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THE SHIPPING TRADE OF THE ISLAND OF NEWFOUNDLAND

*Charles N. Forward**

The vital role played by the shipping trade in the Newfoundland economy has been emphasized by problems that have arisen during recent years. Since Newfoundland is an island, all commodities entering or leaving must move by water, except for the very small amounts carried by air. Strongly dependent upon external trade, the island produces a few specialized primary goods for export but must bring from outside the bulk of its requirements of manufactured goods and foodstuffs. Even the exchange of goods between Newfoundland communities is to a great extent a matter of water transport because of the isolation of so many coastal settlements. Hence it is important to the welfare of the province that efficient shipping services be maintained.

Recognition of the importance of the shipping trade has recently led to a demand for statistical information concerning commodity movements. Although records of foreign shipments have been maintained for some years, coastwise traffic at Newfoundland and other Canadian ports was completely undocumented prior to 1952. At that time the Dominion Bureau of Statistics requested that reports be filed by ships operating in coasting service. Henceforth, all vessels entering or leaving a customs port were obliged to report cargo tonnage and commodity, destination and origin, and ports of call en route. The records thus accumulated provide quantitative data that indicates the volume and nature of commodity movements.

Recently the Canadian shipping trade has become a subject of much controversy. The discussion centres around the regulations controlling the coasting trade, and it is definite that any changes in these regulations would affect Newfoundland. At the present time all ships registered in countries of the British Commonwealth are free to engage on an equal footing in the coasting trade of Canada. That is, all such vessels may carry goods from one Canadian port to another. In practice, only ships of the United Kingdom, besides Canadian ships, take advantage of this privilege. Because ships can be built and operated at much lower cost in the United Kingdom than in Canada, the vessels of British registry enjoy

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a great competitive advantage. The result is that the Canadian shipbuilders and shipowners find it difficult to continue in operation.

To achieve an unbiased opinion a federal royal commission was established to investigate the whole question. The Royal Commission on Coasting Trade held a series of hearings throughout Canada during 1955 and 1956. Voluminous submissions were presented to the commission by interested parties and these have been under consideration. The activities of the Royal Commission have spotlighted the shipping trade and its problems and revealed the shortcomings of the information available.

The present study represents an attempt to provide quantitative information on the Newfoundland shipping trade. The trade relationships of Newfoundland ports are studied to determine the magnitude of commodity exchanges, the importance of market and supply areas, and the efficiency of transportation. In order to make significant comparisons between trading areas, the cargo movements are considered in three main categories. These are: commodity exchange between Newfoundland ports and foreign ports; between Newfoundland ports and mainland Canadian ports; and between Newfoundland ports themselves. Because of lack of statistical data on other ports, this study is confined chiefly to the customs ports, as this group includes all of the major ports and some of the minor ones.

A "maritime" country in the true sense of the word, the population of Newfoundland is distributed almost wholly along the coastal fringe of the land. Its greatly indented coastline has hundreds of coves and harbours that provide shelter for vessels of various sizes. Sea transportation has long functioned as the major contact with the outside world for many Newfoundland settlements. Long stretches of isolated coastline are still not served by roads or railways and it will be some years before major extensions of these services will be possible (Figure 1). At present, numerous schooners reach into every inhabited cove and harbour, carrying goods of all descriptions. The regularly scheduled Canadian National Railways coastal steamships serve the larger settlements in all but a few areas (Figure 2).

Sea ice conditions in winter further restrict accessibility in some areas; the northeast and west coasts of Newfoundland are blocked by sea ice for periods ranging from 1½ to 5 months (Figure 3). Ice begins to form along the shores in northern areas during December. At the same time pack ice

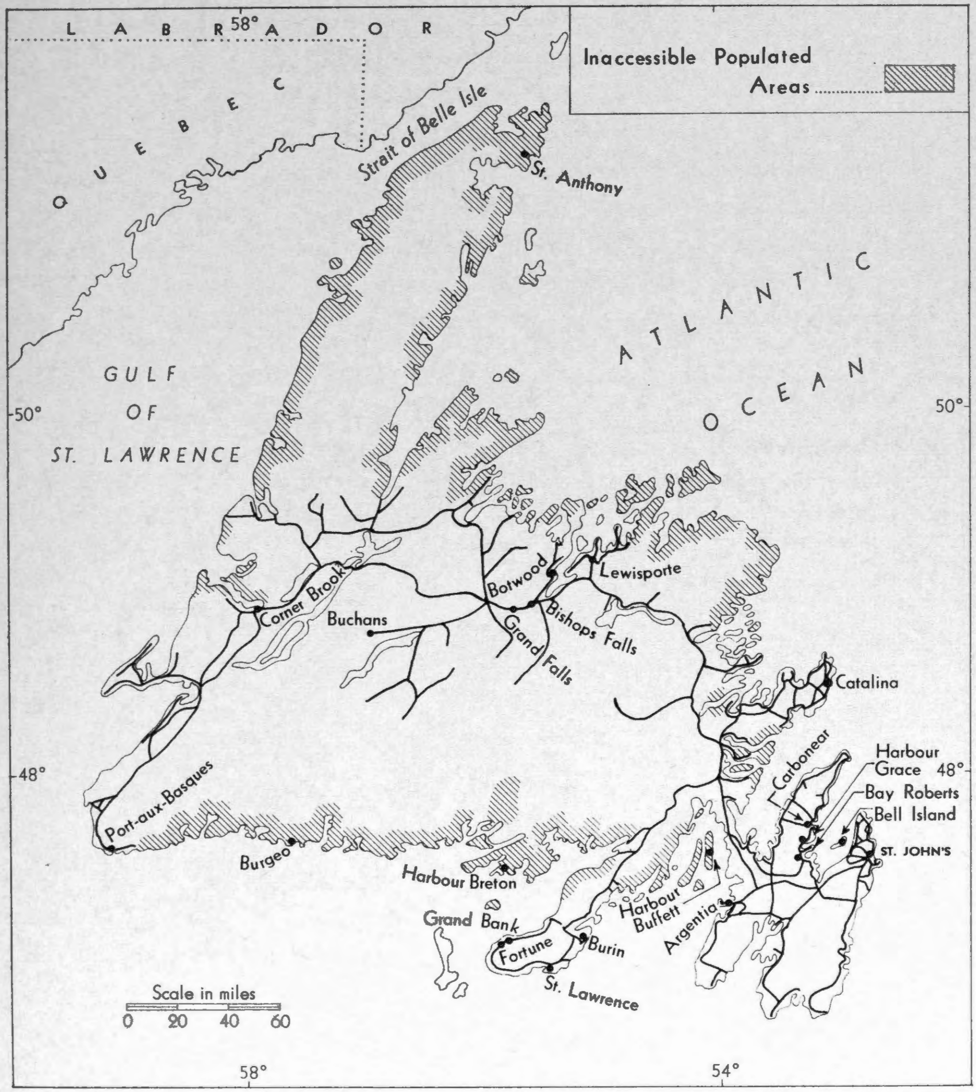

Figure 1. Roads and railways that provide a continuous network.

from the Labrador coastal region moves southward and some ice enters the Gulf of St. Lawrence through the Strait of Belle Isle while the main flow continues along the east coast of Newfoundland. Farther south ice formation is delayed until late January and early February and the appearance of pack ice from the north is similarly retarded. Only the south coast is open to navigation the year round. However, a northward flowing current generally maintains a broad lead offshore between Cabot Strait and Bay of Islands during most of the winter, giving access to the bay. Icebreakers maintain a channel in Humber Arm to Corner Brook.

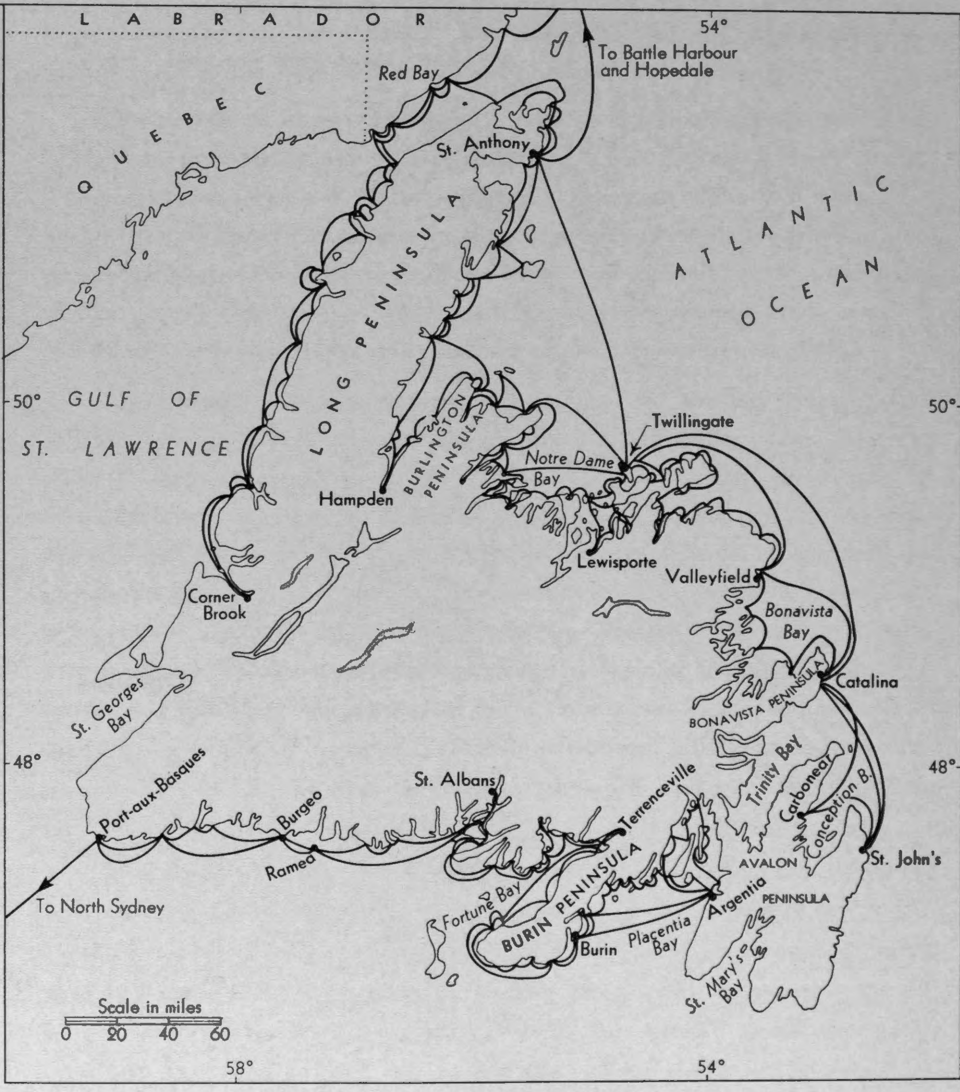

Figure 2. Canadian National Railways Steamship Service routes.

TRADE RELATIONSHIPS

The structure of Newfoundland's shipping trade is best understood by analyzing the foreign trade, the Canadian mainland trade, and the local coasting trade separately, on the basis of the interchange of commodities between ports.

The customs ports are the only sources from which cargo statistics are available, and these ports are used in varying degrees by each of the three types of trade. Foreign shipments must pass through customs ports (Figure 1), and a high percentage of Canadian mainland trade uses them.

To a lesser extent they are used by the local coasting trade; the statistics available for this trade therefore give a good indication of the scale and nature of the shipments between Newfoundland ports.

That the coasting trade assumes great magnitude is to be expected because Newfoundland is an island and its regular transportation connections with the rest of the country must be by water. A distinct difference exists in the character of the shipping trade between Newfoundland and mainland Canada and that between local Newfoundland ports. The types of vessels used are somewhat different in design and size and cargoes differ accordingly.

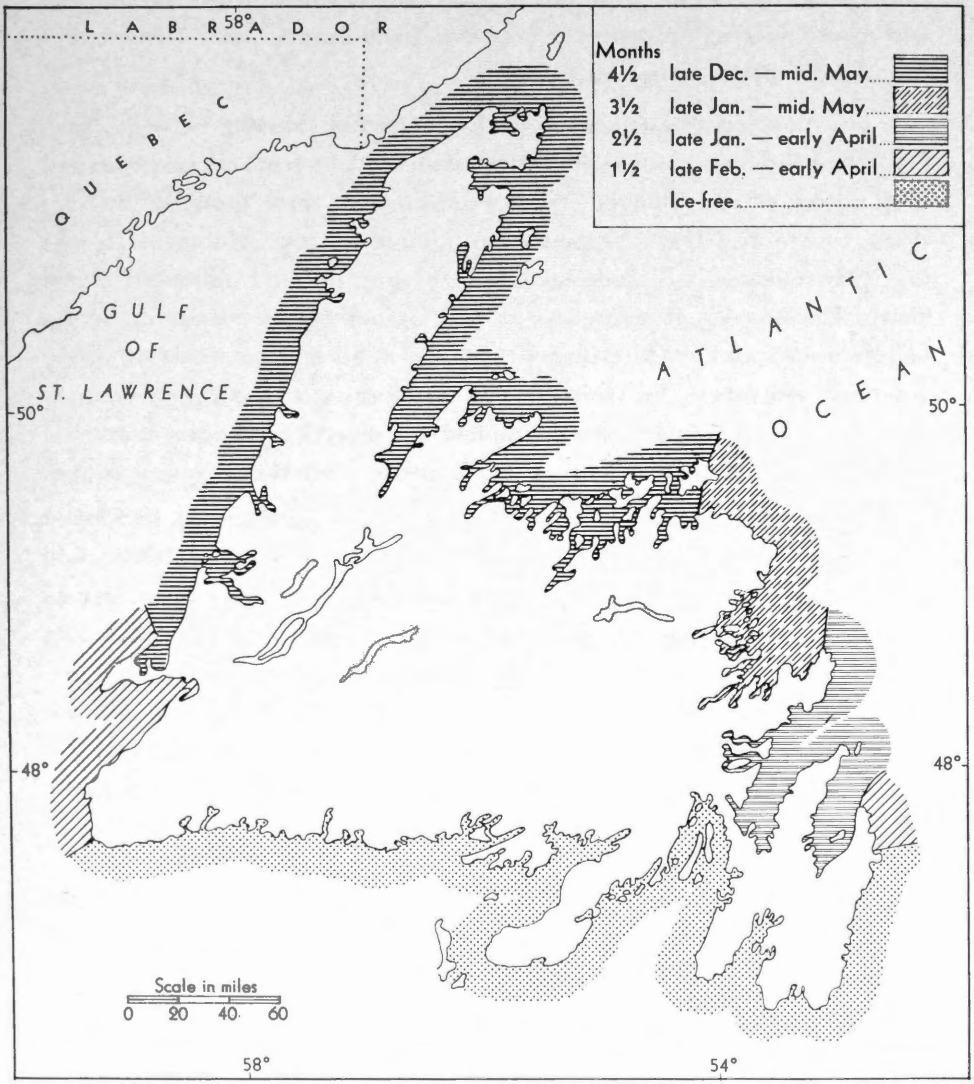

Figure 3. Average duration of ice conditions restricting navigation.

FOREIGN TRADE

Trade relationships with foreign countries are of great significance to the Newfoundland economy. Before confederation in 1949, Newfoundland imported less from Canada and more from other countries than it has since confederation. The elimination of customs barriers between Newfoundland and the rest of Canada and the inclusion of Newfoundland behind the Canadian customs and tariff structure has been partly responsible for this increase, although the volume of exports has not changed radically. A relatively stable flow of exports must be maintained to pay for the great range of goods that are obtained outside the province. Both agricultural and manufacturing industries in Newfoundland produce only a fraction of the island's total requirements.

The most significant feature of the pattern of shipping between Newfoundland and foreign countries is the dominance of a few bulk commodities, both outbound and inbound. The exports go to three principal destinations, United Kingdom, Germany and United States. Shipments to the first two countries are made up largely of iron ore and pulpwood, while nearly 75 per cent of shipments to the United States consist of manufactured newsprint. More than 90 per cent of all imports originate in the Western Hemisphere, the United States standing out as the leading country of origin; the remainder being supplied by several European countries. Overall tonnage outbound is considerably greater than the tonnage inbound.

The Newfoundland ports that originate cargoes destined to foreign countries are not necessarily important trade centres. Bell Island and St. Lawrence are producers of export commodities that move to foreign markets in large quantities, yet these ports are insignificant in the import trade. On the other hand, the ports receiving large tonnages of imported goods are essentially distribution centres, including St. John's, Corner Brook, Botwood and Lewisporte. With sizeable populations, the first two are important consumers as well. All these importing centres with the exception of Lewisporte also export substantial tonnages.

Cargoes Outbound to Foreign Countries

A few major commodities that are produced at specific locations account for a large proportion of shipments to foreign countries (Table 1). Various ores, newsprint, pulpwood and fishery products are the chief exports. They are products of primary industry and reflect the basic nature of the Newfoundland economy.

