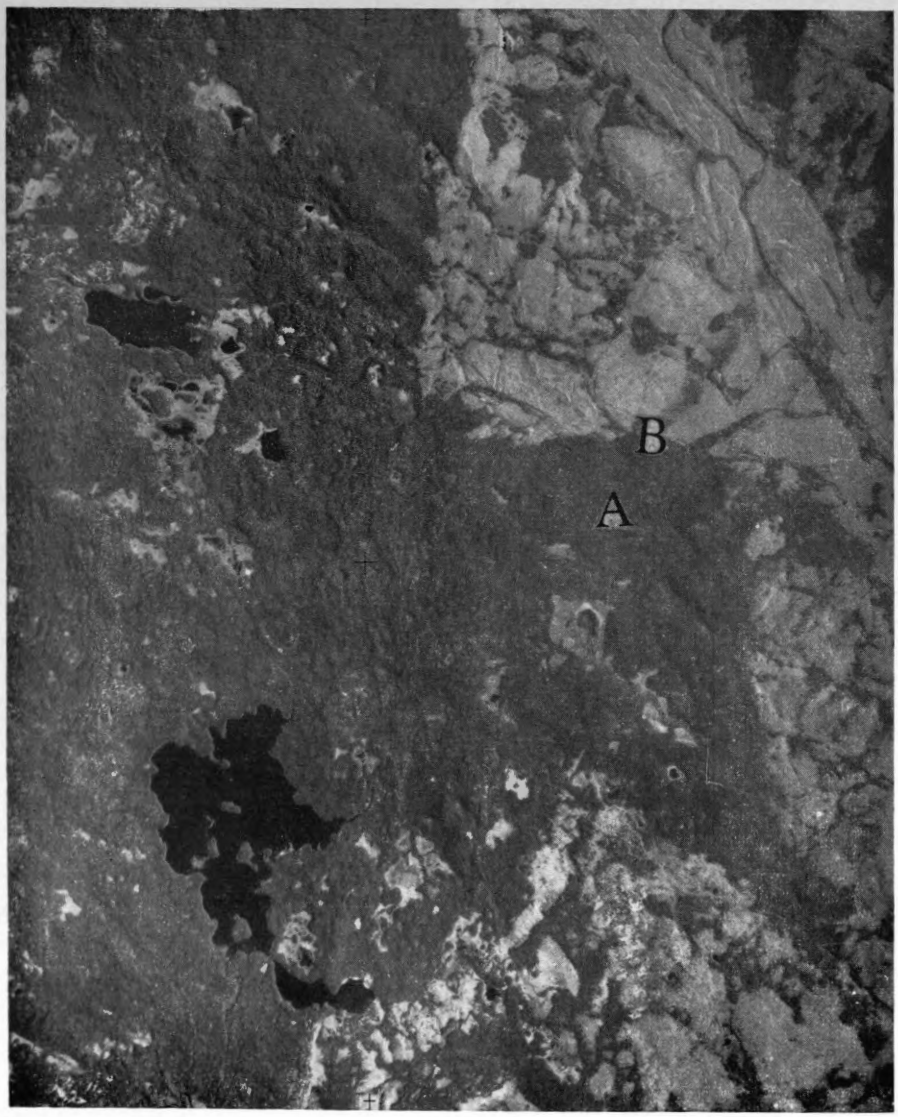

Figure 12. Closed-crown forest (A) which has been severely damaged by fire. Note the sharp boundary of the burn edge (B). (RCAF photo).

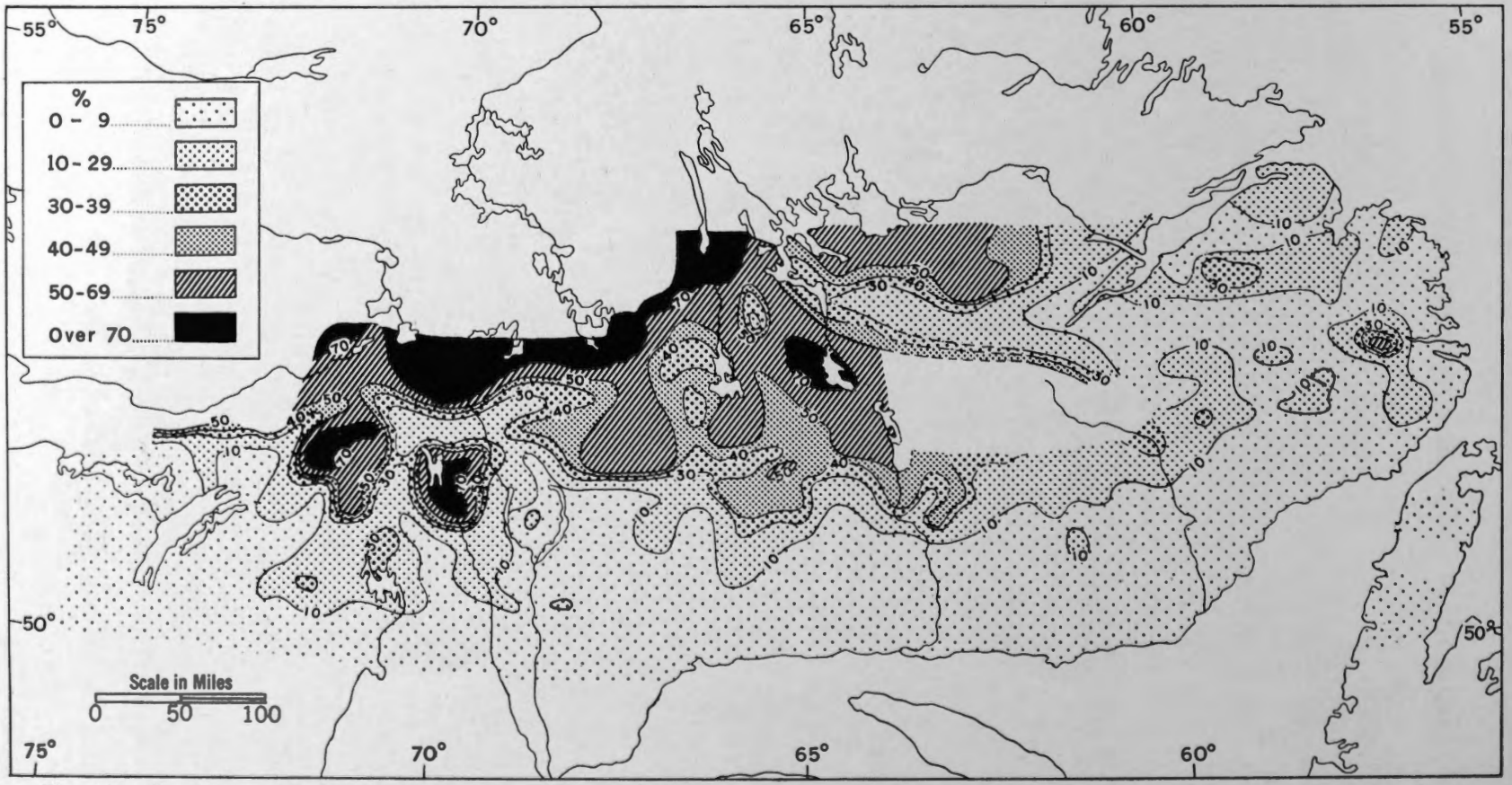

Figure 13. The extent of lichen woodland as a percentage fraction of all forested ground in southern Labrador-Ungava and part of the island of Newfoundland.

CONCLUSION

The authors believe that the positions they suggest for these forest boundaries are objectively determined, for they rest on a purely physiognomic classification of types, a statistical definition, and a wholly quantitative system of representation. Sources of error are the risk of faulty interpretation of the original photographs and the difficulties imposed by the very high altitude from which these were taken.

The other major boundaries within the peninsula—the northern limits of (i) the woodland zone and (ii) the forest-tundra (Rousseau's *hemiarctic*)—remain to be located. The McGill group is attempting to extend its work northward to the tree-line using the vertical photography already existing for the Labrador Trough, and the trimetrogon photographs for other regions.

RÉSUMÉ

La détermination de zones ou subdivisions dans la forêt à dominance de conifères de la partie septentrionale de l'Amérique du Nord a retenu l'attention, ces dernières années, de nombreux travailleurs scientifiques. Les travaux antérieurs effectués dans le Labrador et l'Ungava sur la classification des forêts de ces régions, malgré l'infime quantité d'observations directes et malgré la poursuite de buts différents, présentent malgré tout de nombreux points de concordance. Dans la présente étude, qui couvre la partie méridionale du Labrador et de l'Ungava, les auteurs ont tenté de suppléer aux observations directes sur le terrain par l'utilisation et l'analyse des photographies aériennes. La couverture végétale, telle que révélée par les photographies aériennes, est exprimée en termes physionomiques indépendants de tout système écologique préétabli. Les frontières qu'on a tenté de déterminer sont les suivantes: 1) la limite entre la forêt proprement dite ou la forêt dense, et la forêt clairsemée ou du type parc; 2) la limite à l'intérieur des terres de la toundra dite côtière de l'est du Québec et du Labrador.

Le projet, qui a été commencé en 1948 à l'Université McGill, a nécessité les étapes suivantes: 1) la mise au point d'une classification de la végétation d'après son aspect physionomique; 2) l'établissement de clefs pour l'interprétation des photographies aériennes; 3) la préparation de cartes analytiques (à l'échelle de 1:500,000 et, par la suite, à l'échelle de 1:1,000,000) d'après les photographies aériennes.

Les types de couverture végétale, ou catégories physionomiques, ont été établies d'après la classification de Hustich. D'autres catégories ou types ont été ajoutés, selon les besoins, pour indiquer l'emplacement du roc nu ou l'extension de formations particulières, telles que les lichens, les broussailles et les bouleaux. Dans certaines régions, ces formations occupent de vastes superficicies.

Les différents types de couverture végétale sont représentés sur les cartes contenues dans cette étude par des isoplèthes, les cartes de distribution géographique (originellement à l'échelle de 1:2,217,600) ayant été établies par calculs statistiques d'après l'appréciation visuelle des photographies aériennes verticales (pour la plupart à l'échelle de 1:30,000 et de 1:70,000). Les cartes indiquent, pour chaque unité de surface moyenne d'environ 280 milles carrés, le pourcentage de terre ferme, à l'exclusion des nappes d'eau ouvertes, recouverte par chaque type physionomique de végétation.

Tous les types de forêts qui présentent une synusie ou une couronne arborescente continue et fermée, cachant entièrement de ce fait la surface du sol et les synusies inférieures, ont été réunis dans un même groupe; l'épinette noire est partout l'espèce dominante de ce groupe. Dans certaines régions, l'épinette blanche, le sapin baumier et le bouleau blanc forment des populations distinctes significatives; cependant, vue l'échelle adoptée, il ne fut pas possible de les représenter séparément.

Le type physionomique dominant et caractéristique est une forêt à synusie arborescente ouverte. La distance entre les arbres, dont les espèces les plus fréquentes sont l'épinette noire, l'épinette blanche, le pin gris, avec occasionellement du mélèze et du bouleau blanc, varie de deux à cent verges, et même davantage. Un tapis continu de lichens, piqueté ici et là de touffes plus ou moins nombreuses de bouleaux nains, recouvre normalement le parterre forestier. Bien que le plus souvent confinée aux habitats secs, telles les platières de sable, la forêt à lichens se rencontre cependant sur tous les types de sols et dans toutes les conditions de drainage, à l'exclusion des pentes rocheuses abruptes qu'elle évite manifestement.

Sous la cote générale de tourbières et muskegs, ont été inclus tous les types et sous-types de marécages, depuis les tourbières à sphaignes réticulées et très humides, jusqu'aux marécages à carex et aux muskegs à épinettes.

Dans les endroits les plus secs, ne se rencontre qu'une végétation discontinue et clairsemée: les lichens incrustants et les lichens frutescents sont les éléments typiques de la couverture végétale. Sur les sites plus favorables, s'étale un tapis à peu près continu de lichens, parsemé d'arbres et d'arbustes rabougris. Une description détaillée de ces divers types de végétation est présentée dans le texte, ainsi que des cartes montrant leur répartition géographique. La superficie des nappes d'eau ouvertes et des brûlés récents est représentée sur des cartes complémentaires.

La forêt à synusie arborescente continue et la forêt ouverte à tapis de lichens constituent deux zones de végétation suffisamment différentes pour devoir être séparées. Aussi, sur la base de déterminations quantitatives, les deux frontières suivantes ont été établies et sont proposées: 1) limite entre la forêt continue et la forêt ouverte; 2) limite à l'intérieur des terres de la toundra côtière.