TABLE 1

Foreign Trade of Customs Ports in 1954

Port	Cargo Tonnage Inbound	Cargo Tonnage Outbound
Argentia	11,346	0
Bay Roberts	2,982	0
Bell Island	0	1,793,792
Botwood	60,147	269,767
Burgeo	494	1,183
Burin	1,205	6,006
Carbonear	219	0
Catalina	4,571	5,410
Corner Brook	173,424	379,158
Fortune	135	1,230
Grand Bank	1,471	210
Harbour Breton	0	817
Harbour Buffett	2,702	1,755
Harbour Grace	692	6,654
Lewisporte	70,613	0
Port aux Basques	23	1,856
St. Anthony	4,345	989
St. John's	179,891	85,313
St. Lawrence	736	59,860
Pulpwood Loading Sites		
Indian Bay	0	80,850
Tommys Arm	0	42,000
Butchers Cove	0	28,122
Hall Bay	0	19,554

Iron ore mined at Bell Island constitutes the greatest tonnage shipped from any one port. About three-quarters of the total production moves to export markets and the rest goes to Sydney for use in the steel plant. Reserves are substantial and at current rates of extraction the mines will produce for several centuries. Considerable modernization of the mining and loading equipment has been carried out in recent years to speed up the movement of ore from mine to ship. Freighters generally arrive in ballast and require one or two days to load 10,000 to 15,000 tons of ore. Exports of iron ore are destined exclusively for United Kingdom and Germany (Figure 4).

During the shipping season from May to December lead, zinc and copper concentrates are shipped from Botwood. The ore is mined and concentrated at the inland town of Buchans and the concentrates are moved to Botwood by rail. The concentrates move to the following countries in

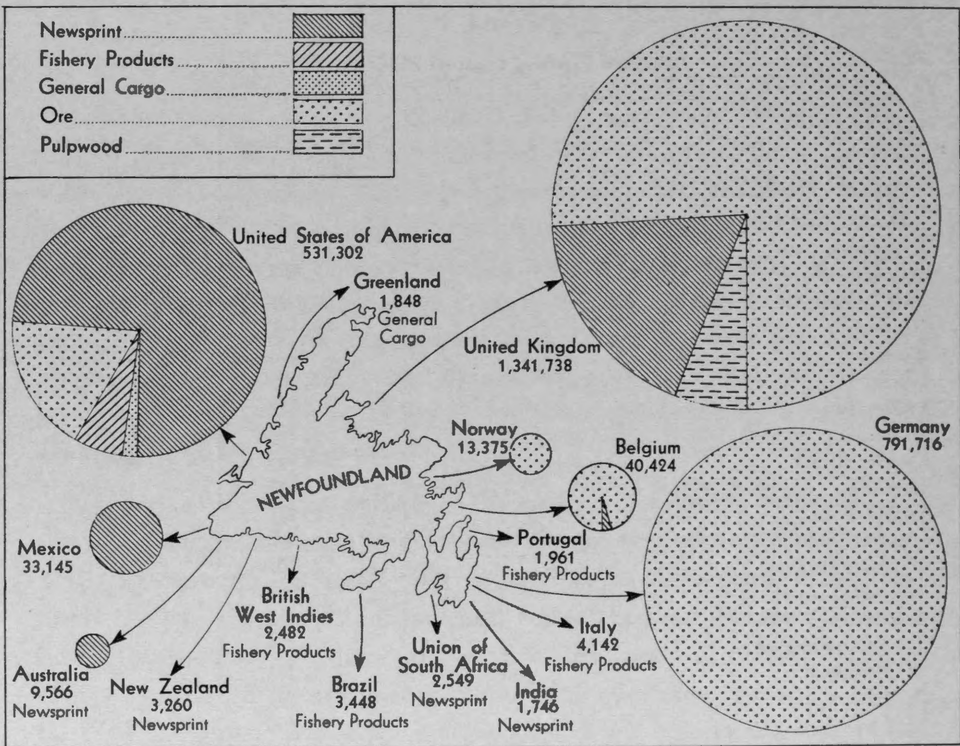

Figure 4. Commodity tonnages outbound to foreign countries in 1954.

order of tonnage received; Belgium, United States, United Kingdom, and Norway. Within the United States the destinations of cargoes are widely scattered; the copper goes to Tacoma, the lead goes to Corpus Christi and the zinc goes to New York.

A third mining area in the vicinity of St. Lawrence ships fluorspar to Wilmington, Delaware. This district is one of the world's leading centres of fluorspar production. Both fluorspar ore and concentrate are shipped from the ice-free port in freighters of various nations.

Newsprint and sulphite pulp are shipped to export markets from three Newfoundland ports. Being situated on the waterfront, the paper mill at Corner Brook enjoys the advantage of being able to ship its products direct to market by water. Since the port is kept open all winter, regular newsprint shipment schedules can be maintained in harmony with plant production. Such a favourable shipping arrangement does not exist for the other newsprint producer situated at the inland town of Grand Falls. During the open season the newsprint moves by rail to the nearby port of Botwood for shipment. While this port is closed by sea ice, however, the export products are carried by rail to the ice-free port of St. John's. Unlike the concentrates that can be stockpiled, the newsprint must be shipped regularly, even though this involves a long rail haul. The bulk of newsprint from both producers moves to United States ports scattered along the eastern seaboard from New York to Miami. United Kingdom and Mexico receive substantial amounts and several other countries, including Australia, New Zealand and India, receive small shipments of newsprint.

Pulpwood is cut on a large scale at various points throughout the province to supply the paper mills, but a small proportion is available for export. The wood is collected at convenient sites on the shores of accessible bays near the cutting areas. Deep-sea freighters anchor in the bays, such as Indian Bay and Butchers Cove, and the pulpwood is loaded aboard from barges because none of these loading sites has suitable wharf facilities. In addition, smaller quantities of pulpwood are shipped from Corner Brook and Botwood. All of the pulpwood exported is destined to United Kingdom.

The various products of the fishing industry are essentially for export markets. Sun-dried, salted codfish has long been the major product and still accounts for a large proportion of the total fishery production, although declining in volume. However, fresh frozen filleted fish is being produced in greater quantities than formerly as a result of the opening of new plants. Among other important products are herring, lobster, cod oil and fish meal. The quantities of fishery products shipped direct to market do not give an accurate picture of the total exports. Large amounts of dried codfish are being sent to Halifax for export. Also, increasing quantities of salt bulk codfish are being shipped from numerous Newfoundland ports to Nova Scotia ports for artificial drying.

The four major fish exporting ports are St. John's, Catalina, Harbour Grace and Burin. The first two ship both frozen and dried fish, while the others ship mainly frozen fish. The major port, St. John's, is the chief collection centre for dried codfish and a number of fish exporting firms maintain packing and shipping warehouses there. Smaller quantities of frozen fish are exported from several other customs ports, mostly located on the south coast. Although the relatively small tonnages of fishery products exported appear insignificant compared with tonnages of ores and pulpwood, the value of fish per ton is considerably higher.

The market for most fishery products is extremely competitive and serious difficulties are being experienced by Newfoundland exporters. Foreign exchange problems have prevented many of the countries that import dried codfish, especially in the Mediterranean area and in South America, from purchasing substantial quantities. Nevertheless, a moderate volume of sales is maintained with some effort. Countries receiving dried codfish in direct shipments from Newfoundland are British West Indies, Brazil, Portugal and Italy. The frozen fish, herring and lobsters go to the United States, chiefly to Boston and Gloucester. Protective tariffs present a formidable barrier that causes hardships to the producers of frozen fish in particular. Lobsters, however, are in such scarcity that the demand is virtually insatiable and few marketing difficulties are being experienced in this commodity.

The final commodity listed as exported to foreign countries is general cargo. Made up of package freight and small amounts of miscellaneous goods, it is truly a general category. The tonnage of this cargo moving to foreign countries is small and originates in two ports only, St. John's and Corner Brook. The great bulk of general cargo is destined to New York, Boston, and Liverpool. The regularly scheduled steamship services carry a large part of this freight. Shipments of military stores from St. John's to Greenland ports are classified as general cargo.

Several companies operate regular steamship services between Newfoundland and foreign ports (Table 2). The Furness Warren Line maintains a service between Liverpool, St. John's and Boston with two vessels of about 4,000 tons each designed to carry both passengers and freight. Another line owned by the same company is the Furness Red Cross Line which operates two freighters between New York, Saint John, Halifax, and St. John's, with a few calls at Corner Brook in summer. All of these ships have refrigeration equipment enabling them to carry large quantities of frozen fish. The Blue Peter Steamships Limited operates a service for freight between St. John's, Halifax and Boston using smaller vessels of approximately 300 net registered tons. Hence it is mainly St. John's that enjoys regular steamship service to the United States and Great Britain and only Corner Brook elsewhere in Newfoundland is a scheduled port of call. Exporters of general cargo and fishery products, both frozen and dried, take advantage of these regular services for their shipments.

Cargoes Inbound from Foreign Countries

Imports to Newfoundland consist chiefly of fuels and raw materials and amount to less than one-fifth of the export tonnage. Many of the items imported are also obtained from the Canadian mainland and the trend is toward an increasing supply from this source. A small number of Newfoundland ports handle the great bulk of import commodities (Table 1).

TABLE 2

Scheduled Steamship Services and Ports of Call, 1954

Steamship Company	Number of Ships	Country of Registry	Newfoundland Ports of Call	Foreign Ports of Call	Canadian Mainland Ports of Call
Furness Warren Line..........	2	United Kingdom	St. John's	Boston and Liverpool	Halifax
Furness Red Cross Line........	2	United Kingdom	St. John's and Corner Brook	New York	Halifax and Saint John
Blue Peter Steamships Limited..	3	Canada	St. John's	Boston	Halifax
Canadian Constantine Services..	2	United Kingdom	St. John's and Corner Brook		Montreal, Toronto and Hamilton
Clarke Steamship Co. Ltd......	1 2	United Kingdom Canada	St. John's and Corner Brook		Montreal
Newfoundland-Canada Steamships Limited..............	2	Canada	St. John's		Halifax
Newfoundland-Great Lakes Steamships Limited..........	3	United Kingdom	St. John's		Toronto and Hamilton

The leading commodity group according to tonnage received is refined petroleum products. Foremost among these products are diesel oil and gasoline. Diesel oil of various grades is an increasingly important fuel in Newfoundland, being used in locomotives, in ships and for power plants in areas that are short of hydro-electric power. In St. John's a new steam power plant has recently been completed that uses petroleum instead of coal as its fuel. Numerous fish processing plants utilize diesel generators for obtaining their power. Part of the gasoline is of aviation quality and the rest is consumed mainly by vehicles and fishing boats. Minor petroleum products such as stove oil and kerosene are imported in smaller quantities.

The ports receiving significant quantities of petroleum products from foreign countries are Corner Brook, Lewisporte, Botwood, St. John's, and Argentia (Table 1). All are distribution centres but Corner Brook and St. John's are large consumers as well. Botwood supplies the pulp and paper towns of Grand Falls and Bishops Falls, while Lewisporte supplies aviation gasoline to Gander International Airport where transatlantic airliners of many nations stop for refuelling. Aviation fuel is used in large amounts also at the United States Naval Air Station in Argentia. The lack of refineries in the province makes it necessary to import only refined products and these come from United States, Venezuela, and Netherlands West Indies (Figure 5).

The rise in petroleum consumption in Newfoundland has been partly at the expense of coal. The recent complete dieselization of the railway was a major factor in the decline of coal consumption, although coal is still used for domestic heating. As in the case of petroleum, part of the requirement is imported and the rest is obtained from mainland Canada. Coal is imported in substantial volume at Corner Brook, Botwood and St. John's, all three of which are also importers of petroleum. The three largest concentrations of population in the province are found in the vicinities of these ports. Most of the imported coal originates in the United States and is shipped from Newport News, Virginia along the Atlantic coast and from Sandusky, Ohio through the Great Lakes-St. Lawrence system. However, a small amount comes from the United Kingdom.

The process of curing codfish requires liberal applications of salt as well as exposure to the sun. Since this method of processing is still common along the fishing coasts, a large market for salt exists. The hundreds of settlements where salt is used are supplied from depots located in a few

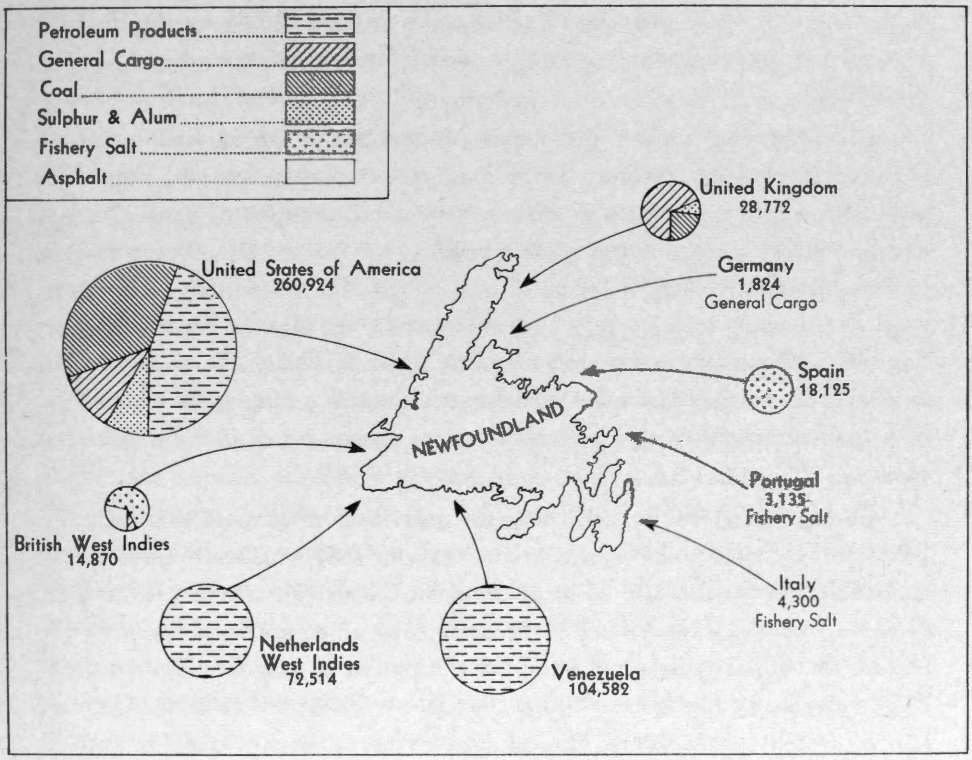

Figure 5. Commodity tonnages inbound from foreign countries in 1954.

distributing centres. Some of these depots obtain their salt directly from foreign suppliers, while others secure it from the large storehouses in St. John's. Among the places that import salt, St. John's receives by far the greatest tonnage and St. Anthony, Bay Roberts, Harbour Buffett, Catalina, Grand Bank and Burin receive smaller amounts. The fishery salt comes from the same areas that consume dried codfish exports; the Mediterranean and the West Indies.

Other raw materials imported for use in Newfoundland industries are sulphur and alum. They are used in the paper-making process and enter the island through the ports of Botwood and Corner Brook. The imported sulphur comes from several Gulf of Mexico ports in United States and the alum comes from Liverpool, England.

Besides supplying salt the British West Indies ships some of its typical products to St. John's in sizeable amounts. These are asphalt from Trinidad, molasses from Barbados, and rum from Jamaica.

Most other imports are listed as general cargo which is received in substantial quantities only at St. John's, although many of the other customs ports receive significant amounts. Carried chiefly by the Furness vessels, the assorted goods originate mainly in United States and United Kingdom.

Much of the import and export commodities are carried by ships engaged in one-way traffic. Ships loading ore, newsprint and pulpwood generally arrive in ballast, or with a very small amount of general cargo and newsprint cores. A few vessels heading for Corner Brook or Botwood to load newsprint carry sulphur or coal in sizeable quantities. However, most of the ships transporting coal inbound do not pick up return cargoes. Similarly, oil tankers operate on a strictly one-way basis. Such a situation is almost unavoidable because cargo movements on a large scale are limited to a few commodities and reciprocal cargo exchanges cannot be arranged easily.

Foreign registered vessels carry the great bulk of cargoes in the foreign trade and Canadian ships operate successfully only in certain cases where conditions are favourable. One of the basic reasons for the success of most of these Canadian operations is the desire among commercial interests for regular and dependable service and the willingness to pay the price required. Also, vessels of a few hundred tons that are well adapted to carrying small lots of freight gathered at several ports present advantages for certain commodity movements. The lack of shipping restrictions in the foreign trade permits open competition for cargoes. Shipping services are thereby made available to Newfoundland exporters and importers at the prevailing freight rates. The limited scope of regularly scheduled services causes inconvenience to business firms outside the two major ports, but service will undoubtedly be expanded when sufficient volume of business warrants it.

CANADIAN MAINLAND TRADE

Trade between Newfoundland and the Canadian mainland has grown tremendously during recent years. Prior to World War II Canada supplied about 40 per cent of Newfoundland's imports, while United Kingdom and United States provided most of the remainder. World War II virtually terminated the flow of exports to Newfoundland from the United Kingdom. Immediately the Canadian share of the total imports rose to approximately 65 per cent and continued at this higher level even after the war. The federation of Newfoundland with Canada in 1949 led to a further increase in shipments from the mainland, as a result of the Canadian tariff structure being imposed on the new province. From this date onward commodities shipped to Newfoundland from mainland Canada were no longer considered as imports that had to pass through customs and be duly registered. Consequently, statistics showing the comparable values of goods entering Newfoundland before and after confederation are not available. The movement of goods in the reverse direction has not kept pace with this increase. A basic reason is that many Newfoundland products do not find a ready market in the rest of Canada. Goods such as newsprint and dried codfish are export products on the mainland as well as in Newfoundland. Secondary manufacturing industries are little developed and provide a meagre contribution toward mainland shipments.

Cargo exchanges with mainland ports are effected by several types of ships operating under different conditions. Steamships of various sizes operate in scheduled services, under individual charters, or as tramps, and numerous wooden schooners shuttle back and forth at irregular intervals. The scheduled shipping services, utilizing chiefly British vessels, connect St. John's and Corner Brook with certain key trading ports on the Canadian mainland. Those lines that serve foreign ports also have scheduled calls at Halifax and in one case at Saint John as well (Table 2). Other shipping lines call at Halifax, Montreal, Toronto and Hamilton. All seven lines serve St. John's and three of them serve Corner Brook, but these are the only Newfoundland ports included on the schedules.

Cargoes Outbound to Mainland Canada

Shipments to mainland Canada are made up chiefly of a few bulk commodities including iron ore and fishery products. Many of the customs ports contribute merely token amounts of cargo and the overall movement is remarkably low on a tonnage basis (Table 3).

Iron ore occupies the leading position by tonnage among the commodities shipped, just as it does in the foreign trade (Figure 6). Several vessels of about 4,000 tons that are owned by the mining company make frequent trips to transport the ore to Sydney. They generally arrive at Bell Island in ballast but sometimes carry a few tons of general cargo or mine supplies and machinery.

The steel mills at Sydney also obtain limestone in Newfoundland that is used as a flux in the furnaces. It is quarried on the west coast at Aguathuna by a subsidiary and is shipped across Cabot Strait on company-owned ships. Since Aguathuna is not a customs port the actual tonnage moved is not reported, but it is known that production is approximately 350,000 tons per year.*

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*Baird, D.M., Mines and Mineral Resources of Newfoundland, *Newfoundland Dept. Mines and Resources*, St. John's, 1953.

TABLE 3

Canadian Mainland Trade of Customs Ports in 1954

Port	Cargo Tonnage Inbound	Cargo Tonnage Outbound
Argentia	8,992	401
Bay Roberts	16,208	1,220
Bell Island	30,467	622,883
Botwood	40,296	0
Burgeo	4,104	990
Burin	24,166	1,863
Carbonear	6,938	2,297
Catalina	4,970	4,593
Corner Brook	107,112	29,909
Fortune	3,749	1,012
Grand Bank	7,225	1,621
Harbour Breton	2,543	12
Harbour Buffett	4,927	3,635
Harbour Grace	5,266	190
Lewisporte	55,601	270
Port aux Basques	166,747	18,953
St. Anthony	4,810	1,438
St. John's	439,204	21,336
St. Lawrence	8,208	57,222

One of the two companies mining fluorspar at St. Lawrence is owned by Aluminum Company of Canada and ships its product to Arvida through Port Alfred, Quebec for use in the aluminum production process. The operation is economically marginal, owing to strong competition from other producers, and proximity to market is an important factor in keeping the mines open.

Fishery products are shipped to the mainland from a number of ports, particularly in the southeastern part of the province. A great proportion of the total is made up of dried salt codfish and salt bulk codfish. The fully cured fish is sent to Nova Scotia ports, chiefly Halifax, for export to foreign markets. This arrangement facilitates the assembling of large quantities of fish in a port where shipping space to various markets can be easily obtained. The salt bulk fish moves to Halifax, Lunenburg and Riverport where it is artificially dried and then exported. The fishermen find it much more convenient to sell their fish in this form instead of undergoing the laborious process of sun-drying it in the unpredictable Newfoundland climate. Although they receive a lower price they are able to spend more time fishing and thereby raise their productivity.

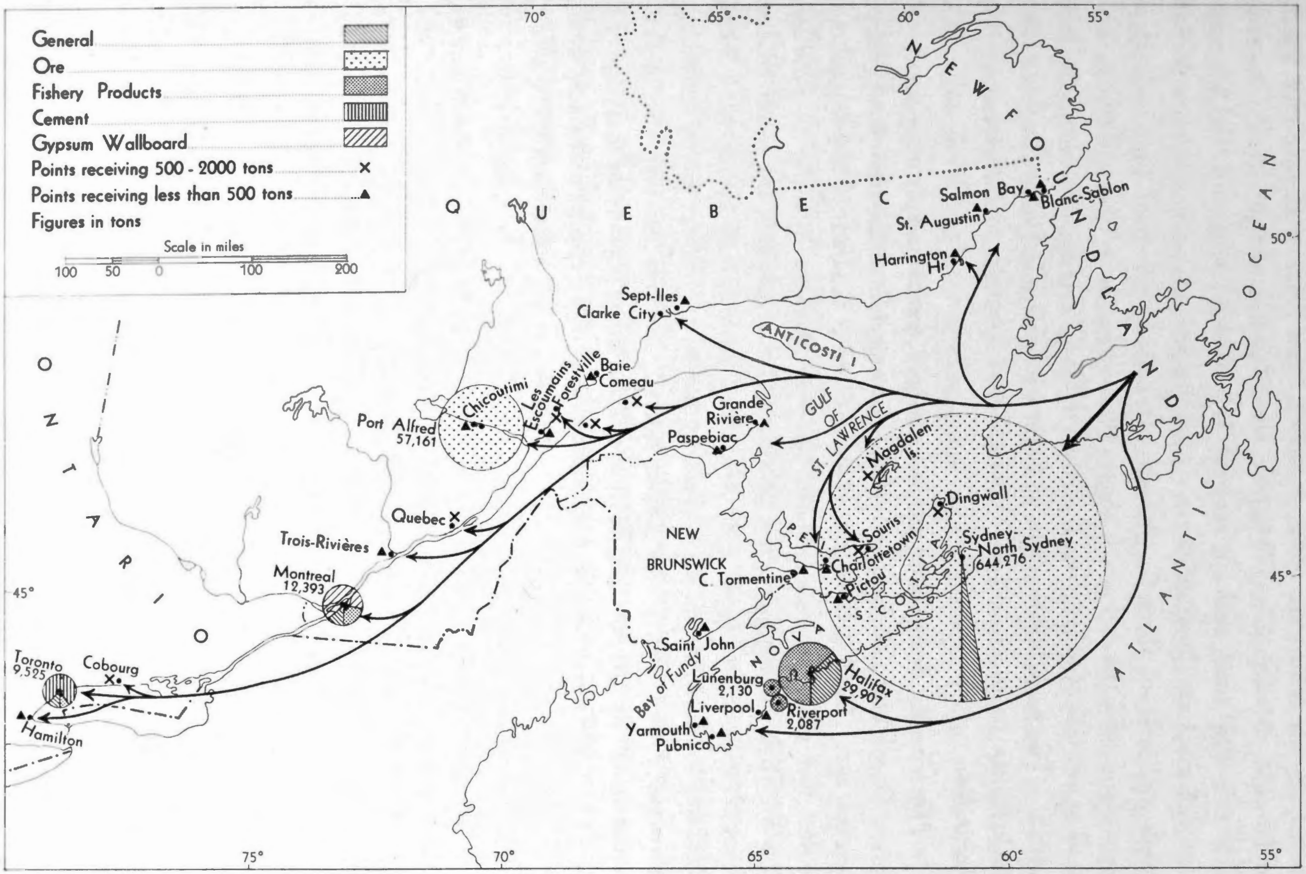

Figure 6. Commodity tonnages outbound to mainland Canada in 1954.

Numerous other fishery products are shipped in smaller quantities. Frozen filleted fish moves from the south coast ports of Burgeo and Burin to Toronto, Montreal and Halifax for domestic consumption. Several ports ship fish meal, cod oil, seal oil, mackerel, herring and live lobsters. Both fish meal and herring oil are shipped in sizeable tonnages from Corner Brook and seal oil from St. John's. It may be assumed that numerous ports along the east and south coasts that do not have customs offices ship small quantities of fishery products, particularly dried codfish and salt bulk codfish. The main destination of fishery products is Halifax, while other Nova Scotia ports as well as Montreal and Toronto receive most of the remainder.

The recently established cement and gypsum manufacturing plants in Corner Brook ship a large part of their production to the mainland Canadian market. Both of these plants are assured of the limited Newfoundland market but must capture a share of other markets in order to produce economically. They ship their products almost entirely by water to cut transportation costs, since they are faced with severe competition from mainland manufacturers. The cement moves to a great many Gulf, St. Lawrence River, and Great Lakes ports. Toronto receives the largest shipments to any one port and at least a dozen other ports receive significant amounts. Wallboard is the major product of the gypsum plant and finds its chief market in Montreal and Quebec, but small shipments go to a few other Quebec ports.

As one of the important salt depots situated at the northern tip of Newfoundland, St. Anthony lies in a convenient location to supply the Gulf of St. Lawrence north shore ports with salt. These ports, such as Blanc Sablon and Harrington Harbour, Quebec, are engaged in the fishing industry and produce dried codfish. The salt is carried by schooner in shipments of about 150 tons.

General cargo is shipped in substantial quantities only from St. John's and Port aux Basques. The regular shipping services operating from St. John's carry a large proportion of the general cargo to Halifax and smaller amounts to Montreal and Toronto. Most of the freight placed aboard the ferries at Port aux Basques is classed as general and all of it moves to North Sydney for transfer to the railway again.

Port aux Basques, and ports eastward, ship mainly to Nova Scotia, while Corner Brook ships to Quebec and Ontario. St. Lawrence is the exception on the south coast since its fluorspar is shipped to Port Alfred. The east coast ports north of Catalina originate very little traffic to the mainland and most of the shipments from St. Anthony go to nearby Quebec ports. Cargoes moving to Nova Scotia ports are especially large in tonnage because of the iron ore shipments. Both New Brunswick and Prince Edward Island receive insignificant tonnages of goods from Newfoundland.

Compared with shipments to foreign countries the tonnages destined to mainland Canada are far less in volume and the commodities differ to some extent. Although the fluorspar and iron move to both mainland and foreign ports, the lead, zinc and copper concentrates, the pulpwood and the newsprint are export items exclusively. The Newfoundland ports that ship fishery products generally send cargoes to export markets as well as to Canadian ports, with a few exceptions. For example, of the three ports, Harbour Grace, Carbonear and Bay Roberts, only the first mentioned exports fish, while the other two ship fish to Canadian ports.

Cargoes Inbound from Mainland Canada

Inbound shipments of freight from the Canadian mainland are of much greater tonnage and variety of products than outbound shipments. The three major classes of commodities are petroleum products, coal and general cargo, the last of which includes a great range of consumer goods. This is indicative of the tremendous flow of manufactured goods and foods of various types that enter the province through dozens of ports besides those with customs offices.

Petroleum products enter Newfoundland from the mainland in greater quantities than from foreign countries. The refining cities of Halifax and Montreal are the sources of these shipments, the first named being the major supplier (Figure 7). The four important distribution centres, St. John's, Lewisporte, Botwood and Corner Brook, that receive large tonnages of foreign petroleum also receive the bulk of mainland shipments (Table 3). Other ports of destination receive relatively small amounts, except for Port aux Basques where the Canadian National Railways is a large consumer, and Burin which supplies many south coast settlements. Although petroleum products move to Newfoundland in tankers, distribution around the island is carried out mostly by schooners loaded with drums. However, there is a trend toward the establishment of more bulk tank stations in an attempt to cut transport expenses.

Coal is shipped from the mines at Sydney to hundreds of Newfoundland ports chiefly for domestic heating consumption. Some of it is moved by steamship, particularly to St. John's by Canadian National Railways freighters and to Bell Island as a return cargo for iron ore carriers, but the

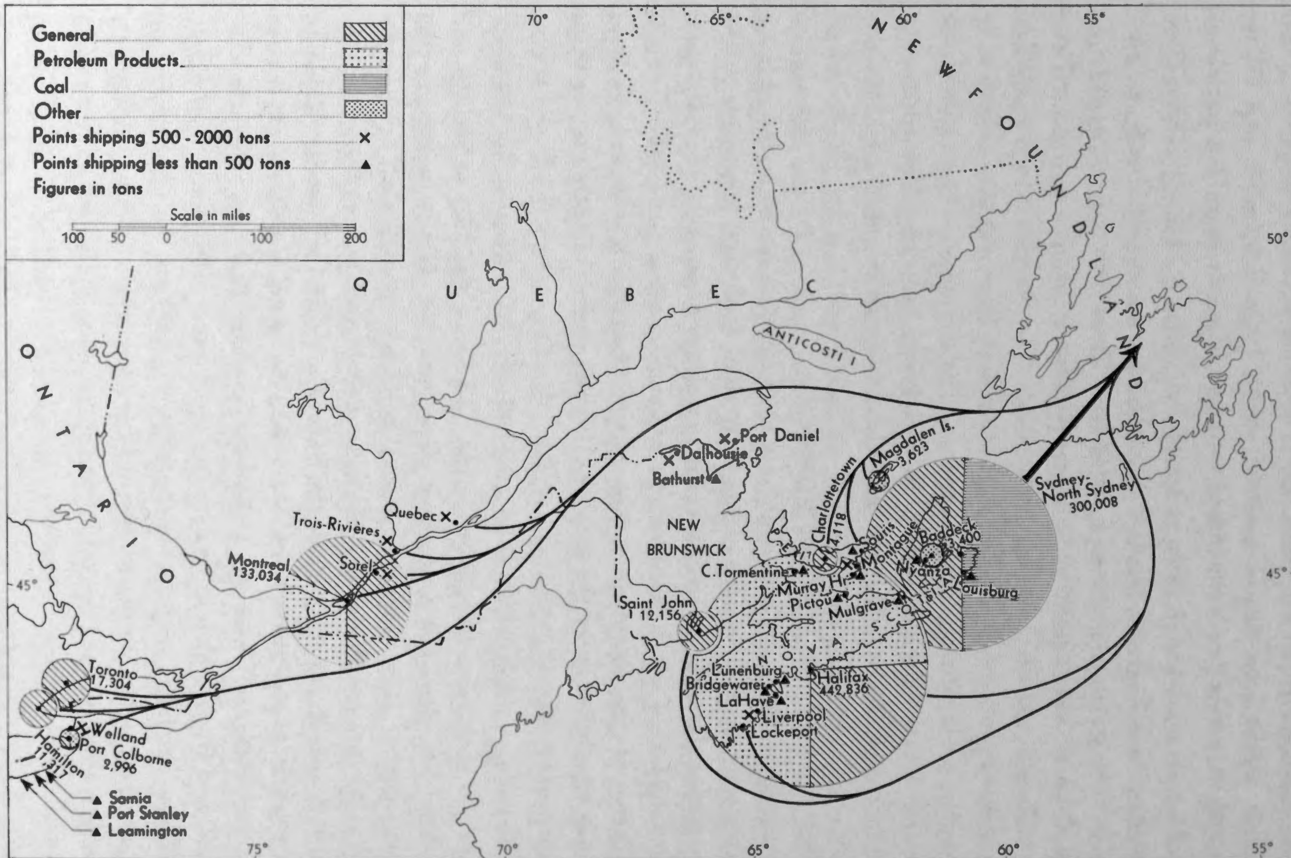

Figure 7. Commodity tonnages inbound from mainland Canada in 1954.

greater part is moved by schooners. The merchants in various settlements who operate schooners generally bring bulk loads of coal for their customers in late summer or early fall. In many fishing communities the purchasers unload the coal themselves from the schooner into their motorboats or dories and convey it to their homes. A few of the larger ports that serve industrial consumers, such as Corner Brook and Botwood, obtain all their coal requirements from the United States. In both of these cases the coal is a return cargo for vessels carrying newsprint and therefore moves at an advantageous freight rate. However, there is very little freight destined to Sydney from Newfoundland, except from Port aux Basques, and ships usually arrive in ballast to load coal at Sydney.

Most other commodities are designated in the shipping reports as general cargo, although a few specific items are listed separately. Railroad rolling stock and steel rails enter St. John's and Argentia from Halifax for use on the eastern division of the railway. Nearly all the customs ports receive flour in small tonnages from Sydney or Halifax, but both St. John's and Bay Roberts obtain substantial amounts of flour directly from Port Colborne, Ontario. Explosives originating at Sorel, Quebec, are shipped to Bell Island and St. John's, mostly for use in the iron mines. Mining machinery moves in small amounts to Bell Island from Sydney as return cargo on ore vessels. Corner Brook is the port of destination for several commodities that arrive in sizeable amounts. Among them is heavy wrapping paper used for newsprint rolls that comes from the producing centres of Quebec, Dalhousie and Bathurst.

Large tonnages of general cargo are shipped to Newfoundland from the Canadian mainland. The scheduled shipping services play an important part in carrying this freight to St. John's and Corner Brook. Both of these ports, together with Port aux Basques, are major destinations for general cargo. The railway freight from North Sydney accounts for the sizeable entry of general cargo at Port aux Basques. Most of these goods are moved eastward by rail for distribution throughout the province. St. John's draws general cargo from numerous maritime and inland ports, Halifax and Montreal being the leading sources of supply. On the other hand, Corner Brook is supplied essentially by Montreal and receives only small tonnages from other ports. General cargo is brought by schooners from Nova Scotia to a great many customs ports besides the three main destinations.

On the whole, the mainland ports of Halifax, Sydney-North Sydney and Montreal provide the great bulk of shipments to Newfoundland.