Il importe de noter que ces deux frontières ont été établies d'après des données objectives. Assurément, il est toujours possible que des erreurs se glissent du fait d'une fausse interprétation ou à cause de la difficulté que présente l'analyse de photographies aériennes prises à haute altitude.

Les limites de la zone de forêt ouverte et de la toundra restent encore à déterminer au nord. Ce travail sera complété à l'aide des photographies aériennes verticales de la fosse du Labrador non encore utilisées, et à l'aide de photographies aériennes obliques.

THE ST. LAWRENCE SEAWAY AND AGRICULTURAL GEOGRAPHY IN THE CORNWALL-CARDINAL AREA, ONTARIO

Harold A. Wood [1]

There are few schemes of national resource development that have aroused as wide and enthusiastic support in Canada as the St. Lawrence Seaway and Power Project. For while it is recognized that the potential increment in commerce and industry will chiefly affect the provinces of Ontario and Quebec, there is a widespread belief that all provinces will benefit from the general rise in the economic level of the nation that the project is expected to bring about.

Yet the prevailing feeling of optimism is not untinged with regret that the construction of the great dam that is the heart of the project will necessitate the flooding of a belt of land some 30 miles long and up to 3 miles wide. Town and village sites, many of historic interest, will be submerged. Roads and railways will be affected. Hundreds of summer cottages and tourist cabins will have to be removed and thousands of acres of farmland will be lost.

The towns and villages doomed to disappear have received the greatest attention. The relocation of urban and transportational land uses clearly involves careful planning. However, in this relocation, there is little or no real loss to the townships and communities concerned. Canada as a whole, and to some extent the United States, will cover the cost of the moving job, and the municipalities that are to be redeveloped should find their future planned layouts more efficient and economically advantageous than their present ones.

Where, however, land is used not merely as space, but for agricultural production, the case is different. The production from areas to be inundated, or to be taken over for other uses, is an immediate and possibly a permanent loss, at least so far as the immediate neighbourhood is concerned, and to this loss of production must be added the direct and indirect effects of suddenly depriving of occupation, and to some extent of income, the cultivators concerned. No section of a geographic entity can be removed without affecting to some extent the remainder. Wise planning must take such matters into account, and this can be done only after careful study of areal relationships.

It is therefore the purpose of this paper to examine the agricultural geography of the area in question in order to ascertain the nature and magnitude of the impact of seaway construction on present and future agricultural developments. For convenience the section to be investigated

[1] H. A. Wood, B.A., M.A., McMaster, Lecturer in Geography, McMaster University. Leader of Geographical Branch party to St. Lawrence Seaway area in 1953.

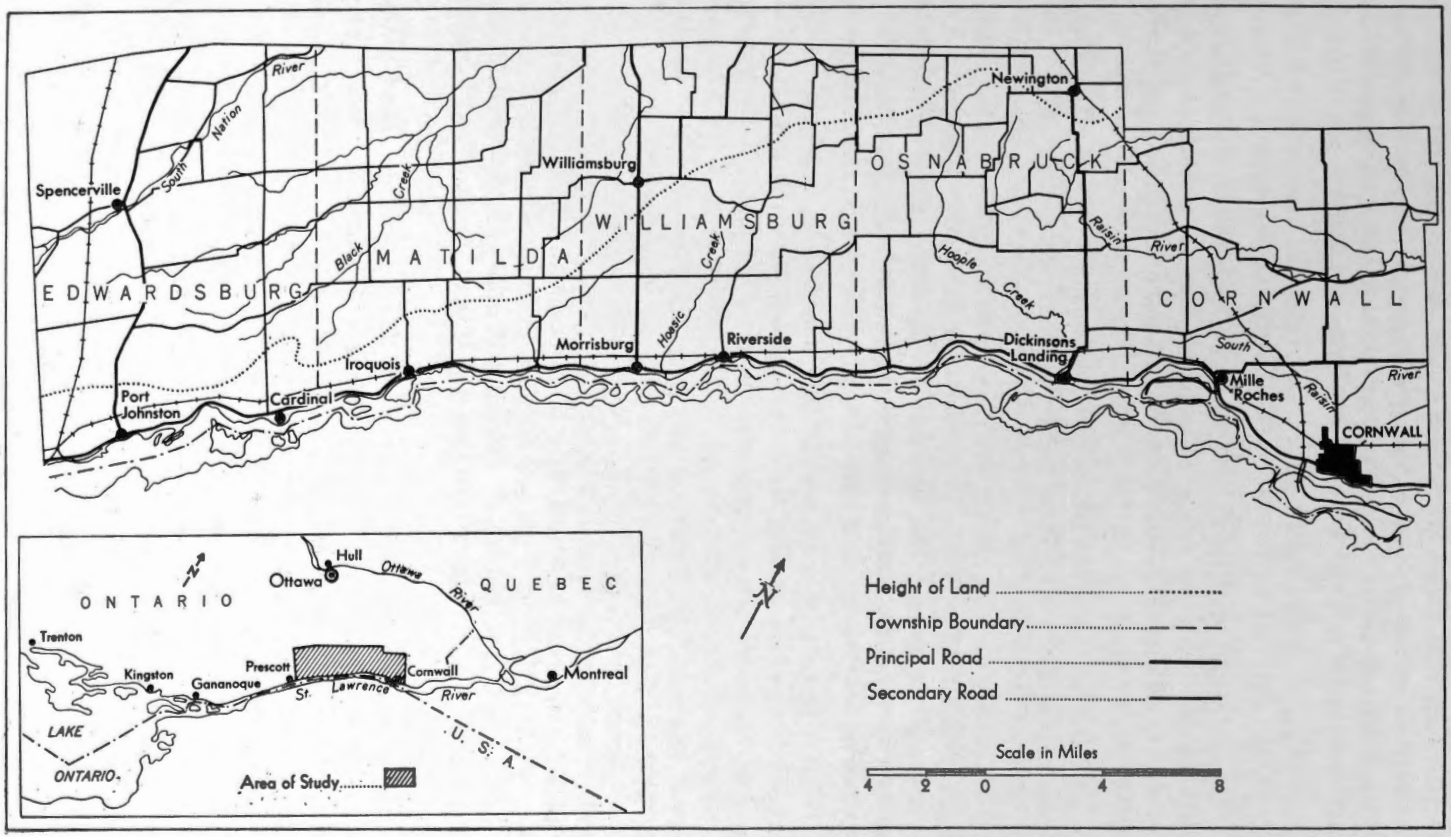

Figure 1. Location maps of the International Rapids area.

is taken to include the total area of the five townships that will be directly affected by construction of the power and navigation facilities. These are Edwardsburg in Grenville County, Matilda and Williamsburg in Dundas County and Osnabruck and Cornwall in Stormont County.

PHYSICAL GEOGRAPHY

The area is underlain by Ordovician sediments, chiefly limestones and shales, that are nearly flat lying; these have imparted to the area a level aspect that has not been seriously altered by subsequent glacial and marine action.[1]

The Wisconsin ice sheet advanced over the area in a general southerly direction and laid down a gently rolling till plain, dotted with low, rather poorly formed drumlins. No halt in the advance was made here, hence no moraines were formed, nor are any recessional features in evidence, with the exception of a few kames in the western section of Matilda and in Edwardsburg townships. The land surface was thus marked by a series of low ridges and valleys running roughly north-northeast, with local relief not exceeding 80 feet.

These irregularities were considerably modified by deposition in the Champlain Sea, which invaded the area following the withdrawal of the ice sheet. In the west, where a great stream, the forerunner of the present St. Lawrence River, entered the sea, an extensive sand delta was built up, masking most of the former variations in the terrain. The sand plain now covers most of Edwardsburg and parts of Matilda townships. Offshore, in deeper water, clay was laid down, and in the northern section of Matilda reached a thickness sufficient to produce a more or less continuous clay plain, interrupted here and there by incompletely buried till and rock ridges. Further east, at a greater distance from the source of sediment, deposition was less pronounced. Depressions were partially filled in, but any general covering of clay was so thin that it has long since been removed by erosion.

As the sea slowly receded, other small, discontinuous sand plains were formed in addition to a large number of well-defined beaches. These beaches, following the general line of the terrain and marked by great boulders, are interesting not only as relief features in their own right but also because they act to disrupt further a drainage system which was already thoroughly disorganized.

The drainage situation is aggravated still more by the fact that the divide between the Ottawa and St. Lawrence Rivers runs through the area, actually approaching at one point within a mile of the latter. There is a relatively broad belt in which neither drainage system has become established, and here a large proportion of the depressions are still un-

[1] For a complete account of the surface features of the area, *see* Owen, E. B.: Pleistocene and Recent Deposits of the Cornwall-Cardinal Area, Stormont, Dundas, and Grenville Counties, Ontario; Geol. Surv., Canada, Paper 51-12, Ottawa, 1951.

drained. It is only to the east, where, after dropping down the Long Sault Rapids, the St. Lawrence reaches a sufficiently low elevation to attract longer tributaries from the north, that drainage improves and the clay of the depressions appears without a deep covering of muck.

Drainage is even better on many of the higher ridges. Unfortunately, however, the most pronounced of these, because of their elevation, stood up as islands at one stage or other in the recession of the Champlain Sea and at that time were subjected to severe wave attack which squared off their summits, leaving behind great fields of boulders.

Another zone with relatively good drainage lies along the bank of the St. Lawrence River. One of the most notable characteristics of this stream is its extreme youth and its very minor effects on land forms adjacent to its valley. It has, however, carved out a bed so deep that the surface of the river is generally some 10-30 feet below the level of the surrounding countryside, the abrupt drop permitting the escape of sub-surface water and speeding up surface run off along the river bank.

Nevertheless, even when these exceptions are taken into consideration, it is evident that poor drainage is one of the dominant physical characteristics of the area.

As a result of the Quaternary activities described above, the bedrock has been almost completely buried within the five townships. Such outcrops as do exist occur principally in Cornwall township, where there is a prevailing west-southwest trend to the landforms and drainage, dictated partly by rock structure; and again scattered throughout a broad zone lying west of a line drawn from the northwest corner of Osnabruck township to the southwest corner of Matilda.

The climate of the area is relatively cool and humid. Winters are cold, springs cool, and summers not excessively hot. The average date of the last frost in spring is May 16. Precipitation totals 30 inches to 40 inches throughout the year, about half falling during the growing season and providing sufficient moisture for most field crops. Table I summarizes climatic conditions at Morrisburg, which is centrally located along the southern boundary of the area.

TABLE 1 [1]

Mean Monthly Temperature and Rainfall, Morrisburg

—	J	F	M	A	M	J	J	A	S	O	N	D	Year
Temperature in degrees F.....	15·6	15·2	26·8	40·0	52·8	62·4	67·2	64·9	62·7	46·6	34·3	19·9	42·4
Rainfall in inches.....	3·69	2·97	3·09	3·28	3·22	3·20	3·12	3·34	2·85	3·42	3·35	3·09	38·60

[1] From Soil Survey of Dundas County; Ontario Dept. of Agriculture, 1952, p. 24.