Goods from these centres move to customs ports around the island, with cargoes from Halifax and Sydney reaching more ports than those from Montreal. Essentially it is the Nova Scotia ports that dominate the inbound trade, but Quebec and Ontario ports contribute an important share.

Total shipments from mainland Canada exceed those from foreign countries and the number of destination points is considerably greater for cargoes of mainland origin. The island draws coal and petroleum in large amounts from both mainland and foreign suppliers, but certain raw materials used in Newfoundland industries, chiefly salt, sulphur and alum are obtained exclusively in foreign countries. The Canadian mainland, however, is the more important source of general cargo.

The amount of cargo carried between Newfoundland and mainland Canada by British registered ships is quite substantial. Since the scheduled shipping lines utilize these vessels as the major element in their fleets, the movement of general cargo to St. John's and Corner Brook is performed chiefly by British ships (Table 2). However, strong arguments have been advanced for restricting the coasting trade solely to Canadian vessels. A protected market for Canadian built and operated vessels would be created by such a restriction and it is claimed that the steady decline of the merchant fleet would be checked.

On the other hand it is claimed that the effects on Newfoundland of the proposed restriction would be detrimental. The railway and steamship rates that are now held down by the competition of British vessels would rise if these ships were withdrawn from service. The fact that much of the inbound cargo handled by vessels of British registry is listed as general indicates a preponderance of consumer goods in this movement. Consequently, it is claimed that the cost of living in the island province would be affected, and that several Newfoundland industries would experience serious difficulties in marketing their products on the mainland at competitive prices.

LOCAL COASTING TRADE

The importance of the local coasting trade cannot be measured solely by the volume or value of goods involved because so many settlements depend on this shipping for their only trade link with outside areas. The ships involved in this trade are mainly the coastal steamships, ranging in size from about 200 to 1,000 net registered tons, and wooden schooners, mostly under 150 tons. Although these vessels operate between the ports of a great number of settlements it is the customs ports among them that handle the largest tonnages. An estimate of the local trade of Newfoundland ports in 1954 was made by the Committee on Newfoundland Coastal Shipping. This estimate was based partly on tonnage figures of cargoes carried, provided by vessel owners, and partly on data concerning gross tonnage of vessels and average number of trips made during the season. By comparison of the total inbound and outbound cargo handled by the customs ports with this estimate it is found that the customs ports account for more than half the traffic. Consequently these selected ports provide an indication of the character of the local trade, particularly in reference to the types of commodities shipped.

The local coasting trade is characterized by small-scale cargo exchanges among a great number of ports, with certain distribution centres handling larger tonnages than other points (Table 4). St. John's stands out as the leading port in both outbound and inbound trade but the other steamship terminals also assume prominence as origins of cargoes. Since shipments from the major ports consist chiefly of consumer goods, general cargo is the main commodity class. Both petroleum and salt are other commodities supplied, while lumber and fish are local products that move in stages from the smaller settlements to the major centres. From the example of several small customs ports one may infer that hundreds of coastal settlements receive greater tonnages of cargo than they originate and that much of it is

TABLE 4

Local Coasting Trade of Customs Ports in 1954

Port	Cargo Tonnage Inbound	Cargo Tonnage Outbound
Argentia	2,170	6,481
Bay Roberts	3,554	1,670
Bell Island	747	0
Botwood	629	260
Burgeo	937	660
Burin	4,648	4,223
Carbonear	2,796	520
Catalina	5,400	4,708
Corner Brook	4,205	8,760
Fortune	2,573	640
Grand Bank	3,169	1,444
Harbour Breton	1,009	275
Harbour Buffet	2,185	1,121
Harbour Grace	400	1,850
Lewisporte	2,093	6,020
Port aux Basques	1,540	6,563
St. Anthony	4,460	3,173
St. John's	31,286	45,938
St. Lawrence	2,729	256

classed as general. The vessels involved in the local trade, mainly schooners and coastal steamships, seldom travel in ballast but frequently carry smaller cargoes in one direction than in the other.

The local trade of the various ports tends to be best developed in the immediate vicinity of the ports themselves. That is to say, dealings with neighbouring ports are more frequent than with distant ports. For example, Fortune carries on most of its trade with nearby ports (Figure 8). However, a centre like Carbonear that handles large quantities of lumber and dried codfish deals with more remote ports (Figure 8). It is not

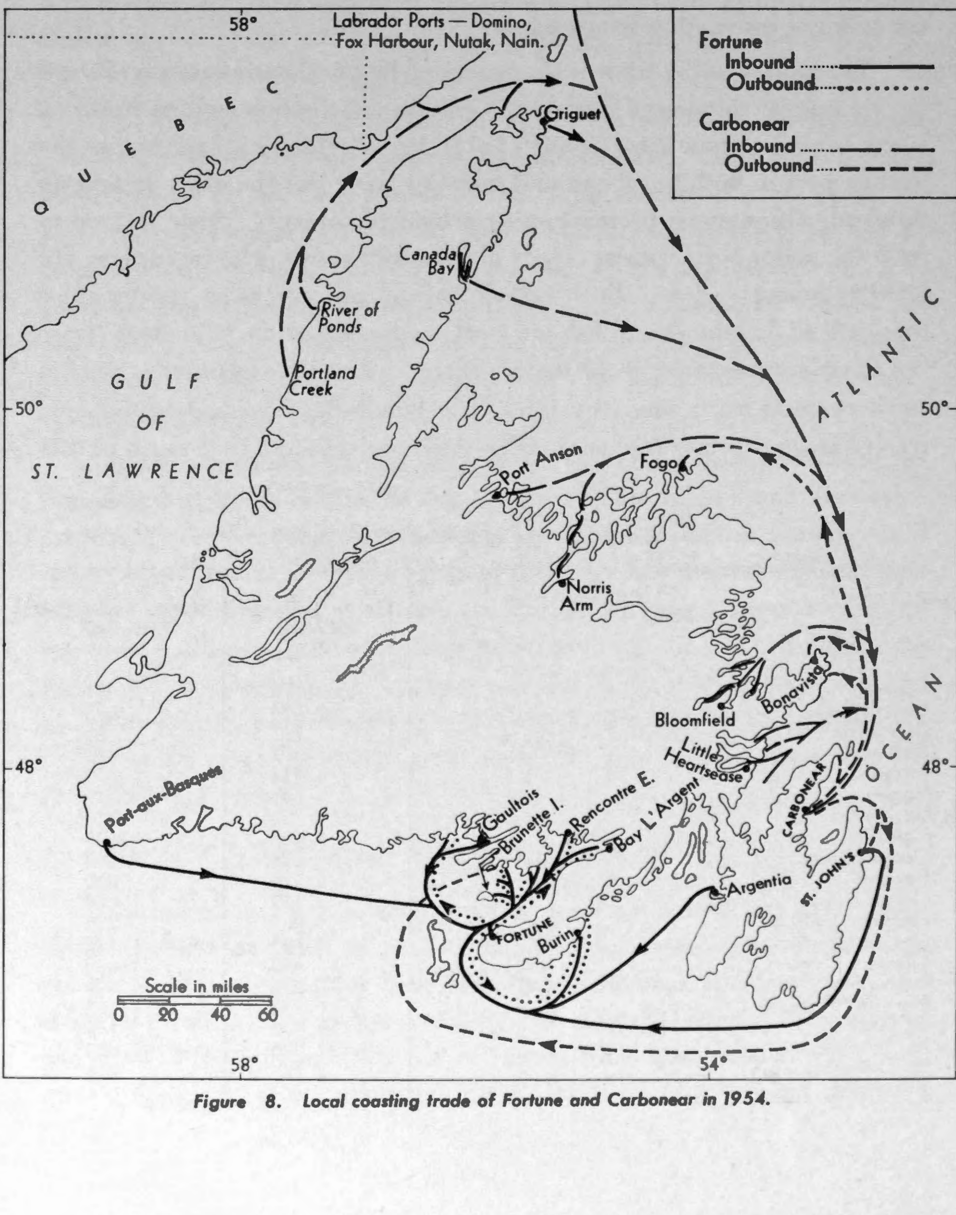

Figure 8. Local coasting trade of Fortune and Carbonear in 1954.

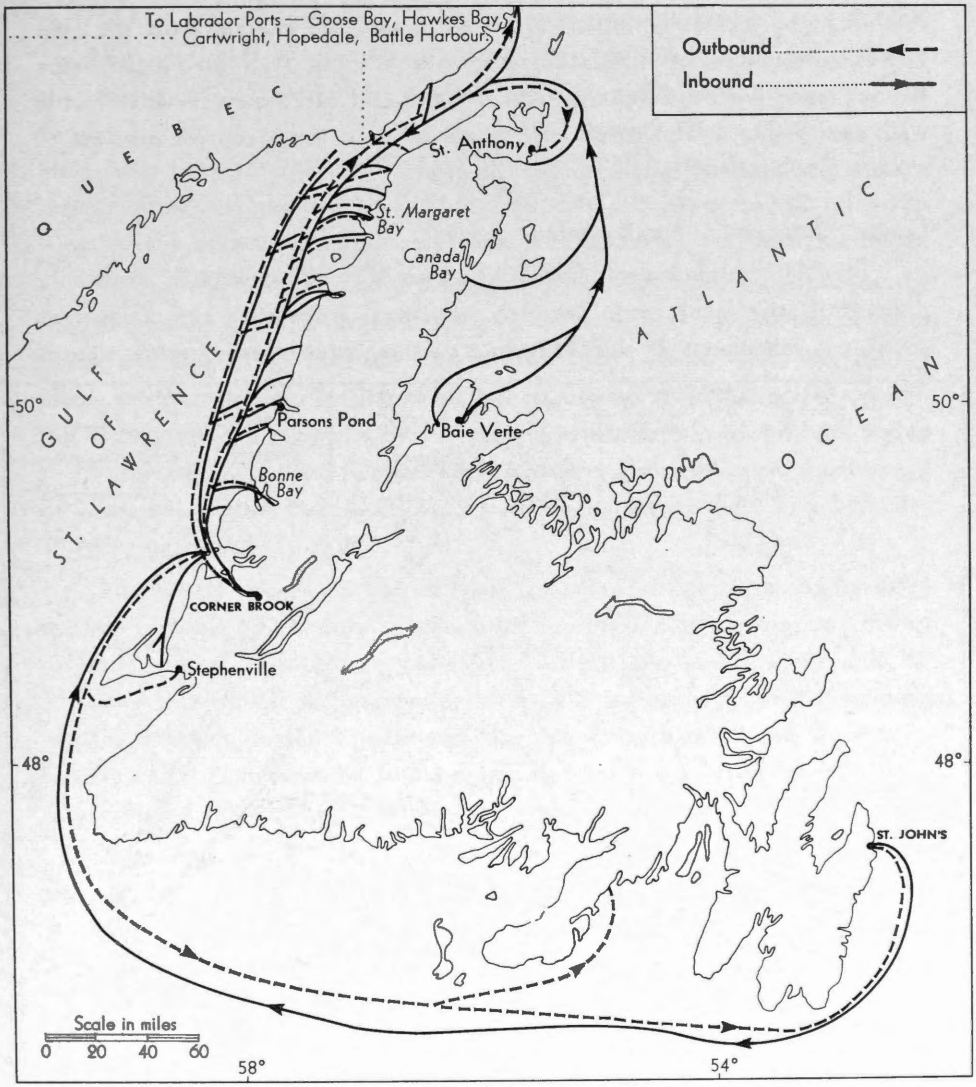

Figure 9. Local coasting trade of Corner Brook in 1954.

possible to ascertain all of the settlements involved in the local trade of the customs ports because many shipping reports are filed that do not list specific ports of call. In many cases they refer merely to "various ports". Those that are listed, however, provide a clear indication of the total.

The local trade along the south coast is dominated by Port aux Basques and Argentia, the steamship terminals, and by Burin and Grand Bank. On the west coast Corner Brook is unrivalled as the leading port (Figure 9). The situation is slightly different on the northeast coast where St. John's is the dominant port although others including Catalina, Lewisporte and St.

Anthony are regionally important (Figure 10). It is significant that the two largest centres of population in Newfoundland, St. John's and Corner Brook, trade with different groups of ports and carry on very little trade with each other. The cargo exchanges between these centres amount to a mere few hundred tons in either direction.

Cargoes Outbound to Newfoundland Ports

The determination of specific commodity movements is especially difficult in the local trade because individual shipments are often very small. A schooner may depart from a customs port carrying a few tons of

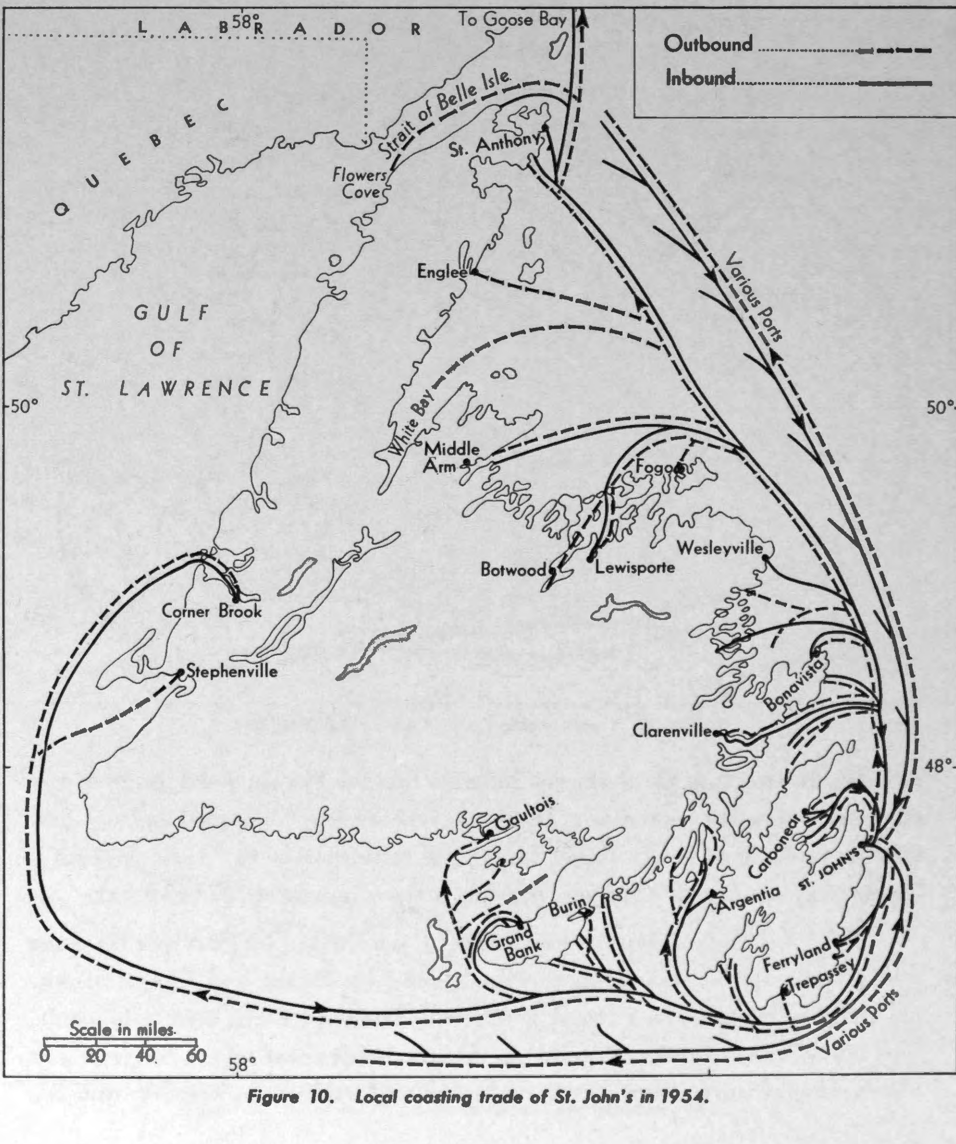

Figure 10. Local coasting trade of St. John's in 1954.

coal, a few tons of petroleum in drums and perhaps bottled soft drinks. Its cargo would likely be reported as general. Hence, it is difficult to trace the movements of petroleum products, for example, with accuracy. Although St. John's is a major petroleum distribution centre obtaining supplies from both foreign and mainland sources, the shipping reports show merely a few hundred tons moving outbound to other Newfoundland ports. Most of the petroleum shipments have been included with general cargo.

Among the ports shipping petroleum products Burin accounts for the largest tonnages. The petroleum moves in drums to various south coast ports, particularly in Fortune Bay and on Burin Peninsula. Argentia is also a south coast distribution point but on a lesser scale. Since the carrying of inflammable products by the coastal steamships is prohibited, owing to the fire hazard, all petroleum, coal, matches, and explosives must move by schooner. Other petroleum distribution ports are St. John's, Lewisporte and Corner Brook.

The fishery products shipped from the customs ports are chiefly dried codfish moving to St. John's for export. Catalina is the major port of origin, being a collection centre itself. Both Harbour Buffett and St. Anthony send small shipments of dried fish, but many other collection centres are not customs ports and their contributions cannot be readily ascertained. A substantial tonnage of fish offal is sent from the Harbour Grace frozen filleting plant to the fish meal plant at Fermeuse.

Shipments of salt move along the coasts to dozens of settlements from the salt depots situated in such places as St. John's, Bay Roberts and St. Anthony. It is likely that salt also is included with general cargo in some instances, particularly in St. John's. The leading distribution port according to the tonnages registered in the shipping reports is St. Anthony which supplies many northern ports.

Cement and wood products are other commodities shipped in significant amounts. The cement originates at Corner Brook and is destined mainly to northern ports in the vicinity of the Strait of Belle Isle. Lumber and logs move to St. John's from both Catalina and Lewisporte. Local Newfoundland lumber is not of high quality for the most part and is generally roughly finished. Nevertheless, there is a market for limited quantities in the larger centres of population. Numerous settlements besides the customs ports supply this lumber.

All of the customs ports ship general cargo in the local coasting trade but the amount varies from a few hundred tons in Harbour Breton to nearly 45,000 tons in St. John's. It moves in small lots to literally hundreds of coastal settlements. The steamship terminal ports originate the largest tonnages of general cargo; Argentia and Port aux Basques on the south coast, Corner Brook on the west coast, and St. John's and Lewisporte on the northeast coast.

Cargoes outbound in the local trade are of lesser volume than those outbound in either the mainland or foreign trade. Also there is less contrast between ports in tonnage shipped, due principally to the fact that large quantities of raw materials are not originated for destination to local ports.

Cargoes Inbound from Newfoundland Ports

Local cargoes inbound to the customs ports do not consist of general cargo so predominantly as cargoes outbound. The total tonnages handled at the various ports are similar in scale to the inbound totals with some ports receiving a little more and others a little less, than they ship (Table 4). Among the ports that handle smaller amounts inbound are the coastal steamship terminals.

The petroleum distributing ports with the exception of Burin do not register petroleum products inbound. Burin, however, obtains some petroleum from St. John's and supplies in turn such ports as St. Lawrence, Grand Bank and Harbour Breton.

Inbound shipments of fishery products appear at many collection centres, the most important being St. John's, Bay Roberts, Catalina and Carbonear. Most of these ports receive dried codfish, chiefly from northeast coast fishing settlements, but a few handle other types of products. Salt bulk codfish enters Grand Bank from various points and fish offal enters Fortune from the plant at Gaultois for processing into meal. Besides receiving large shipments of dried codfish, St. John's is the destination of several small cargoes of seal pelts from northern ports. Fresh fish caught on the fishing grounds is not registered as trade cargo when landed at a customs port. Consequently, the large quantities of fish supplied to the processing plants are not included in the tonnages indicated by the shipping reports.

Wood products, consisting mainly of lumber, enter the larger distribution and consuming centres such as St. John's and Corner Brook in sizeable amounts. The lumber is produced and shipped from small sawmills scattered throughout the island, particularly in northern areas. Both St. Lawrence and Bell Island receive mine timbers as well as lumber. Pulpwood that moves to Corner Brook and Botwood on barges is considered in the same category as fresh fish as far as the shipping trade is concerned. However, it is definite that the movement of pulpwood by water, especially from northern cutting sites on the west coast to Corner Brook, involves tremendous tonnages.

A few of the customs ports show salt as an inbound commodity, but it is mainly the small fishing settlements that receive salt from the distributing depots. Burin does receive salt from St. John's and Burgeo is supplied from Grand Bank, while on the northeast coast Lewisporte is supplied from St. Anthony. Other inbound commodities are included under general cargo, except for some cargoes of sand, stone and gravel entering St. Anthony and limestone entering Botwood. In the former case the stone products are used in construction and in the latter the limestone is used in the pulp and paper mill at Grand Falls.

While primary wood and fishery products account for greater proportions of inbound than of outbound shipments at many customs ports, general cargo is proportionately less. The distinctly smaller volume of shipments is especially noticeable at the steamship terminal ports. A few ports including St. Lawrence, Fortune and Burgeo receive larger amounts of general cargo than they ship, indicating that they resemble the hundreds of settlements that are supplied by the various distribution centres. Although it receives a smaller tonnage of cargo than it ships, St. John's is still the leading port handling general cargo.

Compared with inbound shipments from the mainland and from foreign countries the local trade is on a much smaller scale. The commodities differ in several respects, with general cargo appearing as relatively more important.

The government-subsidized coastal steamships carry out the basic service in the local coasting trade. Equally important are the numerous smaller coasting vessels that operate independently. However, high operating costs are making their continued operation more difficult and the aging schooners that were not designed for the service they perform require systematic replacement. The problem of replacement is a serious one because freight rates cannot be greatly increased to finance improved services without imposing unfair hardships on the people living in isolated locations.

CONCLUSION

The three distinct aspects of the shipping trade have been examined to determine trade relationships. The foreign trade is characterized by the exchange of a few bulk commodities in large amounts. Iron and other ores, newsprint, fishery products and pulpwood are the chief exports, while United Kingdom, Germany and United States are the main destinations. Imports consist of petroleum products, coal and salt for the most part, and amount to a small percentage of export tonnage. The United States, Venezuela and Netherlands West Indies are the countries of origin that supply the bulk of the imports. Owing to the prevailing economic circumstances, the ships carrying goods in foreign trade are mostly engaged in a one-way traffic, either arriving or departing in ballast.

Trade with mainland Canada is even more unbalanced than the foreign trade because inbound traffic greatly exceeds outbound traffic. The mainland is the source of large quantities of petroleum products, coal and general cargo, which includes a great variety of foods and manufactured goods. Consequently, the island depends upon the Canadian mainland to supply a large percentage of the consumer goods required. These requirements are especially broad, owing to the very limited local production. The much smaller outbound flow includes some ores, cement and wallboard, but on the whole, Newfoundland products are marketed in foreign countries. The mainland ports engaged in cargo exchanges with Newfoundland ports on a large scale are Sydney-North Sydney, Halifax and Montreal. As is the case in foreign trade, many ships travel in ballast in one direction or the other on return trips.

The distribution of consumer goods and the collection of primary products are the principal functions of the local shipping trade. Shipments move in small lots and the diverse commodities handled are mostly classed as general. However, among specified commodities distributed are petroleum and salt and among commodities collected are lumber and fish. The distribution centres, among which St. John's is the leading one, ship greater tonnages of cargo to the hundreds of small coastal settlements than they receive. The situation is reversed in these smaller ports where inbound traffic exceeds outbound. Various sections of the coast are dominated by certain distribution centres, including all of the coastal steamship terminals, insofar as local trade is concerned. Cargo exchanges between ports are more evenly balanced in local trade than in foreign or mainland trade, resulting in fewer ballast movements by vessels.

The vessels engaged in the shipping trade face different operating conditions in each of the major aspects of the trade. Existing services are adequate and fairly well adjusted to the present requirements, except in the local coasting trade. Actually, problems affecting operations in both the mainland and local trade are more numerous than in the foreign trade. Few Canadian vessels manage to compete in the foreign trade against the ships of many foreign nations which carry the bulk of the traffic. Those that are successful are relatively small vessels adapted to specialized types of service. Ships of British registry form a major part of the fleets operated by the scheduled shipping services. The Newfoundland consumers and certain industries benefit directly as a result of the fact that these ships offer lower freight rates than competing services. The coastal steamships and a sizeable fleet of motor vessels are providing shipping services in the local coasting trade. The steamships are substantially subsidized by the federal government because it is recognized that the operations are definitely uneconomic. The smaller coasting vessels are mostly of schooner design and are experiencing economic difficulties as well. Designed for fishing operations, they are not efficient for freighting services and need systematic replacement.

RÉSUMÉ

L'efficacité des transports par eau est liée de très près à l'activité économique de l'île de Terre-Neuve. Bien que producteur de matières ouvrables, destinées surtout à l'exportation, Terre-Neuve doit cependant importer la majeure partie de ses denrées et produits manufacturés pour suffire à ses besoins. Depuis quelques années, nombre de problèmes affectant son transport maritime ont surgi et ont suscité beaucoup d'intérêt, surtout depuis le début de l'enquête de la Commission royale sur le cabotage. Le but de la présente étude est de faire connaître les mouvements du trafic-marchandises à Terre-Neuve tel qu'il existe de nos jours, et ainsi fournir un fondement précis aux considérations futures de ces problèmes.

A la lumière des statistiques parues dans diverses publications sur le sujet, l'auteur a établi une relation entre les trois différents aspects du trafic-marchandises. De grandes quantités, mais une variété très limitée, de marchandises en vrac caractérisent les échanges entre l'île et les pays étrangers. Les échanges commerciaux avec la terre ferme, en l'occurrence le Canada, sont dans un état de déséquilibre dû à l'excédent des importations, tels le charbon, le pétrole et le fret ordinaire, sur les marchandises d'exportation. Ce déséquilibre commercial est plus accentué encore entre Terre-Neuve et le reste du pays qu'avec l'étranger. Il en résulte un trafic à sens unique où le ballast semble être la cargaison la plus rentable. Une distribution réduite des produits de consommation et l'expédition de produits non manufacturés, tels le bois de construction et le poisson, sont les principaux emplois du cabotage à Terre-Neuve.

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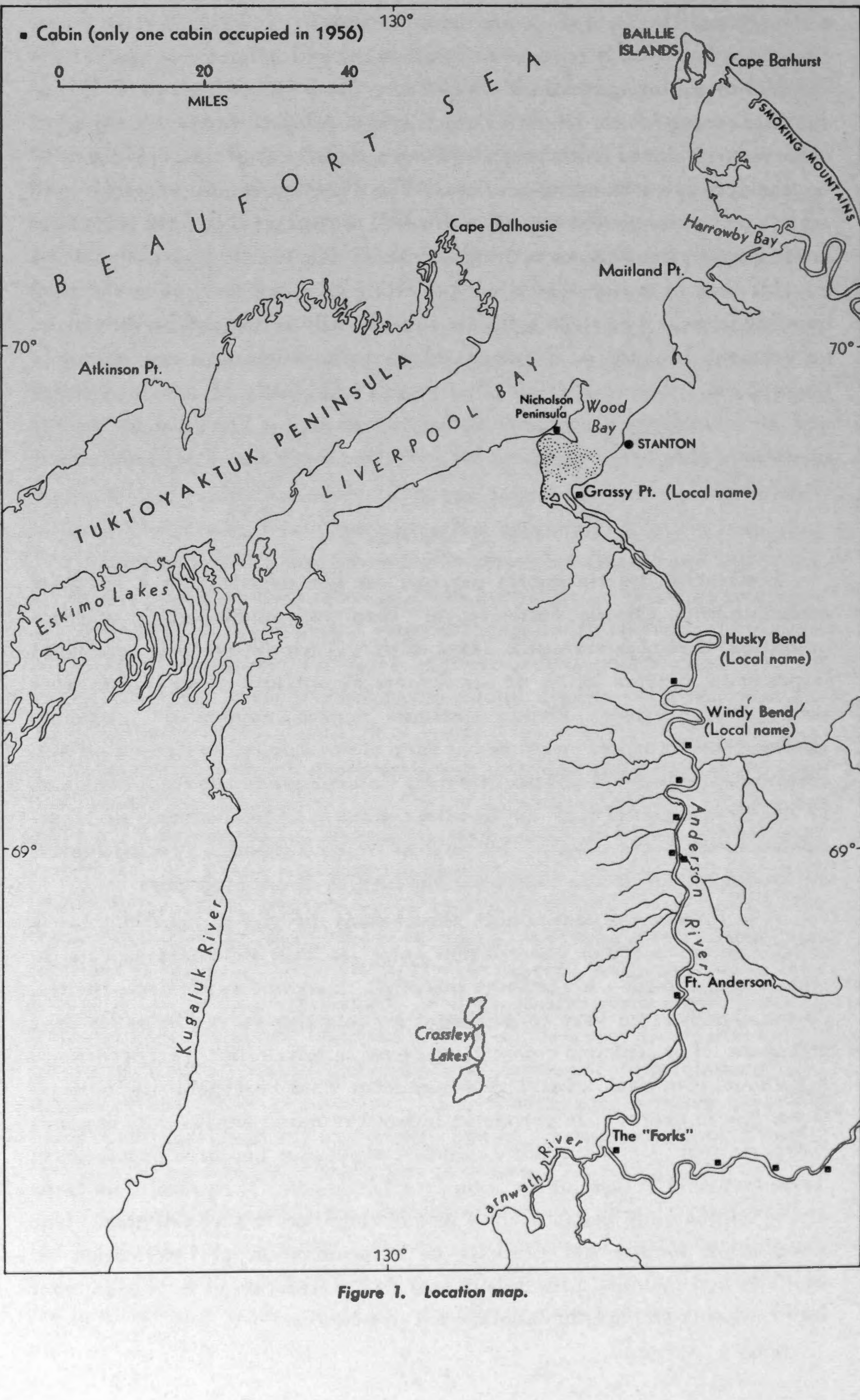

Figure 1. Location map.

THE VALLEY OF THE LOWER ANDERSON RIVER, N.W.T.

*J. Ross Mackay**

The Anderson River is one of the large rivers of the Northwest Territories. Rising from a source north of Great Bear Lake, it flows northwest, roughly parallel to the Mackenzie River, to discharge into the Arctic Ocean at Liverpool Bay. The length from mouth to source cannot yet be measured, because of a lack of detailed maps and the phenomenon of dual-drainage for some headwater lakes, but a conservative estimate would indicate a length of at least 420 miles. The drainage basin is about 22,000 square miles in area. The Anderson River has never achieved the fame of such rivers as the Coppermine or Back, for it has played a subordinate role in the chronicles of the Northwest Territories. There was a brief flurry of interest in the Anderson River valley when the Hudson's Bay Company established Fort Anderson in 1861 for the Eskimo-Indian trade, but the post was abandoned five years later, in 1866. Since then, the valley has undergone intermittent depopulation of both Eskimos and Indians, a depopulation that was accelerated by the tragedies of the whaling period (ca. 1890-1910) and the subsequent adjustments to the predominant white fox trapping economy of the present time.

This report deals with the 150-mile long stretch of the Anderson River from the "forks", where the Carnwath River joins it, to the mouth. It is the section of the river having the largest Eskimo and Indian settlements in the nineteenth century, and the largest number of white trappers in the twentieth century.

The Anderson River was named after James Anderson, chief factor of the Hudson's Bay Company, in charge of the Mackenzie River district at the time.

EXPLORATION

The existence and general trend of the Anderson River was known to explorers from Indian and Eskimo accounts of it many decades before it was descended by R. M. MacFarlane in 1857. On July 16, 1826, Dr. John Richardson, who was in command of the eastern detachment of Captain

* This paper is based on field work carried out by Dr. Mackay in 1951 and 1955, with the assistance of J. K. Fraser of the Geographical Branch and J. K. Stathers, University of British Columbia. The area covered in this paper is an extension of the area covered by Geographical Branch Memoir 5, "Anderson River Map-Area", by J. Ross Mackay (in press).

John Franklin's "Second Expedition to the Shores of the Polar Sea", landed at Nicholson Peninsula within sight of the mouth of Anderson River.[1] Although Richardson did not sail south to the mouth of Anderson River, his map correctly located an inlet at the position of the mouth. Again, in 1848, Richardson sailed not far from the mouth of the river without having occasion to explore it, because he was engaged in the more pressing problem of the Franklin search. Richardson reported, however, that Indians and Eskimos spoke of a large river (the Anderson) that had its source near the west side of Great Bear Lake and flowed into the bottom of Liverpool Bay.[2]

On June 4, 1857, Roderick MacFarlane left Fort Good Hope for the exploration of Anderson River.[3] He crossed to the Lockhart (now known as the Carnwath) River and descended it to the Anderson where he found some Indians encamped at the forks. On June 14 he embarked for the mouth of the Anderson with two canoes and a party of ten. Two days later he was turned back by hostile Eskimos and was forced to abandon the canoes and make an arduous overland return journey to the forks. Obtaining another canoe, MacFarlane set out on June 25 to explore the upper Anderson River to a tributary, the Ross River, which he followed upstream to a number of large lakes. He then crossed to the Hare Indian River and descended it to Fort Good Hope. Not until February, 1859, did he finally succeed in reaching the Anderson River mouth.[4]

In 1861, MacFarlane established Fort Anderson on the right bank of the Anderson River about 35 miles northeast of the forks. Using Fort Anderson as a base, he crossed four times to Franklin Bay in the summers of 1862-1865 to collect birds, eggs, and other specimens for the Smithsonian Institution. During the 1860's his contributions to the Smithsonian Institution of birds and eggs alone exceeded 5,000 specimens.

In 1865 an Oblate missionary, l'abbé Émile Petitot, descended the Anderson River to its mouth.[5] In the next few years he travelled extensively in the area, from the headwaters of the Anderson River system nearly

[1] Franklin, John, Capt./R.N.: Narrative of a Second Expedition to the Shores of the Polar Sea, in the Years 1825, 1826, 1827; London, 1928, 1.221.

[2] Richardson, Sir John: Journal of a Boat Voyage through Rupert's Land and the Arctic Sea, in Search of the Discovery Ships under the Command of Sir John Franklin; London, 1851, p. 265.

[3] MacFarlane, R.: On an Expedition down the Begh-ula or Anderson River; Canadian Record of Science, Vol. 4, 1890-91, pp. 28-53.

[4] MacFarlane, R.: Notes on mammals collected and observed in the northern Mackenzie River district, Northwest Territories of Canada, with remarks on explorers and Explorations of the far north; *Proc. U.S. Museum*, Vol. 28, No. 1405, 1905, p. 681.