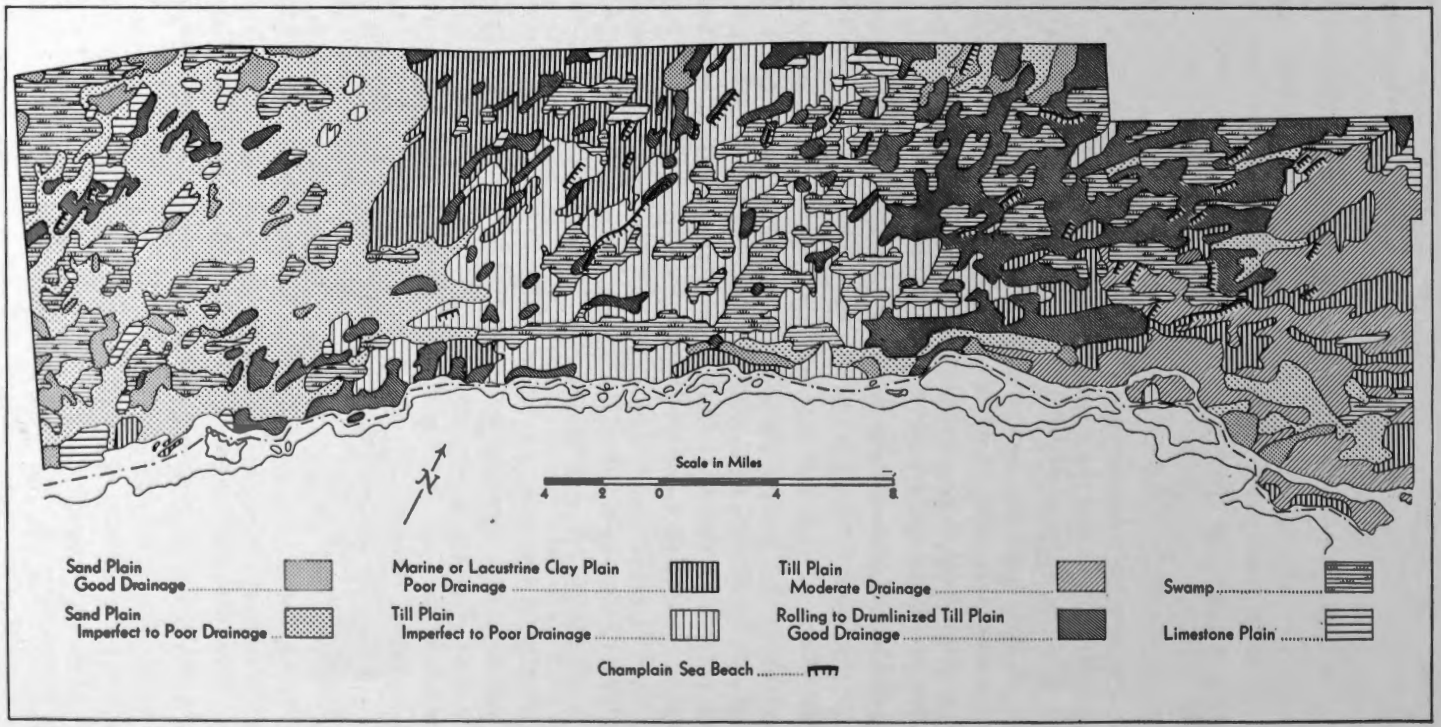

Figure 2. Land types in the International Rapids area. This is a generalization of "Pleistocene Geology of the Cornwall-Cardinal Area" (Preliminary Map 51-12A, Geological Survey of Canada) and Ontario Soils Survey maps supplemented by field observations.

PRESENT AGRICULTURAL DEVELOPMENT

The five townships under discussion are dominated by a single major type of agricultural enterprise: dairy farming. The cool, moist climate is ideal for this activity and the poor drainage is less of a handicap than it would be for many other forms of agriculture. Owing to the remoteness of major markets, however, most of the milk is made into cheese or used in the manufacture of other milk products such as condensed and powdered milk. Cheese factories are widely scattered over the entire area and a large milk processing plant is located at Chesterville, a few miles outside of Williamsburg township, to the north. The output of these factories is marketed across Canada as well as overseas.

That the agricultural picture is indeed in close harmony with physical and economic conditions is demonstrated by the fact that dairying has remained in the forefront since the time of the first census over a century ago. Over this period the only major change in agricultural practice has been the replacement of sheep raising by the keeping of swine as a secondary feature of farm economy. Otherwise, basic agricultural methods have remained virtually unchanged.

This common stress on dairying has tended to minimize differences in the local land use pattern. Each farmer requires hay and pasture in addition to fodder grain and therefore these three forms of land use are represented on almost all farms. Wood for fuel has also normally been produced on a subsistence basis and therefore farm woodlots are almost universal. Where poorly drained or stony sites existed these were the areas usually left in forest, but good land has also been frequently used for this purpose if no other is available. Even in the generalized land use map appearing in Figure 3 the close association of pasture, cropland, and woodland is everywhere apparent.

Yet another feature unifying the area is that it is one of diminishing rural population. Each of the five townships is recorded as having reached its population peak in the census of 1861 or that of 1871. Since that time the number of farm units has declined 37 per cent in Edwardsburg, 20 per cent in Matilda, 22 per cent in Williamsburg, 33 per cent in Osnabruck and 30 per cent in Cornwall. The percentage reduction of rural farm population has, of course, been even greater as machinery has replaced much hand labour and farm families have grown smaller. Everywhere traces of farm abandonment and farm consolidation are seen as, on the one hand, land has fallen out of cultivation altogether and, on the other, neighbouring farms have been linked together to form larger operational units. All such cases still revealed in the visible landscape are shown in Figure 6.

Nevertheless some differentiation does exist. There are areal differences in the relative proportions of cropland, pasture, and woodland; in the extent to which pastures have been improved; and in the distribution

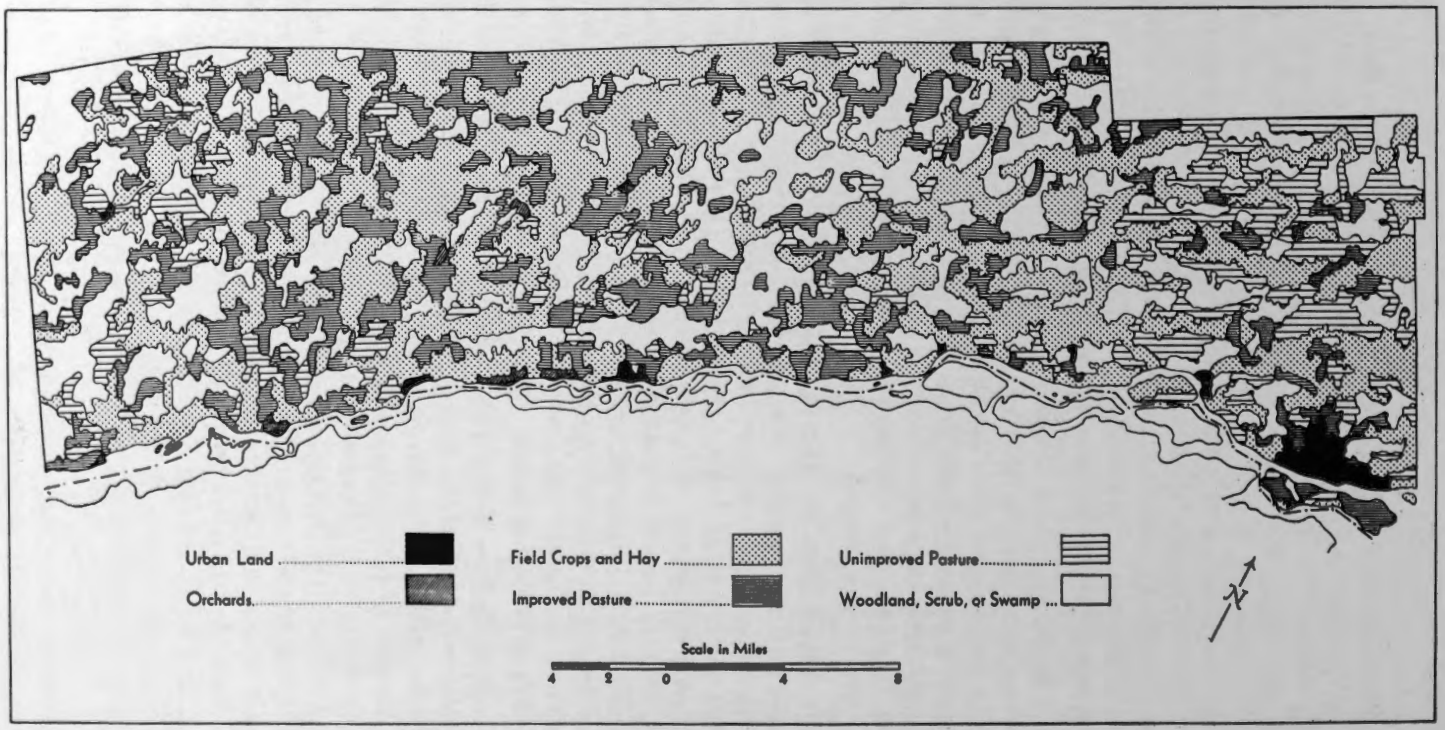

Figure 3. Land utilization in the International Rapids area.

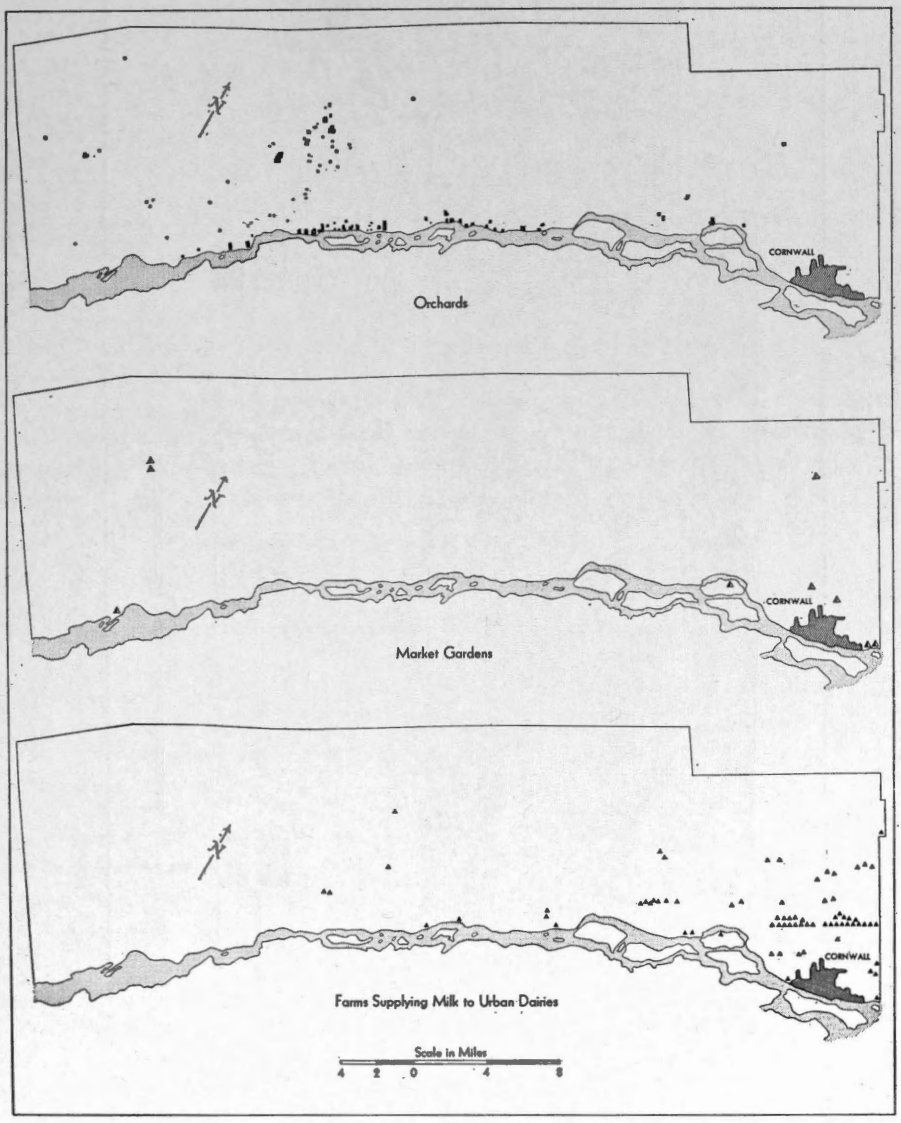

Figure 4. Specialized land uses in the International Rapids area.