[5] Petitot, E.: Géographie de l'Athabaskaw-Mackenzie et des grands lacs du bassin arctique; Bull. de La Société de Géographie, sixième série, tome 10, 1875, p. 36.

to Franklin Bay. His locational map of 1875 was the best reference for much of the region until maps prepared from aerial photographs became available in the 1940's.

SETTLEMENT

The Hudson's Bay Company founded Fort Anderson in 1861 under the energetic supervision of MacFarlane. Fort Anderson was established for the Eskimo trade, and to a lesser extent for the Indian trade, but it proved an unprofitable venture, and in 1866 it was abandoned. All that now remains to mark the site is a small unoccupied trapper's log cabin.

The abandonment of Fort Anderson was to be symptomatic of the future trend of events in the Western Arctic where depopulation by migration and death was becoming prevalent. Changes wrought by the introduction of firearms, a white fox trapping economy, the activities of the whalers, malnutrition, and disease, resulted in heavy depopulation of the area.

A hundred years ago the valley of the lower Anderson River was inhabited by Eskimos, and that of the upper Anderson by Indians. The boundary zone lay between the forks and the site of Fort Anderson. The Hare Indians, who hunted and trapped on the upper Anderson River system, were divided into five bands.[6] When MacFarlane made his exploration in 1857, he found 15 to 18 Indians (mostly Loucheux from Fort Good Hope) at the forks and 9 Indian lodges near Lake Maunoir. He stated that a great many Indians passed the winter at Simpson Lake (probably the Aubry Lake of present maps) where fish were caught the year round. In all, there were then approximately 100 or more Indians living in the vicinity of the upper Anderson River valley.

As a rough approximation, there were about 500 Eskimos living in the lower Anderson River valley downstream from the forks in the summer of 1857. The first Eskimos encountered by MacFarlane were within half a day's canoe travel of the forks, or about 20 miles; from there downstream, he frequently saw large Eskimo encampments with many lodges, over 80 canoes being passed en route.

The combined Indian-Eskimo population in the summer of 1857 numbered about 600. It is not known if this was a representative figure, due to seasonal and annual population shifts, but even if the population in normal years were only half as large, it would still be many times greater

[6] Osgood, C. B.: The Ethnography of the Great Bear Lake Indians; Annual Report for 1931, *National Museum of Canada*, Bull. No. 70, 1932, pp. 33-35.

than the population of the valley in recent decades. The remains of old Eskimo and Indian encampments are fairly abundant in the valley in the form of scattered ruins of Eskimo homes, Indian shelters, and log-covered graves.

The Indians of a century ago traded with the Hudson's Bay Company and, at times, with the Eskimos of the Anderson River valley. Relationships between Indians and Eskimos were, at best, semi-friendly; at the worst, they were openly hostile, and fights were not uncommon.[7] Stories of Eskimo-Indian encounters in the valley are still being related by natives today. The Eskimos traded with other Eskimos to the west, but there was little if any trade with Eskimos to the east, because of an uninhabited coastal stretch between the Cape Bathurst Eskimos and those of the Coppermine area.[8]

In the first half of the present century, there were usually 5 to 10 families living in the lower Anderson River valley. Most of the trappers were white, some being married to Eskimo or Indian women. A few Eskimos, mostly from the Tuk-Cape Bathurst area, and Indians from the west and south, trapped in the area for brief periods.

The immediate cause of recent depopulation of the valley has been attributed by the trappers themselves to conservation measures introduced by the Government for the protection of beaver. The restrictions placed on the trapping of beaver reduced the cash income of the trappers below that required for their yearly supplies. Even without such restrictions, their economy was a precarious one with very little cash surplus from year to year; with restrictions, trappers found they could not earn enough from other furs to purchase even the minimum amount of food and equipment required. Most of the trappers moved to the Mackenzie River delta after 1945.

When the Anderson River valley was the home of white trappers, they built log cabins for their homes. The cabins were spaced about 20 to 40 miles apart. A typical cabin consisted of a single room with a vestibule entrance, with walls of spruce logs chinked with moss, cloth, mud, etc. Roofs were made of logs covered with mud, and floors were of earth or flattened spruce logs. Most cabins had several storage sheds, at least one of which was made rodent proof, usually by supporting it on posts 3 to 4 feet high. Around the cabins were dog kennels, drying racks, etc.

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[7] Richardson, *op. cit.*, p. 265.

[8] Stefansson, V.: The distribution of human and animal life in western Arctic America; *Geog.*, Vol. 41, No. 5, May 1913, pp. 449-59.

In addition to the permanent cabins, overnight trapping cabins were built along the trap lines a day's journey apart. The overnight cabins were small, being just big enough to serve as a shelter.

The log cabins were built in timbered country from near Windy Bend to the forks. Several old clearings, marking the sites of long abandoned cabins, are present at the forks. A few trappers trapped in the Anderson River valley above the forks to at least the third set of falls at about longitude 127°27'W.

The trappers lived largely off the country in a nearly self-sufficient economy. Spruce was used for building and fuel. Except for a few basic necessities such as flour, sugar, and tea, most of the food was secured by hunting and fishing.

At the forks, large numbers of whitefish, crooked backs, and inconnu were caught in late summer and early fall in sweep nets before freeze-up.[9] Ordinary gill nets left in the river proved unsatisfactory, probably because the fish could avoid the nets in the clear water. In a week of fishing, two thousand or more fish were sometimes caught in sweep nets. Large inconnus (connies) weighing up to 70 pounds have been reported to be particularly abundant at the first falls before freeze-up. In the winter, trappers netted whitefish, pike, inconnu and other fish in the deeper holes of the river, particularly in the deeps by undercut slopes. Trappers also set nets or jigged for lake trout, herring, whitefish, pike, etc. in many of the lakes. Most of the fish were caught not only at the forks, but along the full length of the river from the forks to the mouth.

Some of the trappers who lived near the river mouth fished at Stanton and at Nicholson Peninsula where a favourite spot was the southeast sandspit. Crooked backs, herring, whitefish, and inconnu were the principal fish caught.

A hundred years ago caribou were abundant in the valley in the winter and in the tundra north of the mouth in summer. Now few caribou are reported from the valley and they cannot be counted on as a reliable source of fresh meat. Moose are fairly plentiful, especially near the forks where usually one or more have been shot each year.

The trappers of the Anderson River valley have always had a much more diversified economy than those of the coast where the main effort has been directed towards trapping white fox. In the valley, fox, lynx, mink,

[9] Data from trappers; *see also* McEwen, E. H.: Marten Survey—Anderson River, September-November, 1952; Typewritten Report by the mammologist, Northern Mackenzie District, Aklavik, N.W.T., 1952, 20 pp.

marten, muskrat, wolverine, and beaver have all been trapped. An example may be given. The best year's catch of one trapper who lived 13 years on the Anderson River was: 103 fox of all colours; 33 lynx; 22 mink; 64 marten; 11 wolverine; 600 muskrat; and the limit of 15 beaver.

There has been talk in recent years of transferring some trappers from the overcrowded Mackenzie River delta to the empty Anderson River valley. The problem of making a success of the undertaking is not easy. One of the best informed white trappers who lived for over 10 years in the valley has written as follows in a personal communication: "With fish and meat being plentiful, a family of six or seven should live well on a thousand dollars a year, that is, buying nothing but good essential foods and not high grade canned foods". However, a thousand dollars worth of furs a year is more likely to be a maximum catch than a customary one.

A second problem concerns the lack of trading facilities. At the present time, a trapper living at the forks would have to make a round trip totalling 300 miles by river and 350 miles along the coast in order to sell his furs and bring back his outfit for the year, because the nearest trading post is at Tuktoyaktuk. Formerly the Hudson's Bay Company operated posts nearer to the valley at Baillie Island (1916 to 1938) and Maitland Point (1939).

In 1937 a Roman Catholic Mission was opened at Stanton (named after Rev. Father W. Stanton, provincial of the first American province of the Oblates who financed the mission). There is no harbour at Stanton, but transportation for the mission was supplied by the *Lady of Lourdes*, a sea-going ship that obtained shelter, when necessary, at either the northeast or southeast sandspits of Nicholson Peninsula. The site of Stanton was chosen in part because there was good fishing and driftwood nearby. The little settlement comprises only a main building, a storehouse, and several small log cabins at the mouth of a stream. The main building is just above the storm level of the beach, and the hills behind the site rise to about 150 feet. When the mission was founded, only a white trapper and his family lived there, but natives came later with the founding of the mission. Eventually about 5 Eskimo families came to live at or near Stanton. Fuel was obtained from driftwood and from log rafts floated down the Anderson River from as far south as Windy Bend.

A short-lived attempt was made to introduce reindeer at the mouth of the Anderson River in 1938. The herds were grazed near the mouth of the river and on Nicholson Peninsula. In 1942, the herd totalled about

2,500.[10] In 1944, the chief of the native herders and the white supervisor were drowned in the wreck of their schooner near Cape Dalhousie. The Government took active steps to assist the families of the reindeer herders who were lost and endeavoured to regroup the scattered animals. In the next few years the reindeer were moved west to the Eskimo Lakes, Tuktoyaktuk region.

In 1955, there was not one Indian or Eskimo living in the lower Anderson River valley where MacFarlane 99 years before had encountered over 500 people; only one person, a solitary white trapper, lived in the valley, at the forks.

PHYSIOGRAPHY

The broadly U-shaped lower Anderson River valley is incised into a gently rolling upland surface. At the forks, the upland is about 450 feet above river level; between the site of old Fort Anderson and Windy Bend (a locally used name), about 600 or more feet above river level; and on the east side of Windy Bend, about 700 feet above river level. From Windy Bend northwards, the upland surface decreases in altitude so that near Husky Bend (a locally used name) it rises only 300 to 400 feet above river level; at latitude 69°32'N, only 250 feet above river level; and at the east side of the mouth, some 200 feet above river level. Since the river flows, in stretches, with a gradient of several feet per mile, in particular upstream from Husky Bend, the altitudes above sea level considerably exceed the altitudes above river level.

Tributary streams have cut steep-sided valleys back into the upland. Even a stream that is dry in late summer may, in its brief periods of flow, carve a gorge several hundred feet deep.

The Anderson River, while lowering its bed, has left flights of erosional and depositional terraces above it. These terraces border the river from the forks to the mouth. They occur in various stages of preservation at all altitudes from just above the modern floodplain level up to the upland surface. A capping of river gravels helps to delineate the terraces, both in the field and on air photos, because the grassy vegetation typical of such gravelly soils is distinctive and easily recognized.

The river reaches its highest level during the spring break-up with its melting snows. From then on, except for temporary fluctuations caused by heavy downpours, the river level gradually falls until freeze-up in October or November. The variation in river level, which ranges from

[10] Clarke, C. H. D.: Report on Development of Reindeer Industry, Mackenzie District, Ottawa, 1942, typewritten, p. 3.

10 to 25 feet depending upon particular conditions, has two important effects, namely ice erosion and floodplain deposition.

Ice jams often occur at constrictions of the channel or at sharp bends, and aggravate flooding. When the ice overrides the river banks, it may produce ice-shoved heaps, denude the lower alluvial banks of its willows, and push above floodplain level to the zone of spruce growth. Evidences of ice action may be found at least 10 feet above the high water mark.

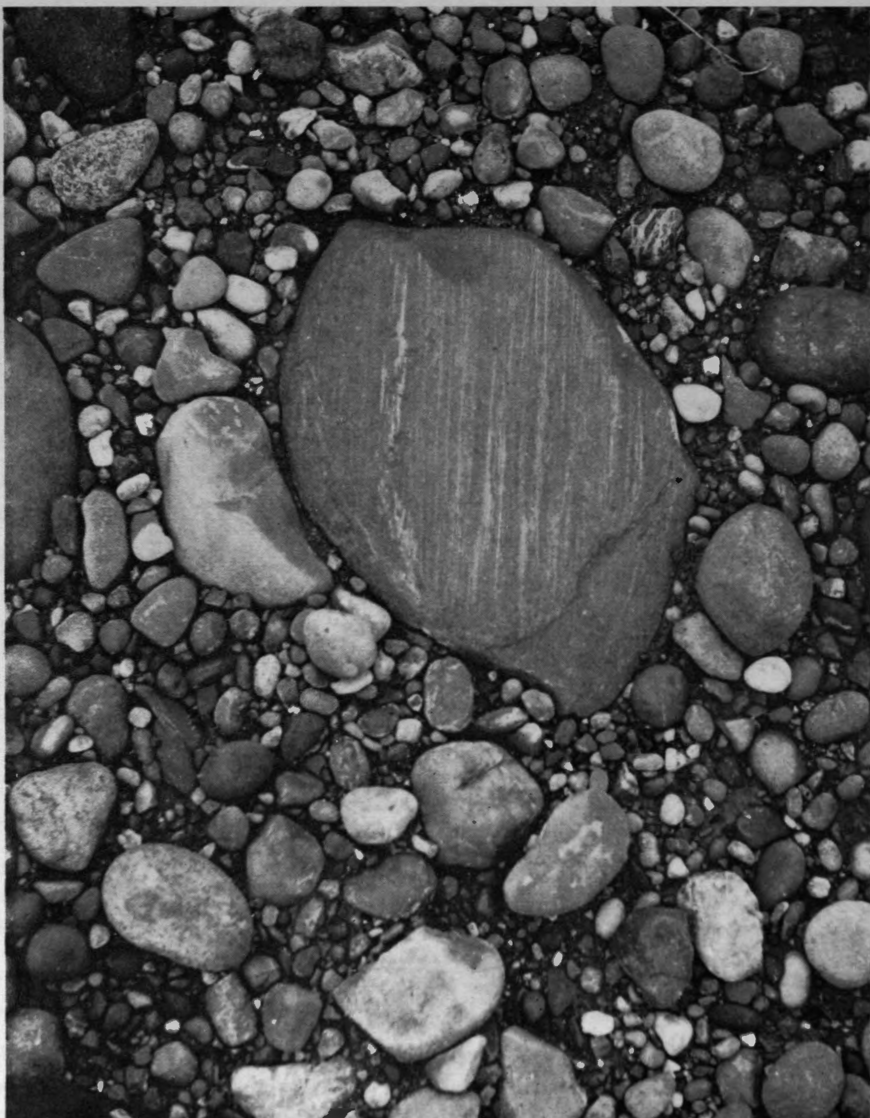

Figure 2. A boulder pavement with a striated boulder about 8 inches in diameter. The striations and faceting of the boulder have been caused by the frequent passage of rock-shod river ice down the Anderson River.

The banks and channels of Anderson River are of mud and sand downstream from Windy Bend. Upstream from Windy Bend, gravelly banks are common and the bottom of the channel is very stony. As river ice is swept downstream, boulders embedded in the bottom of the ice gradually abrade the gravelly banks to form "boulder pavements" in a manner similar to that of glacier ice. Pebbles and cobbles may be packed so tightly into the ground by the weight of the overriding ice that they are hard to pry loose. Many of the boulders are faceted and striated on their upper surfaces. Excellent examples of striated and faceted river boulders held in mud are present along the middle reaches of the Anderson River between high and low water levels. As the Anderson River begins to flood at the end of May or early June, the inundated banks are probably frozen. Boulders are then held tightly in the tenacious grip of frozen mud as if embedded in cement. The repeated downstream passage of rock-shod river ice abrades, striates, and facets the boulders. Even when the muds are unfrozen and water levels have fallen to expose the boulder pavements. the boulders are still tightly held in place and are difficult to dislodge by hand.

Floodplains are built at the high water period following break-up when the river level may rise from 10 to 25 feet depending upon local and climatic conditions. These floodplains do not stand at a constant height above the winter level, nor do they slope uniformly downstream, because of variations in the gradient of the river, the shape of its channel, constrictions or bends favourable to ice damming, the volume of water added by tributaries and so forth (Figure 3). At the forks, floodplains are about 10 feet above winter water level. The altitudes of the floodplains above low water level gradually increase downstream to a height of 20 feet at Fort Anderson. Floodplain heights decrease to about 15 feet in the straight north-south section at about latitude 69°N and then increase again to 20 feet or more

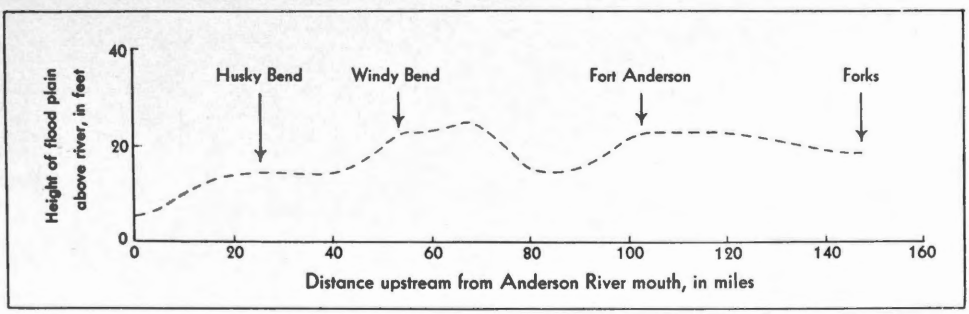

Figure 3. The graph shows the heights of the floodplains (as measured in mid-August, 1955) above the river level as a datum.

from latitude 69°08'N to Windy Bend. Floodplain heights decrease gradually from Windy Bend to the mouth of the Anderson River; they are only 15 feet above low water level at Husky Bend, several feet in the low alluvial islands in the estuarine mouth, and near high tide level in Wood Bay.