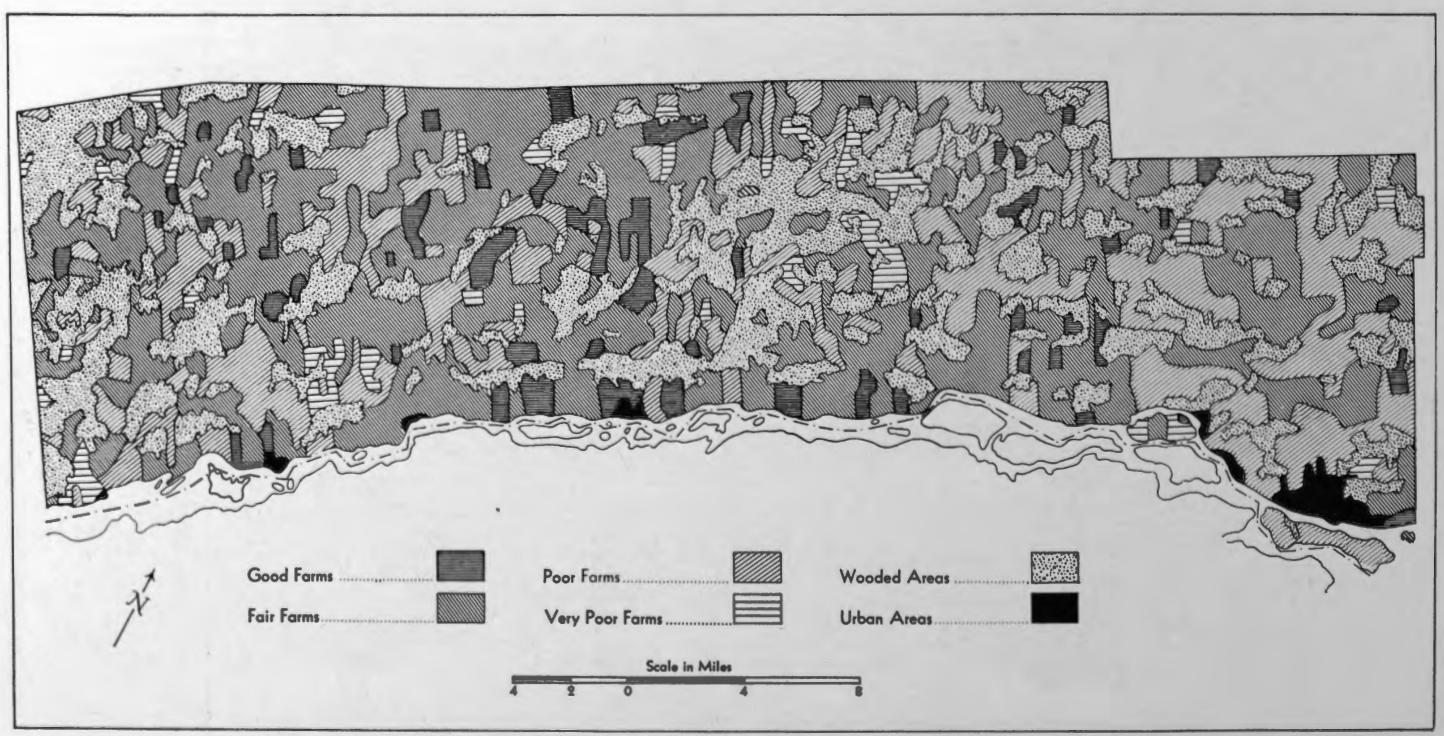

Figure 5. Quality of farms in the International Rapids area.

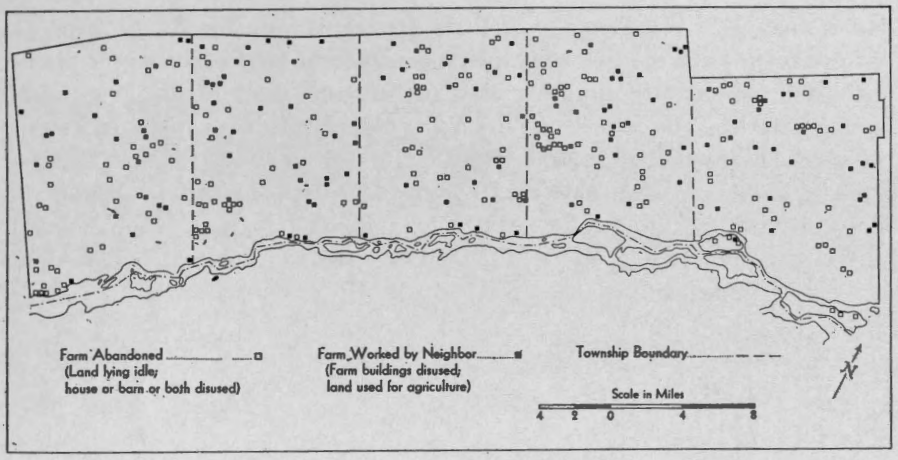

Figure 6. Farm abandonment and farm consolidation in the International Rapids area.

of secondary agricultural activities. There are differences in the extent of farm abandonment and farm consolidation and also in the quality of operating farm units. These differences are summarized regionally in Figure 11 and certain aspects appear statistically in Table 2.

TABLE 2

Agricultural Regions, Statistical Summary

	Total area acres	Percentage of area of townships included in region					Number of occupied farms	Cases of farm consolidation	Abandoned farms
		Edwardsburg	Matilda	Williamsburg	Osnabruck	Cornwall			
1. Dairy and mixed farming	127,500	46	55	21	56	4	952	41	23
2. Marginal dairying	94,000	49	6	52	25	—	425	36	124
3. Dairy and cash grain	24,000	—	19	18	—	—	250	9	6
4. Dairy and orchards	7,000	—	11	—	—	—	56	4	2
5. Riverside diversified region	31,500	5	9	9	16	5	285	9	10
6. Non-intensive dairying	41,500	—	—	—	—	55	253	17	29
7. Cornwall milkshed*	25,000	—	—	—	3	30	195	7	11

*The word 'milkshed' is used in geographical parlance to signify an agricultural area chiefly engaged in supplying fluid milk to an urban community.

AGRICULTURAL REGIONS

The largest single area mapped is that classed as "Dairying and Mixed Farming", and this will be discussed first, not merely for the reason of its size, but because it represents the "normal" agricultural type for the area from which, for various reasons, others have deviated. The region occupies a total of approximately 127,500 acres, or 36 per cent of the area of the

five townships. It extends with little apparent variation in the land use pattern or in farm quality across such contrasting land types as till plains, both well and poorly drained, clay plains, and sand plains (Figure 7). It characterizes, therefore, the high degree of tolerance towards diverse physical conditions that is so typical of the dairy industry within the area under discussion. The only close correlation between soils and land use is seen in the association of very poor drainage and woodland and the practice of leaving old beaches in unimproved pasture. The remaining land is nearly all improved and about 60 per cent is cultivated.

Figure 7. Low cultivated ridge in the dairy and mixed farming region of central Osnabruck township. Some indication of the labour expended on land improvement is given by the number and size of boulders along the boundary of the field.

Twenty-three abandoned farms and forty-one cases of farm consolidation were observed in this region, indicating that in most cases it is worth while to continue working the land even though a farm may no longer be used as a habitation. Actually both figures appear relatively small when compared with the total number of occupied farms, which is 952. Traces of a recent population decline are thus still in evidence but the decline is small and is not accompanied by an appreciable reduction in agricultural production.

Figure 8. Improved pasture on the sand plain in the dairy and mixed farming region of northeastern Edwardsburg township. Note the level terrain and the absence of stones, even along the fence lines. Poorly drained land in the background is in forest.

Turning to the examination of existing farms, we see that most units are classed as "fair" and there are sizable proportions of both "good" and "poor" establishments, but none are "very poor". There is little to suggest, however, any close relation between the variation in farm quality and land types. Some deterioration is noted in the bouldery stretches of ancient beach lines and in places where bedrock is close to the surface, but even here the correlation is far from perfect. Farm quality is more variable within a single land type area than from one such area to another. It appears therefore that human rather than physical conditions are chiefly responsible in this region for the diversity in the size and condition of farm buildings and the intensity of land use.

Even with dairy farming, however, there is a limit to the tolerance of poor edaphic conditions, and within the five townships there is much land that is of distinctly marginal value. Land in this category covers some 94,000 acres, or 26 per cent of the area under discussion, and falls into two major divisions.

The larger of these marginal areas stretches through central and eastern Williamsburg township and extends into Osnabruck. Here, where the till plain lies on both sides of the watershed, swamp reaches its maximum extent, and even though there are numerous low ridges, some of which are not badly drained, these are small and rather isolated (Figure 9). Cultivated land is relatively scarce and most of the cleared area is in pasture, the bulk of which has, however, been improved.

Figure 9. Abandoned land on an island of till surrounded by swamp in southeastern Williamsburg township. This is in the heart of the marginal dairying region, in which over 20 per cent of all farms is abandoned.

The smaller part of the marginal region comprises a discontinuous zone in northern and western Edwardsburg township with some extensions into Matilda. Conditions here are more complex than in the area discussed above. Not only are there many poorly drained sites, including, in the northwest corner of Edwardsburg, the greatest swamp in the five townships, but there are also wide stretches of limestone plain. Furthermore the relatively coarse sand which is common here has in many places been piled up in dunes which, though at present stabilized, represent land of no agricultural value (Figure 10). There are also a number of kames of very limited utility except as sources of sand and gravel. Here again there is relatively little cultivated land and the bulk of the area is in woods or pasture. Much of the pasture lies on limestone plains and has therefore been left unimproved.

Both divisions of this region are marked by extremely high rates of farm abandonment. One hundred and twenty-four abandoned farms were observed along with only 36 cases of farm consolidation, as against a total of 425 occupied farms. The failure of the farmers remaining in the region to avail themselves of such a large unused acreage is an indication of its low productivity. Existing farms are also lower than average in quality. Very few are classed as good, while the region contains almost all of the very poor farms within the five townships. Significantly the road network is also more open here than in any other region. Many road allowances have never been opened up. Others, once developed, have been allowed to fall into disuse.

Figure 10. Sand dune near the northwestern corner of Edwardsburg township in the marginal dairying region. Although cleared and farmed at one time land in this area has now been abandoned.

We next consider two regions in which edaphic and physiographic factors have permitted some diversification of agriculture. In one of these, dairying is supplemented by the production of cash grain, in the other by fruit raising.

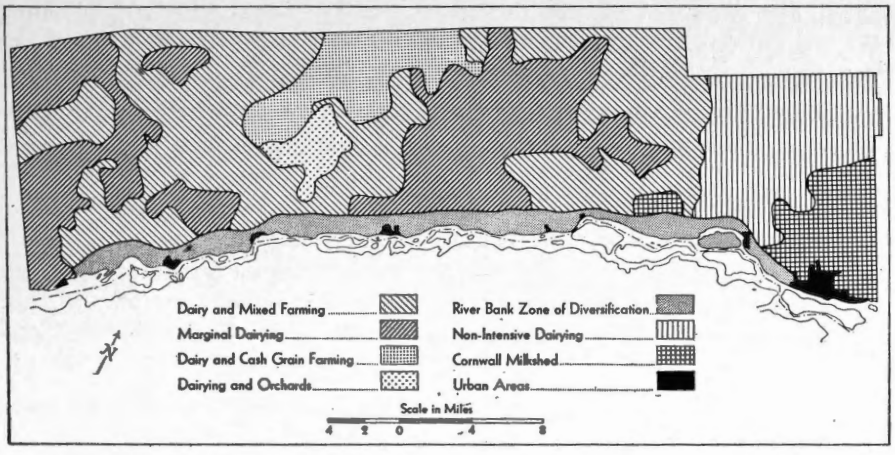

Figure 11. Agricultural regions in the International Rapids area.

The dairy and cash grain region lies in the heart of the clay plains of Matilda and Williamsburg townships, with some overlap into adjacent areas of till that have relatively low relief and into sections of the sand plain underlain by clay at no great depth (Figure 12). The region covers about 24,000 acres, comprising 7 per cent of the area of the five townships.

Figure 12. Cultivated land along the southern border of the clay plain of Matilda township in the dairy and cash grain region. Note the stonefree, imperfectly drained soil. The swamp in the background is not typical of the region as a whole.

Here is found the greatest extent of level, fertile, stone-free land throughout the entire area. Internal drainage is slow, but the stream system is well developed and valleys are clearly incised into the plain, this fact contributing to an acceleration of surface run off during most of the year, though springtime floods are common.

Since virtually the entire region is arable and potentially highly productive it is not surprising that here the percentage of land in cultivation reaches a maximum. There are a few wooded swamps and a few areas in pasture, restricted for the most part to the sides and crests of low drumlins projecting from the clay, but all the pasture is improved and the over-all intensity of land use is very high. More grain can be produced than the farmers of the region require for the feeding of their own cattle, and this is sold to supplement the income derived from the marketing of dairy products.

A total of 250 occupied farms is found in this region, with only nine cases of farm consolidation and six abandoned farms. This is the lowest relative incidence of abandonment and consolidation to be found anywhere within the five townships, a clear testimony to the high productivity of the land. Actually, of the six abandoned farms, five are found on stony till ridges or poorly drained pockets of sand that are not typical of the region. The sixth is on the border of the only large swamp.

Existing farms are well above average in quality, being almost entirely within the categories of "fair" and "good".

Immediately to the south of the region described above, and falling entirely within Matilda is a zone which is characterized by the presence of orchards on a large number of farms. There are even some farms specializing entirely in fruit raising, though the majority depend primarily on dairying. This is the smallest of the agricultural regions, comprising only 7,000 acres, or 2 per cent of the area under investigation.