The floodplains from the forks to latitude 69°32'N are not continuous, but composed of many terrace strips, usually on the sides of the slipoff slopes. From latitude 69°32'N to the mouth, a distance of 20 miles, the river flows on the right-hand (east) side of a gradually widening floodplain. Higher land rises to the right (east) of the river with the left (west) side marked by branching channels, lakes, and low alluvial islands. The alluvial flats at the mouth are 4 miles wide.

The Anderson River is building its delta northwards into the shallow waters of Wood Bay. The discharge into Wood Bay is through two primary channels each of which branches into two secondary channels. Tidal flats, exposed at low water for a distance of 1 to 2 miles from the mouth, are covered to a depth of 5 feet or more at extreme high waters.

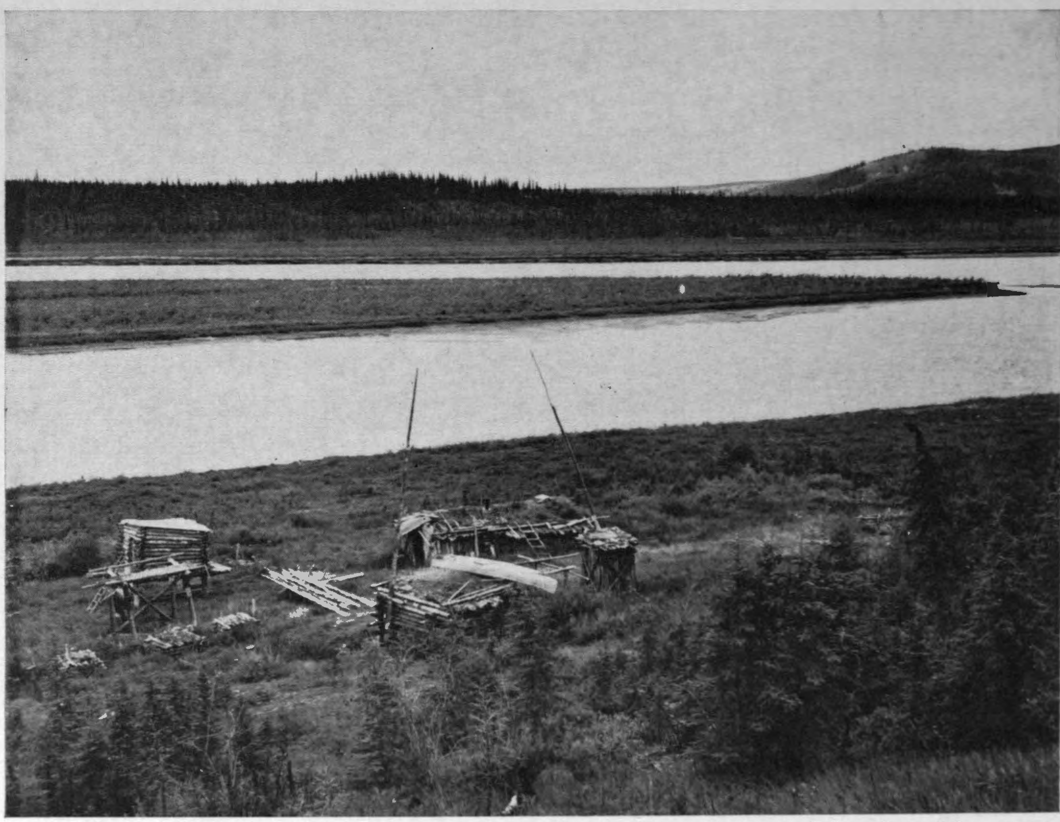

Figure 4. Looking southwest across the Anderson River at the "forks". The Carnwath River flows at the base of the hill (top right). A trapper's cabin is in the foreground.

Grassy vegetation is being established on the higher parts of the mud flats which form favourite feeding grounds for whistling swans.

Anderson River water can usually be detected by salinity and colour as far north as the northeast sandspit of Nicholson Peninsula. A sharp line of contact between the fresh silty waters of the Anderson River and the clear brackish waters of Liverpool Bay may be seen frequently extending to or beyond the northeast sandspit of Nicholson Peninsula. The water at the northeast sandspit is, at times, fresh enough to drink.

The lower Anderson River valley has been cut into easily eroded grey shales and associated sediments. Resistant Devonian limestones[11] are exposed along the channel upstream from the forks to the east of longitude 128°W. Swift, narrow constrictions of the river, interrupted by rapids and small falls, are present where the river has cut into bedrock. At the forks a grey shale is exposed in the hills and along steep, undercut river banks; the shales weather rapidly into light grey muds. From about 10 miles downstream from the forks to within a few miles of Windy Bend a dark grey shale with a few thin beds of iron-cemented sandstone is exposed in many sections. Fragments of a few clam shells, bright with mother of pearl, are present in the shale. Constant slumping and landsliding takes place in the deeply weathered shale wherever slopes are steep, in particular along undercut slopes.

From the valley of the large right-hand tributary at latitude 69°10'N to about latitude 69°31'N, there is a formation in which spontaneous combustion has taken place. Exposures are present in the valley of the tributary river at 69°10'N, on the east side of Windy Bend and from Husky Bend northwards. The exposures on the north side of Husky Bend are scenic with brick-red and yellow ochre crags, pinnacles, and slopes. Burnt areas extend from near river level to over 300 feet above the river, and grade laterally into unburnt sections of laminated shale with much carbonaceous material which is easily ignited with a match. Many of the beds, both fresh and burnt, are folded as a result of slumping and combustion. Active burning was only observed in a ravine on the east side of Husky Bend.

Near the mouth of the Anderson River, on the east side, there is a hill about 190 feet high. The slopes expose light grey shales similar to

[11] Meek, F. B.: Remarks on the geology of the valley of the Mackenzie river, with figures and descriptions of the fossils from that region, in the Museum of the Smithsonian Institution, chiefly collected by the late Robert Kennicott, Esq.; *Trans. Chicago Acad. Sci.*, Vol. 1, Pt. 1, 1868, pp. 61-114; Warren, P.S.: The Role of *Sphaerospongia Tersellata* in the Mackenzie River Devonian; *Can. Field Naturalist*, Vol. 58, No. 1, Jan.-Feb., 1944, pp. 28-29.

Figure 5. Looking east across the Anderson River to the undercut bank at Husky Bend. Carbonaceous material was burning in this area during August, 1955.

those farther south on the river near Stanton, and at Harrowby Bay. Every 3 to 10 feet there are blackish iron-stained beds 1 to 3 inches thick. Some plant remains are present in the darker bands.

No tabular sheets of ground ice were seen along the Anderson River in contrast to the abundance of such ground ice along the Liverpool Bay coast to the north. Evidently the grey shales of the Anderson River valley and similar shales near Stanton and Harrowby Bay have not provided suitable conditions for the growth of extensive ice sheets like those in the younger coastal deposits. So far as is known, any ice sheets near the mouth of the Anderson River are in Pleistocene or Recent deposits and not in the older Cretaceous (?) shales or their weathered muds. Large polygons outlined by fissures forming a network 50 to 100 feet in diameter are present in the valley. They are most easily recognized on floodplains where alders frequently grow on the sides of the fissures and outline the polygons.

All of the Anderson River valley has been glaciated, although not necessarily during the last ice advance. Erratics are present on the hills near the forks, on the hilltops at about 800 feet above sea level at Windy Bend, and at 300 feet above sea level at Nicholson Peninsula. It should be pointed out, however, that some of the erratics at the lower altitudes might have been ice-rafted during a period of submergence. Nicholson Peninsula has been thrust-faulted by glacier ice moving eastwards along the Eskimo Lakes.[12]

Glacially fluted ground with a northwest-southeast lineation is present east of longitude 128°W. The same trend is present to the west, south, and southeast of Crossley Lakes. Between latitudes 68°N and 68°20'N, longitudes 128°W and 129°30'W, the trend varies from almost north-south in the east to north-northwest—south-southeast on the west by the Carnwath River. There is very little evidence of fluting between the forks and the mouth.

East of longitude 128°W an end moraine with outwash deposits and ice-contact faces trends roughly east and west at a distance of 12 to 15 miles north of the Anderson River. Several large east-west Pleistocene valleys partly filled with glacial deposits lie just north of the end moraine. A network of drainage channels, some probably formed by glacial meltwater and others by streams which have been captured, lie on the east side of the Anderson River from Windy Bend southwards.

NICHOLSON PENINSULA

Nicholson Peninsula is only 8 miles long, with a maximum width of 4 miles. It is joined to the mainland by a low isthmus which narrows to less than 200 feet and drops to 10 or 15 feet in height. An east-west profile of the island brings out its asymmetry. The higher land in the west culminates in a series of ridges that extend north-northeast to south-southwest parallel to the coast. Individual ridges range from several hundred feet to a thousand feet in length. Although they show up remarkably well on aerial photographs, the linearity is so inconspicuous in the field that the ridges are very hard to recognize. The ridges occur at altitudes from about 200 feet to 300 feet, the latter being the highest altitude on the peninsula. The eastern part of the peninsula lies below 100 feet in altitude, and there are many ill-drained depressions and lakes in the southern half. The southeastern part of Nicholson Peninsula has five pingos, which are conical

[12] Mackay, J. R.: Mackenzie Deltas—A Progress Report; *Can. Geog.*, No. 7, 1956, p. 8.

to elongated hills with ice cores.[13] Tabular ice sheets with associated slumping are present along the eastern coast.

The height of Nicholson Peninsula is much greater than that of nearby areas of the mainland with similar sands, silts, and clays, and the material on it is quite different from that of Stanton, Anderson River valley, and Harrowby Bay, although it resembles that of Cape Bathurst-Baillie Islands, "Tuk Peninsula" and the unusual "fingers" of the Eskimo Lakes. Partially carbonized logs and water-worn branches are present in the sediments. Small clam shells, identified by Dr. F. J. E. Wagner, Geological Survey of Canada, as *Yoldia arctica Gray*, are abundant in the clays. This marine species is often associated with glacial meltwater.

The linear ridge pattern of the western part of the peninsula has been formed by glacier-induced thrust-faulting with pressure directed from the west. Particularly good sections are exposed along the wave-cut cliffs on the north and northwest sides of the peninsula. At the northern end, the beds have a dip of about 20° to the west. Locally, however, the beds are faulted, crumpled, folded, and overturned, especially in beds of interlaminated sand and clay. Slickensided slabs of clay are common. Beds of massive grey clays, 10 to 20 feet thick, often overlie sandy beds up to 60 feet thick. The sandy beds are finely laminated, crossbedded, or massive. Both the clays and the sands are free of extensive ice segregations.

The bluffs on the northwest side of the peninsula are cut into sands and silts, and the thick clay beds exposed at the northern end are absent here. There is a beach a hundred feet wide with depths hardly exceeding a foot at a distance of 100 feet offshore. The bluffs are not being actively undercut so that parts are covered with vegetation. Even some of the westward flowing creeks are not downcutting. One creek that was ascended for half a mile has a flat-floored valley, in places 500 feet wide. Fans are being built into the valley and solifluction lobes are encroaching upon it. The small stream follows the fissure pattern of tundra polygons for much of its course. The valley indicates that the stream, once vigorous, is now in senility and barely able to maintain its channel.

The evidence for thrust-faulting is substantiated by exposures on the east side of the peninsula. At latitude 69°56'55"N, the sea cliff is 30 to 40 feet high and exposes beds of clay and silt loam. There is an effect of false bedding imparted by closely spaced, nearly horizontal shear planes one to several inches apart. The surfaces are smoothed and slickensided.

[13] Porsild, A. E.: Earth Mounds in Unglaciated Arctic Northwestern America; *Geog. Rev.*, Vol. 28, Jan. 1938, pp. 46-58.

Small clam shells (*Yoldia arctica Gray*) have been mashed out along the shear planes. Pieces of wood are found in the clay. No ground ice was seen in the sea cliff, although a tabular ice sheet was exposed half a mile to the north beneath some windblown silts.

No exposures of till were found but gravel and boulders are present from sea level to the highest ridge. The most extensive concentration of boulders is at the base of the northeast sandspit. Many of the larger boulders are coarse-grained, porphyritic granitic rocks with feldspar crystals an inch long. These boulders have probably been glacially transported from the Precambrian areas to the southeast. A grey limestone containing Devonian brachiopods and corals is also present. The rocks may have come from the upper Anderson River area. A sandstone with Cretaceous (?) pelecypods, similar to sandstones found near Tuktoyaktuk and Kitigazuit[14] is also fairly common along the beaches.

Evidences of post-glacial submergence are preserved nearly to the top of the peninsula.

CLIMATE

There are no climatological stations along the Anderson River so that data can only be interpolated from the nearest stations such as Aklavik, Coppermine, and Port Radium. The northern part of the valley lies in the climatologically defined arctic, the southern part in the subarctic. One of the more widely used lines for delimiting the arctic-subarctic boundary is the 50°F mean monthly isotherm for the warmest month of the year. In the Anderson River valley, the line trends almost east-west near the latitude of Husky Bend. The isotherm agrees well with the climatic micro thermal tundra boundary based upon Thornthwaite's potential evapotranspiration, or water need.[15]

The mean annual range of temperature is about 70°F from a low of about –20°F in January-February to a high of close to (i.e. either above or below) 50°F in July. Minimum winter temperatures may drop down to –50°F or –60°F with maximum summer temperatures approaching 85°F. The mean annual precipitation, with a summer maximum, is about 10 inches. Roughly half of the total precipitation falls in the form of snow.

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[14] Richards, H. G.: Postglacial Marine Submergence of Arctic North America with Special Reference to the Mackenzie Delta; *Proc. Am. Phil. Soc.*, Vol. 94, No. 1, 1950, pp. 31-37.

[15] Thornthwaite, C. W.: An Approach Toward a Rational Classification of Climate; *Geog. Rev.*, Vol. 38, Jan. 1948, pp. 81-85; Sanderson, M.: Drought in the Canadian Northwest; *Geog. Rev.*, Vol. 38, April 1948, pp. 289-299.

VEGETATION

The mouth of the Anderson River valley lies within the tundra. The valley half way between the mouth and the forks is treed with scrub birch and willow on hilltops and upper slopes. Near the forks there is fairly continuous open woodland cover with trees in the valley and on the hills.

The vegetation of the open woodland is characterized by a sparse open stand of white spruce with interspersed shrubs and heaths and a ground cover of lichens, mosses, grasses, sedges, and other plants. At the forks is a hill 600 or more feet above sea level. In 1955, the hill was forested with white spruce averaging 15 feet apart, 25 to 30 feet high, and 6 to 8 inches in diameter one foot above the ground. In between the trees were alder clumps averaging 25 feet apart and 4 to 6 feet high. Willows, 2 to 4 feet high, were more closely spaced than alders and averaged 10 feet apart. Ground birch (*Betula glandulosa*), 1 to 3 feet high, grew about 5 feet apart. Labrador tea (*Ledum decumbens, L. groenlandicum*), avens (*Dryas integrifolia*), bilberry (*Vaccinium uliginosum*), cranberry (*Vaccinium Vitis-idaea*), crowberry (*Empetrum nigrum*), bearberry (*Arctostaphylos* sp.) buffalo-berry (*Sheperdia canadensis*), and Lapland rhododendron (*Rhododendron lapponicum*) were widely dispersed. Larch (*Larix laricina*) grew every hundred feet or so. The ground was broken into sedgy hummocks 1 to 3 feet across and up to a foot high. Each hummock carried a growth of sedges, lichens, mosses, and some of the plants mentioned above.

Near the forks, larch grows on the floodplains in small stands up to an acre in extent and about 15 feet high. The number of larch gradually decreases downstream, the northernmost trees seen being at latitude 69° 7'N. Birch trees and balsam poplar also grow near the forks, the northernmost birch observed being at latitude 68°49'N. Balsam poplar is found most commonly on southward facing gravelly bluffs. A southerly facing slope at Husky Bend has some balsam poplar over 10 feet tall and 2 inches in diameter.

In proceeding downstream the hilltops become noticeably less well-forested within the short distance from the forks to the site of old Fort Anderson. On the higher hills, the spruce grow 50 to 100 feet apart. Few spruce are over 10 feet tall. Low willows and ground birch are abundant; they cover roughly 30 per cent and 40 per cent of the ground respectively. The numerous alluvial fans in the valley are covered with tall willows, 5 to 10 feet high, with many bleached, white, dead branches that give a grey ashy tone to the slopes. In sheltered places, however, spruce of 40 feet and willows of 20 feet were measured.

At Windy Bend spruce are found on many bluffs and slopes but the higher hills are treeless. The hills for miles around are covered with ground birch and willow 1 to 2 feet high. The area looks like a grassy meadow from a distance, but the vegetation is thick, knee high and scrubby with willows and grassy vegetation abundant on slopes. Alders, whose dark green leaves look almost black in the distance, are present in ravines, especially where the ground is well watered.