It will be noted that the dairy and orchard region falls almost entirely within the areas mapped as clay or till plain. Nevertheless, it depends mainly on the presence of sand for its distinctive agricultural complex. The sand represents deposition from the ancient river which also laid down the sand plain immediately to the west, but within this region most of the sand has been removed by run off, leaving only scattered remnants on low heights of land between the drainage channels. Although relief is subdued, it is sufficient to impart relatively good drainage to these sandy knolls, while the presence of a clay substratum prevents the drainage from becoming excessive and helps to raise soil fertility. Edaphic conditions are thus suitable for horticulture, though the low minimum temperatures in winter prevent the successful raising of tree fruit other than apples.

Although orchards serve to differentiate the region from adjacent areas, the land devoted to this use is comparatively limited in extent, as can be seen by referring to Figure 3. The largest acreages are in field crops, pasture, and woodlot. Much of the more poorly drained pasture has been left unimproved.

As in the dairying and cash grain region, cases of farm consolidation and farm abandonment are low, numbering respectively 4 and 2. There are 55 occupied farms, an unusually large proportion of which are of good quality. Some are classed as very poor, but significantly none of these contain orchards. Clearly the greater versatility of the land in this region constitutes a not inconsiderable advantage for agriculture.

The fifth region comprises the shore of the St. Lawrence River. Here the slope of the river bank permits the quick run off of surface water and also contributes to a lowering of the water table. Good air drainage and the proximity of the river act to moderate temperature extremes.

Even more important, perhaps, is the excellent transportation afforded the region, as Ontario Highway No. 2, the main road between Toronto and Montreal, follows the river shore. All the major towns within the five townships are also in this region since they developed originally as transportation centres. In addition, we find here numerous tourist homes and groups of tourist cabins and several hundred summer cottages. In short, a greater diversity of economic activities is seen along the river front than in any other region within the area under investigation.

Agriculture too is varied; among the ubiquitous dairy farms there are several engaged in production of fluid milk for the towns of the region. A large number of farms specialize in apple growing, some in the keeping of

poultry, and a few in vegetable raising. In many cases the farm income is supplemented by the rental of accommodation to the travelling public. Within the area there are also many people, a large proportion of whom are retired, who live here primarily to enjoy the beauty of the scenery and who work their farms largely as a form of recreation.

Because of the diversity of opportunity and the intensity of activity, most of the land is improved and the bulk of it is cultivated. Farm quality is higher than in any other region. Examples of farm consolidation and abandonment are low, numbering respectively 9 and 10, as against 285 occupied farms, most of the abandoned farms lying on the outskirts of towns where the land is being held for speculative purposes.

There can be no doubt that the long-impending threat of submergence associated with the construction of the Seaway has retarded to some extent the development of parts of this area. Nevertheless, the area has a clear relative advantage over most of the other regions contained within the five townships.

It will be noted that the river bank zone of diversified agriculture is not taken to include the shore of the St. Lawrence in eastern Cornwall township, which is urbanized, or the southwestern corner of Edwardsburg, which is a limestone plain of low agricultural value. Altogether the region contains approximately 31,500 acres or 9 per cent of the total area.

The two remaining agricultural regions owe their distinctive character more to cultural than to physical factors. These are the Cornwall township region of non-intensive dairying and the city of Cornwall milkshed.

When the land utilization map of the area is examined, it will immediately be evident that most of Cornwall township falls into a distinct category. This is the only section within the five townships in which unimproved pasture assumes a dominant place in the land use picture. Improved pasture occupies a very limited acreage and cropland occupies a proportionally smaller area in Cornwall than in the other four townships included in this study. Forest is no more abundant than in Edwardsburg, Williamsburg, or Osnabruck, yet closer examination of the distribution of major woodlots fails to reveal the close coincidence between woods on the one hand and areas with very poor drainage or shallow soils on the other that characterizes large wooded sections in the other townships. Evidently there has been less effort expended here than elsewhere in the area under investigation to realize the maximum productivity of each piece of land.

This is not easy to explain. It is true that the till ridges cutting across the northwestern third of the township have been seriously modified by wave action in the Champlain Sea and are now covered with extensive boulder pavements (Figure 13). Also the northeast corner of the township consists of a relatively useless limestone plain. But more favoured areas within the township are also used at a lower level of intensity than

Figure 13. Upper slope of a drumlin of the non-intensive dairying region in the south-western corner of Cornwall township. The extensive boulder pavement was formed during the recession of the Champlain Sea and has discouraged land improvement.

we find in other parts of the five townships, and no strictly physical explanation can account for the abrupt change in the land use pattern that occurs at the Cornwall-Osnabruck township line.

The only additional light that the author can direct upon this problem comes from the history of settlement. Colonization of this part of the St. Lawrence shore was carried out on a township basis, each township being settled originally by folk with a common national or ethnic origin. Matilda and Edwardsburg were settled by Irish, Williamsburg by Germans, Osnabruck by Dutch, and Cornwall by Scots. Is it unreasonable to suppose that the approach taken by these people to their new homelands was influenced by the conditions under which they had formerly lived? The Dutch, particularly, but also the Germans and the Irish, familiar with intensive farming on relatively stone-free land, would attempt to create environments similar to the ones they had left, even at the cost of great labour in the removal of boulders and stumps. The Scots, on the other hand, enured to less favourable conditions and accustomed to eking out a meagre livelihood from thin, stony soils, found in Cornwall township a situation that appeared relatively good. The desirability of land improvement did not seem particularly pressing and less of it was carried out.

Be this as it may, the general level of farm quality is lower here than anywhere else within the five townships. Many of the farmhouses and barns are small log structures dating back to the earliest days of settlement and contrasting strongly with farm buildings in other regions, which are of more recent frame or stone construction.

Farm abandonment in the region is relatively high, though much lower proportionally than in the region classed as marginal. Twenty-nine abandoned farms were counted. Farm consolidation is low, only 17 examples being seen, a further reflection of the low intensity of agriculture in this area. Occupied farms number 253.

An additional characteristic of the region is the incompleteness and openness of the road system. Considerable areas are inaccessible by motor vehicle.

The non-intensive dairying region occupies about 41,500 acres, comprising 12 per cent of the area under investigation.

Out of the region just described has been carved the city of Cornwall milkshed. Over-all control over the shape of this region is exercised chiefly by the factor of accessibility, though the area assumes the form of a semi-circle rather than a complete circle, owing to the obstruction provided to the south by the St. Lawrence River and the international boundary.

The precise position of the boundary, however, and the location of fluid milk farms within the area are not insensitive to physical controls. It will be noted that in the immediate vicinity of the city there are few farms supplying city dairies. Poor drainage and infertile sandy soils have placed this area at a disadvantage despite its proximity to the market. It is thought of more in terms of future urban expansion than present agricultural productivity and five abandoned farms were seen here.

Farther north, in the till and clay plains, soil fertility is higher and fluid milk farms reach their maximum numbers, but the producing area is asymmetrically developed along the axis of the main north-south route leading into Cornwall, with the greater extension to the east of the highway and some overlap into adjacent Charlottenburg township. A major reason for this asymmetry is found in the better drainage to the east where the stream system is well developed. Another factor is the abundance of old beaches and boulder pavements to the west, discouraging intensive land use.

Further illustration of the importance of soil conditions in the location of fluid milk producers is seen in the outlier of the milkshed that falls within the southeast corner of Osnabruck township. This is the section of the well-drained till plain that lies closest to the city of Cornwall in terms of travel time. It is moreover characterized by relatively low relief and by soils of less than average stoniness.

Since cattle producing milk for sale to dairies require more winter feed than any other dairy animals, the Cornwall milkshed contains a higher proportion of land planted to fodder grain than the northern section of the township. Nevertheless the two areas have certain similarities, for in the milkshed as well as in the non-intensive dairy region a large proportion of the pasture is unimproved. This results from the fact that the transition to fluid milk production has been both recent and incomplete.

Seventy-two percent of the operating farms have not changed their earlier method of marketing, and among those which have switched over to production for dairies, many have been unable to effect the land improvement which their intensified activities would appear to justify.

Indeed, when the quality of the farms is examined, one may question whether the change has brought much improvement in the financial position of the farmers. Milk sold to dairies brings a higher price than that sold to cheese factories, but in this area the price differential seems only barely sufficient to cover the greater costs of handling and of maintaining production through the winter months. The 195 occupied farms in this region are no better than the average for the five townships. Most are poor to fair in quality, the only good farms being in the Osnabruck outlier and in a few well-drained sites near the eastern boundary of Cornwall township.

Nevertheless the assured market has kept farm abandonment at a low point. Only six abandoned farms were seen in addition to the five on the outskirts of the city. Seven examples of farm consolidation were noted.

The Cornwall milkshed is 25,000 acres in extent, covering 7 per cent of the area.

THE EFFECTS OF SEAWAY CONSTRUCTION ON AGRICULTURE

The effects of seaway construction upon agriculture within the five townships will be of two kinds, direct and indirect. There will be first of all an absolute loss of farm land by flooding and in the establishment of new townsites, parks, roads, and railways. Secondly there will be an indirect influence to the extent that there are changes in the demand for or the marketing of farm products.

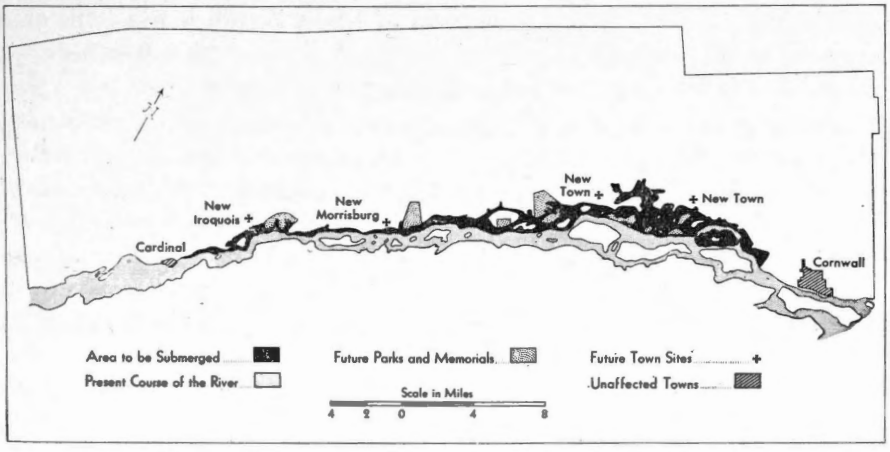

Figure 14. Planning proposals in the International Rapids area.

The extent of farm land to be lost in the initial stages of the project is approximately 18,000 acres. Later, if urban expansion occurs as anticipated, the figure will rise. As it stands, however, it represents the equivalent of 180 farms of average size for the area.

The loss in farmsteads will actually be greater than this number would suggest, since farm buildings are generally close to the river and in many cases lie below the future water level, while more of the farm acreage is on high ground, secure from inundation. This is particularly true to the west of Morrisburg. Altogether approximately 235 farmsteads will be removed or destroyed.

These crude figures, however, do not give a completely true picture, for both land and buildings are well above the average in quality for the area. The river-front region has already been described as one of high agricultural productivity, with a diversity of economic activities sufficient to give its occupants a higher and more certain income than is available farther north. The removal of land from agricultural use here, therefore, represents a greater economic setback to the local municipalities than would the loss of farm production in any other region, with the possible exception of the Dairy and Cash Grain belt.

It will be seen from an examination of Figure 14 that the major loss will be in the area lying east of Morrisburg. Much of the shore here is low and very little if any of the acreage of the river-front farms will escape the rising water. Indeed, the future shore-line near Wales will extend up to 3 miles from the present river bank, submerging a large area of crop land as well as one of the largest chicken hatcheries in eastern Ontario.

In contrast, to the west of Morrisburg, there will be a smaller increase in the water level as the river bank is steeper and higher than in the area discussed above. Hence only sections nearest the St. Lawrence will be submerged. Much of the farm land and, in particular, fully two-thirds of the apple trees along the river will remain. The only extensive flooding west of Morrisburg will be at the town of Iroquois, which was built at a low point along the shore to permit it more readily to carry out its function of a landing point for goods and freight moving upstream.

From the viewpoint of the Canadian economy as a whole, of course, this loss in land and buildings appears almost insignificant. Where agricultural surpluses are more common than shortages, the reduction of the producing areas may even appear economically advantageous. Nevertheless, within the five townships, certain problems are raised. The most evident and perhaps the most pressing of these concerns the farm families that are to be evicted from the homes which they have occupied, in some cases, for over a century. Where can they go?

For farmers in the area west of Morrisburg the problem is not unduly difficult. They will receive compensation for their land and buildings and may move elsewhere to farms of their choice or else retire from agri-

culture altogether. But those who do not desire to leave will find that in most cases the remaining portions of their farms will be sufficiently large to permit continued operation, except where the land has to be taken for some non-agricultural use in connection with the Seaway.

To the east of Morrisburg, on the other hand, the problem becomes more acute, as the situation is less flexible. Here there is no possibility of remaining on the land. All those whose homes are flooded out will have to move. For these people, and they comprise the bulk of the farmers affected, a major relocation is essential.

The question naturally arises as to whether suitable land for resettlement might not be found within the five townships with which we are concerned. It so happens that the number of abandoned farms (205) is nearly equivalent to the number of farm families that will have to move from the river bank area, and this might suggest that a simple transfer would solve the problem. Township population and assessment would be maintained, as well as farm output, at only slightly reduced levels. An inflow of people into thinly settled districts might also help to stabilize the existing population by providing more neighbourly contact and making it economically feasible for the municipalities to maintain roads, schools, and other services now neglected.

Such a solution, however, ignores the fact that in most cases those farms that have been abandoned are on land of marginal quality, requiring heavy expenditures for artificial drainage and fertilizers to make it reasonably productive. Much capital would also be needed to repair or restore houses and barns, and it is not certain that with present world prices for dairy products this capital could be quickly recovered.

Of course, most of the dispossessed farmers will be equipped with capital received as compensation for their property and some will no doubt choose to use it in this fashion. Of those who do many are even likely to succeed, for in dairy farming personal industry and the wise use of one's resources are of greater relative significance than in almost any other form of agriculture. There are numerous examples within the area under investigation of farms that are outstanding for their excellence, yet are on land inherently no better than that associated with typical mediocre establishments.

The key to success under these conditions is energy and determination and enthusiasm for farming, but it is unlikely that the majority of those to be relocated possess all these attributes. Many are young, and for them the glamour and the higher monetary rewards of non-agricultural pursuits will probably offer the greater attraction. Others are elderly, without the vigour necessary to make a new start. Many indeed have already lost sons and daughters from the farm to the city, and welcome the opportunity of being able to retire and live near their children.

65270—7½

It appears then to be inevitable that, with construction of the Seaway, the five townships except Edwardsburg, which is barely affected, will suffer an appreciable loss both in rural assessment and in rural population. Fortunately, however, the removal of a part of the agricultural base will have a negligible effect on farming operations in the remainder of the area. Because of the nearly uniform nature of the farm economy, individual establishments are more often mutually competitive than mutually complementary. The only clear-cut instance of any interdependence of agricultural areas is the transfer of surplus grain from the dairy and cash grain belt to the other agricultural regions, but with local demand normally exceeding local production a reduction in the number of consuming farms poses no problem to this exchange.

The two services essential to the agricultural area, if output is to be maintained, are the provision of various items of equipment and supplies, and of marketing facilities for farm products. The former, in the area under investigation, is essentially a rural-urban relationship which will be threatened only if the towns decline, or lose this particular function, and one can see little likelihood of this coming to pass. Along the St. Lawrence there will be a relocation and a consolidation of urban centres, but the net result should be to strengthen their commercial position, not undermine it.

The marketing of farm products in the five townships is much less closely linked with river-front towns and villages than is the provision of farm supplies. Except in Cornwall, there is no large-scale local consumption of milk, and processing plants tend to be located inland so that they can draw from farms in all directions rather than along the river where no supply from the south is available. Of all the cheese factories in the area, only one lies within the area to be submerged. Another, near Wales, will have to move because it will find itself on a peninsula, in a poor position to act as a collecting point for milk. But with these two exceptions, facilities for the marketing of dairy products will remain intact.

Finally one may consider whether, with increasing urbanization, the demand for fluid milk and vegetables may bring out some modifications in the existing farm economy. Undoubtedly more farmers will switch to the supplying of milk for city dairies, yet, as was seen in the case of Cornwall, this involves merely a change in the form of marketing. There is little reflection in the land use picture other than a slight increase in the proportion of crop land, and no striking rise in prosperity is likely to result. The advantages for the farmer in changing his outlet lie more in increased security than in increased income.

For market gardens also the future is not particularly promising, as the poorly drained, heavy soils do not lend themselves readily to vege-

table production. It is surprising to note how few and scattered are the market gardens even around the city of Cornwall, despite a demand far greater than will exist for decades in other towns of the area. Nevertheless, between Iroquois and Morrisburg there are a number of hummocks of well-drained sands and sandy loams, now largely in orchards, that could just as well produce vegetables and would undoubtedly bring in larger profits if devoted to the latter use, provided that local labour and markets were available. It is significant that most of the farms that now specialize in market gardening are of exceptionally high quality.

CONCLUSION

Within the townships of Edwardsburg, Matilda, Williamsburg, Osnabruck, and Cornwall, agriculture is broadly homogeneous with a general emphasis on dairying. Some differentiation is seen, based partly on soils and physiography, partly on historical factors and partly on proximity to the city of Cornwall and to Provincial Highway No. 2, which follows the St. Lawrence River. However, there is little areal interdependence within the area except on a rural-urban basis, the most important example being the provision of fluid milk for Cornwall.

Removal from agricultural production of some 18,000 acres, most of which lies outside the Cornwall milkshed, and the relocation of several towns and villages will therefore have a negligible effect on the over-all organization of the farm economy. Reoccupation of abandoned farm land is not likely to take place on any large scale. The chief impact of the agricultural changes upon local municipalities will therefore lie in the reduction of rural assessment.

Although the five townships may suffer some economic setback in the period immediately following the submergence of much of their present river frontage, completion of the St. Lawrence Seaway and Power Project will bring to the area industrial advantages which, accompanied by the termination of half a century of uncertainty, should stimulate a great increase in manufacturing and a consequent spread of urbanism.[1] The modified shoreline will also prove much more suitable for recreation than the present one, and development in this direction may be expected.[2] Consequently the townships of Edwardsburg, Matilda, Williamsburg, Osnabruck, and Cornwall, although they will see their agricultural role slightly diminished, should also witness an over-all diversification and quickening of their economies more than compensating for any loss suffered and ushering in an era of general prosperity far beyond anything that exists today.

[1] Wood, H. A.: The St. Lawrence Seaway and Urban Geography, Cornwall-Cardinal, Ont.; Geographical Review, vol. XLV, October, 1955, pp. 509-530.

[2] Wood, H. A.: Recreational Land Use Planning in the St. Lawrence Seaway Area, Ontario; Community Planning Review, vol. V, March, 1955, pp. 23-30.

RÉSUMÉ

L'auteur étudie d'abord la géographie agricole de cinq cantons ontariens: Edwardsburg, Matilda, Williamsburg, Osnabruk et Cornwall, qui seront directement touchés par les travaux de canalisation et d'aménagement hydraulique du Saint-Laurent. Il discute ensuite de l'effet de ces travaux sur l'agriculture de la région.

Au point de vue physiographique, il s'agit d'une région faiblement ondulée, où le drainage est généralement mal assuré; la texture des sols est très variée, allant du gravier à l'argile avec de grandes étendues recouvertes de marécages ou de cailloux. Le climat est frais et humide; les minima d'hiver sont bas et le printemps est tardif.

Au point de vue agricole, toute la région est spécialisée dans l'industrie laitière, principalement dans la production du fromage, bien qu'il y ait quelques différentiations régionales. Vingt-six pour cent de la région a une valeur agricole "marginale" et renferme un grand nombre de fermes abandonnées. D'autre part, la productivité est passablement plus élevée que la moyenne dans quelques secteurs. Sept pour cent de la superficie est consacré à l'industrie laitière combinée à la production de grains pour la vente tandis que 2 p. 100 allie des cultures fruitières à l'industrie laitière. Le bord du fleuve, représentant 9 p. 100 de l'étendue totale des cinq cantons, a une agriculture encore plus variée et qui ne représente qu'une partie des nombreuses activités économiques de ce secteur.

Sur 12 p. 100 de la superficie, entièrement compris dans le canton Cornwall, la mise en valeur du sol est remarquablement peu avancée par suite de facteurs physiques et historiques. L'approvisionnement en lait de la ville de Cornwall se fait dans un secteur qui représente 7 p. 100 de la superficie des cinq cantons, bien que même à l'intérieur de ce secteur trois quarts des fermes en opération trouvent leur principal débouché dans les fromageries.

Par suite de la canalisation et de l'expansion qu'elle provoquera dans le territoire urbain et celui consacré aux divertissements, environ 18,000 acres seront soustraits à l'agriculture et 235 fermes devront être abondonnées. Plusieurs des meilleures fermes vont être ainsi affectées mais, par suite du faible degré d'interdépendance régionale, on ne prévoit pas une désorganisation de l'économie agricole.

Quelques-unes des personnes déplacées pourront s'établir sur des fermes, actuellement inoccupées, dans un secteur situé au centre et au nord des cinq cantons; mais la plupart vont probablement abandonner leurs occupations agricoles. En conséquence, il y aura d'abord une perte dans la population rurale ainsi que sa répartition mais qui sera éventuellement compensée par un accroissement dans d'autres activités économiques.

MAP NOTES

Canada. 1:6,336,000 ou 100 milles au pouce. Canada, Ministère des Mines et des Relevés techniques, Division des levés et de la cartographie, Ottawa, 1955. Prix 50 cents.

C'est l'édition française de la carte du Canada à la même échelle publiée en 1951 et revisée en 1953 (*voir* 'Geographical Bulletin' n° 4). Imprimée en sept couleurs, cette carte donne la nomenclature officielle française de tout ce qu'elle représente.

[E.L.B.]

Canada, Régions Polaires et Extrême-Nord Soviétique. 1:12,000,000. France, Direction de la Documentation, Paris, 1954.

Cette carte, construite sur une projection polaire, montre le Canada et le nord de la Russie. Différents symboles indiquent les ressources naturelles et économiques les plus importantes. Le réseau de voies aériennes et maritimes qui relie le Canada avec les autres pays est aussi indiqué. Un carton à l'échelle de 1:5,000,000 montre les régions industrielles les plus importantes du sud des provinces d'Ontario et de Québec.

[E.L.B.]

Economic Classification of Land Based on Suitability for Wheat Production (2 sheets) *Eastern and Western Saskatchewan.* 1:380,160. Canada, Dept. of Agri., Econ. Div., in cooperation with the University of Saskatchewan, 1953-54.

Both maps show the potential annual production of wheat for sale on an average per quarter section from less than 350 to over 900 bushels as well as on the long-term averages per acre arranged by land classes.

[E.L.B.]

Southwestern British Columbia. 1:6,336,000. British Columbia, Dept. of Lands and Forests, Surveys and Mapping Br., Victoria, 1955. Price 35 cents per sheet.

This sheet, the second of a new series is published in three different formats. One sheet indicates landforms by means of brown shading and gives principal elevations. A second sheet omits physical features but gives cultural details. The third sheet is a composite of the others with physical features indicated by grey shading.

[E.L.B.]

New Brunswick. 1:500,000. Canada, Department of Mines and Technical Surveys, Surveys and Mapping Branch, Ottawa, 1955.

Based on a transverse mercator projection with central meridian at 66 30′, this new map shows in detail the road and rail networks. Parish and county boundaries are indicated in addition to parks and Indian reservations.

Geological Map of Canada. 1:7,603,200. Canada, Department of Mines and Technical Surveys, Geological Survey of Canada. Map No. 1045A. Ottawa, 1955.

This most recent geological map represents the latest available geological data derived from published and unpublished maps and reports of the Geological Survey of Canada, the provincial Departments of Mines, mining companies and other sources. The legend indicates the different formations of sedimentary and volcanic rocks as well as intrusive rocks.

[E.L.B.]

BOOK NOTES

THE BOUNDARIES OF CANADA, ITS PROVINCES AND TERRITORIES. By Norman L. Nicholson. Canada, Dept. of Mines and Tech. Surv., Geog. Br., Mem. 2, Ottawa 1954; 142 pp.; maps; illus; biblio. Price 75 cents.

This memoir is a geographical appreciation of the historical, political, and economic factors associated with the location of Canada's boundaries. The main emphasis of the study is on provincial and territorial boundaries. The author discusses the influence of terrain on the actual location of the boundaries, and analyses the influence of their location on regional economy. The process of boundary demarcation and administration is described and illustrated. The memoir includes a series of sketch maps on the evolution of the country and its boundaries.

[B.V.G.]

A REVIEW OF CANADIAN OCEANOGRAPHY. By H. B. Hachey, J. P. Tully, H. J. McLellan *et al.* Joint Committee on Oceanography, Nanaimo, St. Andrews, and Dartmouth, 1954; 46 pp.; 16 pp. biblio.; maps.

This report discusses Canadian oceanography under three sections:—General Review, Oceanography on Canada's Pacific Coast, and Oceanography on Canada's East Coast. The first part is a discussion of oceanographic research facilities and the activities of allied organizations. Parts 2 and 3 give a general treatment of physical conditions on each of the two coasts and also provide an outline of the functions of the Pacific and Atlantic oceanographic groups.

[W.A.B.]

A SELECTED LIST OF PERIODICAL LITERATURE ON TOPICS RELATED TO CANADIAN GEOGRAPHY FOR THE PERIOD 1930-1939. Canada, Dept. of Mines and Tech. Surv., Geog. Br., Biblio. Ser. No. 11, Ottawa 1954; 97 pp.; mimeo.

This aid to geographical research lists items according to Canada as a whole, the sections of Canada, the individual provinces, and under special topics such as the Great Lakes-St. Lawrence Seaway.

[B.V.G.]

CANADIAN URBAN GEOGRAPHY. Canada, Dept. of Mines and Tech. Surv., Geog. Br., Biblio. Ser. No. 13, Ottawa 1954; 80 pp. Price 50 cents.

The object of this bibliography is to present information on publications concerned with the planning and development of settlements across Canada. Communities are listed alphabetically and general studies are arranged by provinces or under Canada as a whole. The bibliography includes a short section on ports and an appendix giving references to publications of Canadian origin on methodology and concept of urban geography.

[B.V.G.]

SELECTED BIBLIOGRAPHY OF CANADIAN GEOGRAPHY WITH IMPRINT 1953. Canada, Dept. of Mines and Tech. Surv., Geog. Br., Biblio. Ser. No. 14, Ottawa 1955; 61 pp. Price 50 cents.

This bibliography lists, under ten subjects, publications on Canadian Geography for the year 1953. The items are presented under Canada as a whole, the sections of Canada, the individual provinces and territories.

[B.V.G.]

THE HORIZONTAL DISTRIBUTION OF TEMPERATURES AND SALINITIES OFF THE CANADIAN ATLANTIC COAST. By W. B. Bailey, W. Templeman, and R. P. Hunt. Joint Committee on Oceanography, St. Andrews, N.B., 1954; 21 pp.; 16 maps; biblio.

This report is the first over-all appraisal of the temperature and salinity characteristics of the Canadian Atlantic Coast, from the Bay of Fundy to Davis Strait.

[W.A.B.]

TEMPERATURE AND SALINITY DISTRIBUTION OF THE WATERS OF THE LAURENTIAN CHANNEL. By the Atlantic oceanographic group. Joint Committee on Oceanography, St. Andrews, N.B., 1954; 3 pp.; 3 tables; 34 graphs; biblio.

This report brings together in graphical form the unreported data up to 1952. It was prepared to show the vertical distribution of temperature and salinity by sections across the Laurentian Channel from Cabot Strait to Anticosti Island.

[W.A.B.]

THE CONTINENTAL SHELF FROM LABRADOR TO CAPE COD. By H. B. Hachey. Joint Committee on Oceanography, St. Andrews, N.B., 1954; 5 pp.; map; biblio.

The similarities and differences of the various banks that comprise the continental shelf off the east coast of Canada are briefly described in this report.

[W.A.B.]

COBALT IN CANADA. By R. J. Jones. Dept. of Mines and Tech. Surv., Mines Br., Ottawa 1954; 96 pp.; maps; charts; graphs; diagrams; photos; tables. Price $1.50.

This report constitutes the first comprehensive study of the mining, marketing, and uses of cobalt in Canada. It commences with a short but fairly complete history of cobalt mining, the influence of World Wars I and II upon the production and manufacture of the mineral in Canada, and the agreements formed between various companies to control the marketing of it. The report goes on with a description of cobalt and its ores and minerals, the mining districts and companies most concerned with its production both in Canada and other parts of the world, and its increasing use for both civil and military purposes.

[N.L.N.]

CONTRIBUTIONS TO THE ECONOMIC GEOLOGY OF WESTERN NEWFOUNDLAND. By Helgi Johnson *et al.* Canada, Dept. of Mines and Tech. Surv., Geol. Surv., Bull. 27, Ottawa 1954; 65 pp.; diagrams; tables; illus. Price 50 cents.

This report discusses the occurrences of four metallic or industrial minerals in three separate areas in western Newfoundland, centering about St. Georges Bay. The minerals concerned are the strontium deposits of Port au Port Peninsula, the magnetite and gypsum deposits of the Sheep Brook area, and the iron deposits at Indian Head. The report includes notes on four other mineral deposits at Indian Head, and is well-documented with tables, diagrams and selected bibliographies for each of the principal occurrences.

[B.V.G.]

RECLAMATION OF DYKELANDS IN THE MARITIMES, 1913-52. By W. W. Baird. Canada, Dept. of Agri., Exptl. Farms Serv., Nappan, N.S., 1954; 63 pp.; tables; illus.

This gives a brief account of the history, organization, and early utilization of dykelands in the Maritime Provinces, followed by a detailed discussion of the steps taken and the programs devised to rehabilitate the once valuable dykelands.

The main part of the report is concerned with work on the experimental farm at Nappan which includes soil analysis, fertilizer studies, crop rotations, drainage, and various problems of construction. The study ends with a pictorial account of the construction of the Habitant Aboiteau at Canning, Nova Scotia.

A varied selection of photographs illustrates the text.

[M.R.D.]

SOIL SURVEY OF ANTIGONISH COUNTY, NOVA SCOTIA. By D. B. Cann and J. D. Hilchey. Canada, Dept. of Agri., and Nova Scotia Dept. of Agri. Rept. No. 6, Truro 1954; 54 pp.; illus.; tables; graphs; map.

This report is the sixth of a series of soil survey reports providing, on a county basis, fundamental knowledge of the soils of Nova Scotia. The first part is a general description of the county and deals with such topics as population, racial origin, transportation, markets, and industries. The second part discusses the various factors affecting soil formation and is followed, in part three, by a classification and description of soils. The latter section of the report is an account of early and present agriculture, with a division into land use classes of all the soils in the county, according to their suitability for commonly-grown crops.

The soil map, on a scale of 2 miles to 1 inch, shows the distribution of the different soils that are described as to profile, parent material, topography, present land use, and land use capability.

[M.R.D.]

DESCRIPTION DE LA CULTURE DE L'ÎLE VERTE. Par Marcel Rioux, Musée national du Canada, Ministère du Nord canadien et des Ressources nationales, Bull. n° 133, Ottawa, 1954; 98 pages; illus.

Cette étude est la première d'une série de monographies sur la culture canadienne d'expression française. Les habitants de l'île Verte—située dans l'estuaire du Saint-Laurent près de l'embouchure du Saguenay—permettent d'étudier les éléments les plus simples et les plus archaïques de cette culture.

La monographie se divise en trois parties: milieu physique et démographie, économie et culture technique et culture non technique. Cette dernière partie décrit la famille, le langage, la propriété, le gouvernement, les relations avec l'extérieur, les relations sexuelles, les loisirs, le cycle de la vie, la maladie et la religion. Quelques appendices sur les jeux de société, le folklore et la psychologie complètent la monographie.

[P.C.]

SOIL SURVEY OF BRUCE COUNTY. By D. W. Hoffman and N. R. Richards. Ontario Soil Surv. Rept. 16. 110 pp.; tables; illus.; map.

SOIL SURVEY OF GREY COUNTY. By J. E. Gillespie and N. R. Richards. Ontario Soil Surv. Rept. 17. 79 pp.; tables; illus.; map.

SOIL SURVEY OF STORMONT COUNTY. By B. C. Mathews and N. R. Richards. Ontario Soil Surv. Rept. 20. 72 pp.; tables; illus.; map. Canada, Dept. Agr., Exptl. Farms Serv. and Ont. Agr. Coll., Guelph, 1954.

A descriptive section on the location, area, population, and transportation of each of these counties is followed by a description of the factors that affect the formation of their soils, including parent material, natural forest vegetation, climate, relief, drainage, age, and erosion. The three distinct profiles of the Great Soil Group (Grey Brown Podsolic; Brown Forest; Dark Grey Gleisolic) within these areas are presented, and each soil type is described in detail. The description deals with the physical characteristics of the soil and discusses its use, fertility, and adaptabilty to crop production. The 1 inch to 1 mile soil map for each county indicates the location and extent of the different soils and shows adequate cultural features.

[S.S.B.]

INDUSTRIAL WATER RESOURCES OF CANADA—UPPER ST. LAWRENCE-CENTRAL GREAT LAKES DRAINAGE BASIN IN CANADA. By J. F. J. Thomas. Canada, Dept. of Mines and Tech. Surv., Mines Br., Water Surv. Rept. No. 3, Ottawa 1954; 212 pp.; tables; map; append.

From studies carried out between 1948 and 1952, this report gives in detail the chemical quality of waters available for industrial use in southern Ontario, exclusive of the basins of the Ottawa and French Rivers. After an introduction that defines the areas and methods of survey and includes general data on lake levels and water temperatures, Part I deals with the chemical quality of surface waters in the areas. Graphs showing the relationship between discharge in major rivers and mineral content are given for selected locations. Part II describes municipal waterworks systems in the area with regard to sources, ownership, treatment, storage capacity, consumption, industrial uses, and chemical analyses of raw and finished water.

[J.L.]

FACTS ABOUT FLIN FLON, THE PAS. Manitoba Dept. of Industry and Commerce, Winnipeg 1954; maps; tables; photos; graphs.

These two booklets are part of the series concerning incorporated towns and cities of Manitoba which was noted in Geographical Bulletin No. 6. Each booklet incorporates facts about the history, natural resources, industry, population, labour, public services, and living conditions of the settlement concerned.

[N.L.N.]

INDUSTRIAL RESOURCES OF MANITOBA. R. E. Grose (editor). Manitoba Dept. of Industry and Commerce, 1954.

Trends of economic development are revealed in this study of the Industrial Resources of the Province of Manitoba. The report presents the economic position of Manitoba from the provincial viewpoint, bringing together comprehensive factual economic information and thus providing a unified source of basic information on the province's economic structure.

[J.M.]

FOREST RESOURCES OF THE CUMBERLAND LAKE-FLIN FLON AREA OF SASKATCHEWAN. Forest Inventory Series, Rept. No. 4, Dept. of Natural Resources, Saskatchewan, Forestry Br., Regina 1955.

This is the fourth in a series of reports giving statistics of forest inventory surveys begun in 1947 by the Saskatchewan Department of Natural Resources. This report covers 2.1 million acres in the Cumberland Lake-Flin Flon area and is a compilation and analysis of the statistical data obtained through combined aerial photo-interpretation and ground sampling. It gives particulars of the present cut and discusses the possibility of an increase, particularly from a pulpwood standpoint.

Notes on the general geography of the area and a brief history are included.

[N.L.N.]

SASKATCHEWAN'S FORESTS. A report prepared by the Dept. of Natural Resources, Saskatchewan, 1955.

During the early 1940's, the cut of white spruce and jack pine saw-timber in Saskatchewan rose to an extremely high level. In 1947 the provincial department of Natural Resources began an inventory of forest resources in order to appraise the existing situation and to establish a policy for future management and utilization. A summary of the data obtained is presented in this report, which deals with the accessible commercial forests of the province, that is, the area south of 55 degrees north latitude.

The report covers vegetation zones, the physical features of the commercial forest area, forest resource statistics, the administration program, and existing forest industries. The portion dealing with the climate of the commercial forest area was prepared with the assistance of Dr. D. P. Kerr of the Department of Geography in the University of Toronto and is discussed in relation to Thornthwaite's climatic classification. In summary, the inventory studies show that the province has extensive forest reserves which are suitable for wood-processing industries, and especially for pulp and paper operations.

[J.G.]

SOIL SURVEY OF THE EXPERIMENTAL STATION AND SUBSTATIONS OF THE CANADA DEPARTMENT OF AGRICULTURE IN SASKATCHEWAN. By J. S. Clayton and J. G. Ellis. Sask. Soil Surv., 1952; maps; tables.

The soil survey of the experimental farms and substations in the province was begun in 1939 and continued, with some interruption, until 1949 when reconnaissance surveys of all active illustration stations and substations were completed. This report is an appraisal of soils on the 43 stations in relation to the soils in the surrounding districts and in the province generally.

Tables at the beginning and at the end of the report present, in detail, the form and content of individual soil reports, the system of topography classification, the key to zonal and soil group profiles, the principal genetic soil profiles, soil climatic zones, and finally an analysis of cultivated surface soil samples from all stations.

Soil maps showing the major basis of classification, as well as soil textures, profiles, and topographic characteristics for each individual unit are submitted, together with a report in tabular form for comparison and uniformity.

A comprehensive review of the application of soil surveys to agricultural programs in Saskatchewan, including the steps by which maximum use may be made of the soil information, ends the report.

[M.R.D.]

POST-WAR SETTLEMENT OF VETERANS IN ALBERTA. By R. A. Benedict. Canada, Dept. of Agri., Econ. Div., Mark. Serv., Ottawa 1954; 26 pp.; tables.

The report describes the financial progress made by a group of World War II veterans established on farms under the Veterans' Land Act in west central, central, and southwestern Alberta. Within the three distinct farming areas comparisons between individual farms are drawn up to show differences in net worth, farm capital, farm income, and other financial factors.

[M.R.D.]

BRITISH COLUMBIA GEOGRAPHY MANUAL. British Columbia, Dept. of Educ., Victoria 1954; 119 pp.; maps; tables.

The material for this book was prepared originally in 1952 by a workshop of social studies and geography teachers at the University of British Columbia. The final draft was written by Professors J. L. Robinson and J. D. Chapman of the Geography Division of the University. It presents factual information about the Province to assist in obtaining a better understanding of its history, physical setting, and present resources and contains a series of questions at the end of each chapter which may be used to test this understanding. The 29 clearly drawn maps are on different scales, so that the reader may adjust his ideas of distance and relative position.

The manual is divided into three parts: Physical Geography, Human and Economic Geography, and Regional Geography. It contains many statistical facts to support the general statements and principles set forth in the text and many references have been listed at the end of each chapter.

[N.L.N.]

INDUSTRIAL WATER RESOURCES OF CANADA—FRASER RIVER DRAINAGE BASIN, 1950-51. Canada, Dept. of Mines and Tech. Surv., Mines Br., Water Surv. Rept. No. 6, Ottawa 1954; 87 pp.; maps; tables; graphs.

This report is the sixth in a series on the chemical quality of surface and municipal water supplies available for industrial and domestic use in Canada. The greater part of the report consists of a statistical treatment of the chemical analysis of surface waters in the area. Other sections deal with municipal waterworks systems and a chemical analysis of civic water supplies.

[B.C.]

WATER POWERS. British Columbia, Dept. of Lands and Forests, Water Rights Br., Victoria 1954; 182 pp.; maps; photos; tables; graphs.

The purpose of this publication is to present a compendium of the Province's developed and undeveloped water powers. These are discussed according to the seven areas into which the Province was divided for convenience: Vancouver Island, Fraser River below Lytton, Fraser River above Lytton, Columbia River, Interior-Coastal, Coastal, Northern.

[H.I.]

SOIL SURVEY OF THE QUESNEL, NECHAKO, FRANÇOIS LAKE AND BULKLEY-TERRACE AREAS. By L. Farstad and D. G. Laird. Canada, Dept. of Agri., Exptl. Farms Serv., Ottawa 1954; 88 pp.; maps; photos; tables; diagrams.

This is the second of a series of soil surveys covering the central interior of British Columbia and the fourth dealing with the soils of the province. It contains a brief description of the areas (including topography, geology, drainage, climate, native vegetation, natural resources, transportation and marketing facilities, history, and development) in addition to a description of the major soil groups and soil types. The report concludes with a discussion of agricultural problems and the chemical characteristics of the more important soil types. In addition, there is a list of references and a glossary of terms.

[D.F.P.]

TRANSACTIONS OF THE SEVENTH BRITISH COLUMBIA NATURAL RESOURCES CONFERENCE. The British Columbia Natural Resources Conference, Victoria 1954; 334 pp.; maps; tables.

For the seventh successive year representatives of industry, government, and the University of British Columbia met to discuss the resources of British Columbia. The transactions consist of reports and discussions on fisheries, water, soil and agriculture, forestry, mining, the B.C. Research Council, wild life, people and recreation, power and energy, and pollution, all guided by the theme "The value of survey and research in resource development". The highlight of the conference was a banquet address "Human resources—the international viewpoint" by Dr. Brock Chisholm.

[B.C.]

ÓKANAGAN, SIMILKAMEEN, AND KETTLE VALLEYS, REGIONAL STATISTICS. 31 pp.; map; tables. WEST KOOTENAY, REGIONAL STATISTICS. 31 pp.; map; tables. EAST KOOTENAY, REGIONAL STATISTICS. 27 pp.; map; tables. British Columbia, Dept. of Trade and Industry, Bur. Econ. and Stat., Victoria 1954.

The purpose of these pamphlets is ". . . to provide, in summary form, some of the pertinent statistics . . ." of each of the areas. This is achieved through short, descriptive notes and statistical tables dealing with population, labour force, employment and earnings, households, dwellings and families, agriculture, and retail and wholesale trade.

[B.C.]

SOME ASPECTS OF THE CANADIAN IRON AND STEEL INDUSTRY WITH PARTICULAR REFERENCE TO BRITISH COLUMBIA. British Columbia Research Council, Vancouver 1954; 86 pp.; illus.; maps; tables; biblio.; append.

The scope of this report has been extended beyond its original limits of a re-examination of the commercial possibility of pig-iron production in British Columbia. The extension has included a survey of the industry in Canada plus a supplement to the report entitled "A brief review of the iron and steel industry in the Pacific countries". Both sections contain maps and detailed statistical tables.

[B.C.]

PHYSICAL AND CHEMICAL DATA RECORD, HECATE PROJECT 1954, QUEEN CHARLOTTE SOUND, HECATE STRAIT, DIXON ENTRANCE. 99 pp. mimeo.; maps. DATA RECORD CURRENT MEASUREMENTS, HECATE PROJECT 1954, QUEEN CHARLOTTE SOUND, HECATE STRAIT, DIXON ENTRANCE. 74 pp., mimeo.; map. Pacific Oceanographic Group, Joint Committee on Oceanography, Nanaimo, B.C., 1955.

The data for these publications were obtained during the 1954 cruises of the Pacific Oceanographic Group, in Queen Charlotte Sound, Hecate Strait, and Dixon Entrance aboard H.M.C.S. *Cedarwood* and C.N.A.V. *Ehkoli*.

The physical and chemical data consist of meteorological observations, water temperatures, salinity and oxygen content at standard depths, Secchi disc readings, and bottom samples. Observations were made between May 3 and December 7, 1954.

The current measurements are divided into two main divisions: Ekman current meter observations and current drag observations. Data consist of depth, speed, and direction of current as well as speed and direction of wind. Each period of observation usually extends over four tidal cycles (50 hours), there being eight such periods between May 19 and September 7, 1954. The data are presented as observed and are not adjusted or interpreted.

[G.F.]

THE CAPITAL REGION TAKES STOCK. By J. W. Wilson. Capital Region Plan. Bd. of B.C., Victoria 1954; 64 pp.; maps.

The Capital Region Planning Board was established in 1951 to prepare plans for the physical development of an area of approximately 16 square miles, including the city of Victoria and adjoining municipalities. In this report a brief outline of the history, population, land use, economic resources, transportation, and administration of the region is presented with the aid of a number of lucid diagrams and maps. The report concludes with a series of recommendations for the future development of this fast-growing area.

[C.W.R.]

THE GREATER VANCOUVER METROPOLITAN COMMUNITY. A PRELIMINARY FACTUAL STUDY. The Lower Mainland Regional Plan. Bd. of B.C. New Westminster 1954; 35 pp.; maps; illus.

The Lower Mainland Regional Planning Area includes the municipalities and unorganized areas of the Lower Fraser Valley. By far the most populous part of the region is the Greater Vancouver area, which contains approximately half a million people. In this report a case is made for the integration of the various municipalities of Greater Vancouver under some form of metropolitan government. It is shown that metropolitan problems already exist and are bound to increase with the immense rise in population predicted for the area during the next 50 years.

[C.W.R.]

VANTA KUTCHIN. By Douglas Leechman. Canada, Dept. of North. Aff. and Nat. Res., Nat. Parks Br., Nat. Mus., Canada, Bull. No. 130, Ottawa 1954; 35 pp.; sketches; photos; biblio. Price $1.

This publication is an account of the Vanta Kutchin, "the people of the lakes", a group that occupies the village of Old Crow on the Porcupine River in the northern Yukon. This summary presents general information related to the cultural aspects of the people, the principal informants being the various occupants of the village.

After a brief description of the locale and the people, the author deals with methods of gaining a living, material culture, and social organization of the group. As archaeological research was the author's primary objective, the book is not a complete account of the culture of the Vanta Kutchin. It is, rather, a presentation of the accumulated data under various cultural headings.

[R.T.]

WATERFOWL AND OTHER ORNITHOLOGICAL INVESTIGATIONS IN YUKON TERRITORY, CANADA, 1950. By J. Dewey Soper. Canada, Dept. of North. Aff. and Nat. Res., Nat. Parks Br., Wildlife Serv., Wildlife Management Bull., Series 2, No. 7, 1954; map; photos; tables.

This is a compilation of material on the waterfowl and other birds of the Yukon. The text is supplemented by tables, pictures, and a map at the back of the book.

[J.N.]

FLORA FAUNA, AND GEOLOGY OF THE NORTHWEST TERRITORIES. Canada, Dept. of North. Aff. and Nat. Res., North. Admin. and Lands Br., Ottawa 1954; 35 pp.; maps; illus. Price 15 cents.

This pamphlet is one in a series describing the administration, industries, transportation, and natives of the Northwest Territories first noted in Geographical Bulletin No. 6. In this one the natural resources, their occurrence and importance, mainly to the natives, are discussed and the geology and the climate are described.

[A.K.]

THE NORTHWESTERN MUSKRAT OF THE MACKENZIE DELTA, NORTHWEST TERRITORIES. By W. E. Stevens. Canada, Dept. of North. Aff., and Nat. Res., Nat. Parks Br., Wildlife Serv., Wildlife Management Bull., Series 1, No. 8, 1953; map; photos; tables.

A bulletin on the muskrat, the most important fur-bearing animal of the Mackenzie Delta. The information is obtained from the 1947 survey, based on five widely separated study areas. The tables, pictures, and a map at the back of the book supplement the written material.

[J.N.]

FORT SIMPSON, N.W.T., DOMINION EXPERIMENTAL SUBSTATION, PROGRESS REPORT, 1947-1953. Canada, Dept. of Agri., Exptl. Farm Serv., Ottawa 1954.

The Dominion Experimental Substation at Fort Simpson, N.W.T., was established in 1947 to explore the agricultural potential in the District of Mackenzie. In this report the geographical conditions of the Mackenzie River Basin are described, and temperature, precipitation, and frost data for Northwest Canada are noted.

Owing to the increasing interest in horticulture, special attention is given to gardening practices; fertilizers, irrigation, wind protection, and insect pests are discussed. Tests of grain growing showed satisfactory results, the wheat having an excellent baking quality. The need for better strains and varieties of crops is recognized.

[A.K.]

A PRELIMINARY STUDY OF THE MUSK-OXEN OF FOSHEIM PENINSULA, ELLESMERE ISLAND, N.W.T. By J. S. Tener. Canada, Dept of North. Aff. and Nat. Res., Nat. Parks Br., Wildlife Serv., Wildlife Management Bull., Series 1, No. 9, 1954; photos; map; tables.

A discussion of the musk-oxen in the study area based on past and present investigations. The last part of the paper supplements the text by tables, a map, and pictures.

[J.N.]

GEOGRAPHICAL DISCOVERY AND EXPLORATION IN THE QUEEN ELIZABETH ISLANDS. By Andrew Taylor. Canada, Department of Mines and Technical Surveys, Geog. Br., Mem. 3, Ottawa, 1955; 172 pp., maps, illus., biblio., index. Price $1.00.

A systematic and comprehensive account of land and sea exploration in the Queen Elizabeth Islands is presented in this memoir, and covers the period up to the voyage through the Northwest Passage by the R.C.M.P. schooner "St. Roch" in the summer of 1944.

The work is organized in general chronological sequence but chapter divisions are based upon the major emphasis of expeditions at specific periods. There is, for example, a chapter devoted to the numerous voyages in search of Sir John Franklin between 1848 and 1859. Another chapter covers attempts to reach the North Pole from 1860 until the final successful expedition of 1909. British and foreign expeditions in the post-Franklin period and Canadian expeditions after 1903 are discussed in separate chapters.

Within each chapter major expeditions, named generally for the commander, are treated chronologically. A general account of the objectives, routes followed, and contributions of each group is included. In addition, the author has included a great deal of information about the methods and difficulties of polar exploration.

Of particular value is the bibliography containing over 700 entries. Thirty-seven maps show the sea voyages and sledge journeys made by members of the more important groups.

[V.W.S.]

EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1956