At Husky Bend there are several spruce groves. The higher land is largely in ground birch and willow. By latitude 69°30'N, a few spruce are found on slightly drier ridges but the hills are entirely in willow-birch. The northernmost spruce seen in the valley were 10 miles south of the Anderson River mouth at latitude 69°39'N. Natives report that a spruce grove has recently started growing near Stanton, but this area was not seen in the field. However, on the east side of Wood Bay at latitude 69°47'N, a stream cut exposes 5 to 10 feet of peat and logs (probably of spruce) up to 8 inches in diameter. The fresh looking logs are in place and are not driftwood.

The rolling terrain at the mouth of the Anderson River has low willows 1 to 2 feet high covering about 50 to 75 per cent of the surface. Ground birch is not as widespread on the hilltops near the Anderson River mouth as farther south but is more restricted to slopes and flats. The low alluvial islands at the mouth of the river are covered with several species of willow. The first colonizer of the alluvial muds of the islands appears to be a low prostrate willow a few inches high. Other plants are grasses, sedges, vetches, etc.

Near Stanton, most of the rolling land is covered with low willows less than 2 feet in height. Avens, grasses, and sedges are abundant, but ground birch is sparse. In areas of slumping, marsh fleabane is an early colonizer.

The vegetation of Nicholson Peninsula seems more tundra-like than that of Stanton. This may in part be due to past grazing by reindeer, but the striking differences between Nicholson Peninsula and the Stanton area can hardly be attributed to reindeer alone. Climate and soil must play a part. Nicholson Peninsula has large areas of cloddy ground covered with avens, low willows a few inches high, heather, sedges, and other plants. Sedgy polygonal flats are found in some depressions.

NAVIGATION

Trappers who have lived in the Anderson River valley in recent decades have usually travelled up and down the river by boat to sell their furs and obtain their yearly supplies, although a few have come overland by dog team in the winter.

River break-up may occur as early as mid-May or as late as mid-June, but in most years trappers report it to be either in the last week of May or the first week of June. MacFarlane has recorded break-ups for six years.[16]

June 12, 1857 at the junction of Anderson and Lockhart River
May 15, 1861 at Fort Anderson
May 19, 1862 at Fort Anderson
May 30, 1863 at Fort Anderson
May 31, 1864 at Fort Anderson
June 2, 1865 at Fort Anderson

The ice of the Anderson River breaks up before the ice of Liverpool Bay so that Wood Bay may be ice-free when Liverpool Bay is frozen solid. The river ice also goes earlier than most of the ice in the larger lakes.

Freeze-up of the Anderson River may commence in late September, and lakes may have several inches of ice by the end of September or early October. The river may not freeze over solidly until late October or early November because open stretches are maintained for some time by river flow.

Navigation from the mouth of the Anderson River in early summer is dependent upon ice and weather conditions in Liverpool Bay and along the coast. Coastal boats can rarely make the passage to Tuktoyaktuk before the second week in July. In some summers, ice conditions may prevent boats from reaching Tuktoyaktuk until early August. The normal navigation season for coastal boats closes in early September although it might be prolonged several weeks in a late season.

Trappers have usually taken their boats downstream shortly after break-up. At this time the water level is high so that shallow draught canoes, skiffs, or flat bottomed scows sail downstream with ease.

On the return journey, normal approach to the Anderson River from Liverpool Bay is by means of the easternmost distributary channel of the delta (Figure 6). The entrance is best tried at high tide when the extra depth lessens the chance of going aground. At low tide mud flats are exposed or lie under a few inches of water on either side of the channel.

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[16] Preble, E. A.: A biological investigation of the Athabaska-Mackenzie region; North American Fauna No. 27, *U.S. Dept. Agriculture*, Washington, 1908, p. 49.

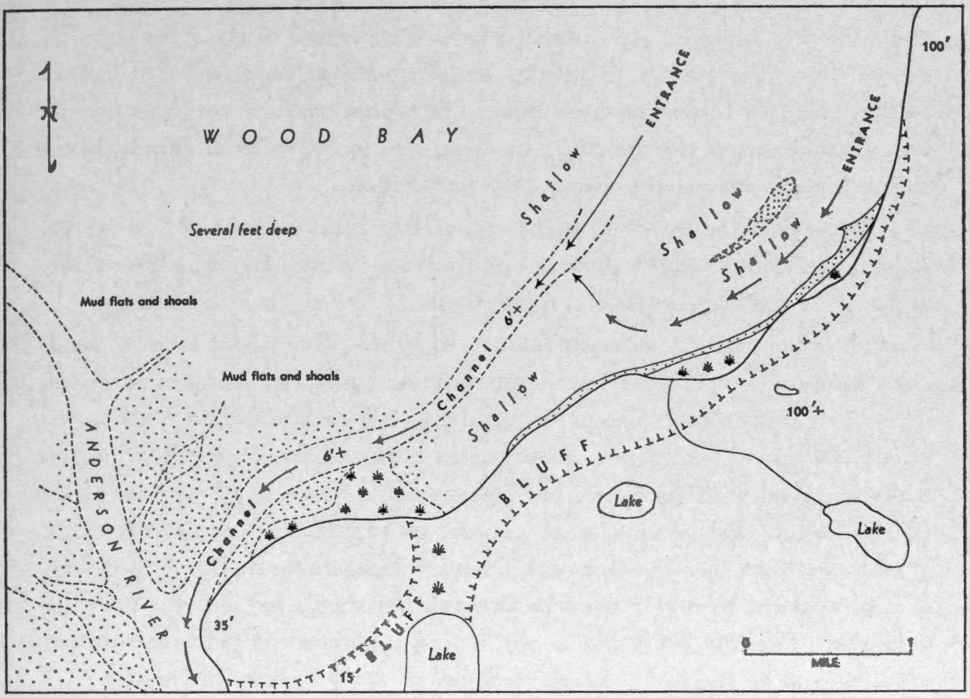


Figure 6. Mouth of the Anderson River, drawn from an air photograph. Depths are given where possible, in terms of low tide level. The two most commonly used entrances into the distributary channel of the Anderson River are shown.

The channel, which is about 200 or 300 yards wide, is bordered by low levees. Trappers have found it useful to mark the seaward end of the channel with a buoy on their outward trip so that it may be easily re-entered from the seaward side on the return trip. If there is no marker in the channel, some trappers skirt the east side of Wood Bay and then cross over to the channel. If the channel is carefully approached at high water, boats drawing 3 or 4 feet of water can navigate it. On a calm day, a navigator used to "reading the water" can detect riffles which delimit the channel, but on a breezy day, navigation is tricky even for those familiar with the course.

Once a boat passes Grassy Point (a local name) navigation is relatively easy. The tides are small, being only 1 to 2 feet, but tidal effects are said to be felt as far as Husky Bend. There is a definite slackening of the current for at least 20 miles upstream with a rising tide. In addition, a strong west wind may raise the water level at the mouth at least 5 feet with effects felt beyond Husky Bend. A strong easterly wind may lower the level of Wood Bay by several feet, but not as much as a westerly wind may raise it. As a result of the tidal rise and fall the concentrated flow at flood stage in early summer, and other factors, the channel of the river is much deeper from the mouth to Husky Bend than it is upstream. Channel depths down to 15 feet or more below low water level are common for the first 20 miles from the mouth. The decrease in depth from Windy Bend to the forks is very slight, being only 1 to 2 feet.

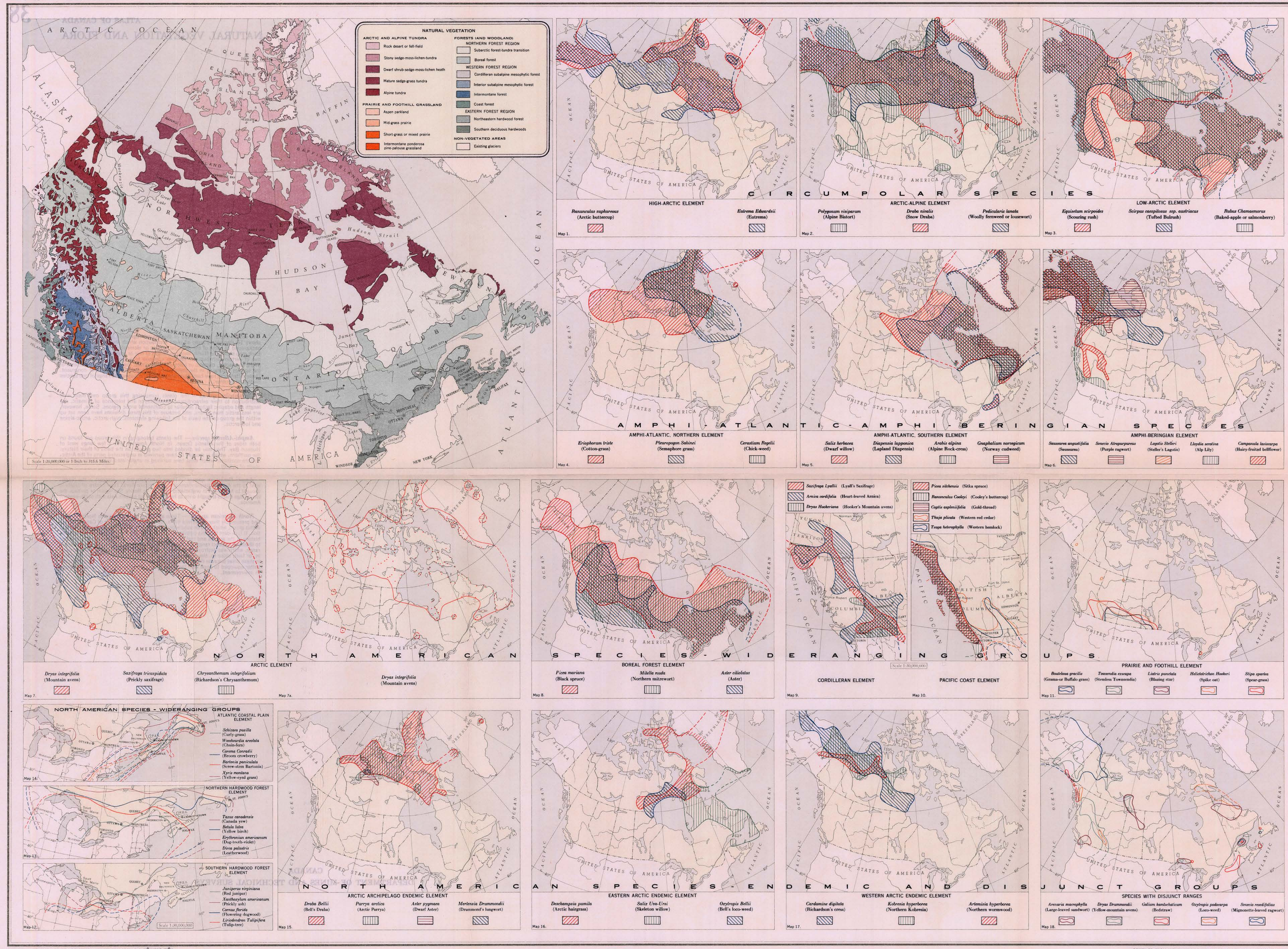
Boats of 3- to 4-foot draught can sail to Husky Bend at low water. A boat of 2-foot draught could probably reach Windy Bend at low water, although it might run aground a few times.

The river bottom from the mouth to Windy Bend is of mud or sand, even in mid-channel, as are the islands, stream banks, and deltas of affluents. There is a transitional zone at Windy Bend between sand and mud downstream, to gravel upstream. The channel bottom from Windy Bend to the forks is paved with boulders, but stream banks have much gravel, as do islands and deltas. At low water, miniature rapids are present over many gravel shoals so that even though channel depths are usually 4 to 6 feet, it is often hard to find a passage through the shoals for a canoe drawing 6 inches. Shallow draft boats proceeding upstream in the late summer may have to be tracked through stretches of gravelly bars and shoals.

RÉSUMÉ

L'auteur présente dans cet article une partie des observations faites dans le bassin hydrographique de la rivière Anderson (T.N.-O.) au cours de travaux sur le terrain en 1951 et 1955. Un exposé complet des travaux exécutés fait l'objet d'un rapport publié par la Direction de la géographie dans sa série des Mémoires; la région étudiée ici est un prolongement de la vallée principale. On y traite en détails des phénomènes d'ordre physiographiques et glaciologiques rencontrés le long du cours inférieur de la rivière Anderson, y compris la péninsule de Nicholson. Le rapport compte un abrégé des conditions climatiques, de nombreuses observations sur la végétation, ainsi qu'un court relevé des problèmes de la navigation rencontrés dans les basses eaux de la rivière Anderson.

Les explorations de Richardson en 1826, suivies de celles de MacFarlane sur la rivière Anderson en 1857, amenèrent, en 1861, l'érection de Fort Anderson par la Compagnie de la Baie d'Hudson. L'abandon de ce poste en 1866 fut un indice des tendances démographiques de l'Ouest arctique où déjà prévalait la dépopulation par les migrations et les épidémies. Récemment la population de la vallée Anderson était réduite à quelques trappeurs blancs seulement et, en 1955, un seul d'entre eux y demeurait encore.



LAMBERT CONFORMAL CONIC PROJECTION STANDARD PARALLELS 49°N AND 77°N

SCALE 1:50,000,000 or ONE INCH to 789.1 MILES

COMPILED FROM INFORMATION SUPPLIED BY THE NATIONAL MUSEUM OF CANADA.

NATURAL VEGETATION AND FLORA

In addition to a general map of the natural vegetation of Canada, this plate shows 18 elementary types of plant distribution which illustrates the historical background of some of the principal groups or elements in the flora of Canada. Each map shows the North American ranges of one or several species representative of certain distributional patterns common to a group of plants. However, owing to edaphic, climatic or historical differences, the distributional patterns of the species belonging in the same group are not always identical or congruent. These differences have been illustrated by superimposing the range of one species on that of another.

Circumpolar species — The plants composing this group owe their wide distribution to their extraordinary adaptability to and tolerance of climatic, day length and edaphic factors peculiar to continental arctic regions. Some, however, are less arctic than others, and because of this three divisions have been set up within the group on the basis of the following elements: high-arctic, arctic-alpine and low-arctic.

Amphi-Atlantic species — The plants belonging in this group are found on both sides of the Atlantic Ocean. In North America only a few range west of Hudson Bay. They may be divided into two groups on the basis of their history: the northern, which is thought to have survived in unglaciated parts of the Arctic, and the southern, which must have survived in unglaciated areas to the east and south of the ice.

Amphi-Beringian species — These constitute the counterpart in the North-west to the Amphi-Atlantic element in the eastern flora. Their centre of origin is thought to have been in unglaciated parts of the Bering Sea region or perhaps the landbridge that is thought once to have connected eastern Asia with north-western America.

North American species — These are peculiar or endemic to North America and presumably they all evolved there. By far, most of the flora of Canada belong in this group, which may be subdivided according to present geographical distribution. It is evident that this distribution closely reflects the post-glacial or preglacial history of the groups and that of the land they occupy. The five species selected to illustrate disjunct ranges are thought once to have had a more nearly continuous range, which was destroyed or broken up during the ice age, and to have survived in, or fairly close to, the areas where they are now found. Some may be isolated in these areas because they have lost the ability to compete with species genetically better equipped to cope with the vicissitudes of migration and resultant changes in environment.

CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOGRAPHICAL DISTRIBUTION OF SOME ELEMENTS IN THE FLORA OF CANADA

*by A. E. Porsild**

There are a number of reasons why plants are not evenly distributed over the Earth. Some of the most obvious and best known are temperature, moisture and soil. Thus, in Canada the tulip-tree (*Liriodendron Tulipifera*), the redbud (*Cercis canadensis*) and the pawpaw (*Asimina triloba*), to mention only three, are restricted to southernmost Ontario where winters are mild because of the latitude and the tempering influence of the Great Lakes. If planted elsewhere in Canada in a more rigorous climate, these trees might succeed for some time, but sooner or later would be killed by winter frosts. Conversely, many arctic plants, if transplanted to botanical gardens in the south, might survive for some time, but few would produce flowers and fruits. However, the north to south range of some plants is not controlled by temperature alone but also by the length of the day. Thus some plants, especially those of the tropics, do not flower and fruit when the hours of daylight exceed 12, whereas many arctic plants require a long day, and some even continuous daylight during the growing season, in order to flower and mature fruits.

The range and distribution of some other species are controlled by their soil and water requirements. The cat-tail (*Typha*) will grow only in a wet marsh; the water-lily (*Nuphar*) only in a moderately deep pond or shallow lake. Most members of the heath family (*Ericaceae*) and many of the ferns and fern allies are oxylophytes, requiring an acid peaty soil, such as is found in peat bogs or in some woods, whereas a good many of the members of the mustard family (*Cruciferae*) require a mineral soil rich in lime. Other plants again are adapted to saline soils of sea-beaches, and some to strongly alkaline soils. Sometimes the combined habitat and climate requirements or tolerance determine the range of species; thus the cat-tail will not succeed in a marsh unless the summer temperature is about that required for wheat to ripen.

Groups of plants of similar soil or climatic requirements or tolerance often grow together in plant communities, in habitats that suit their requirements. The northern hardwood forest, the boreal spruce forest, or the

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assembly of plants inhabiting peat bogs or sand dunes are examples of plant communities. The distributions of the first two are controlled mainly by climate and soil, those of the latter chiefly by soil and moisture. Although the assembly of plant species of which such regional or local plant communities are composed may vary according to local climate and topography as well as according to the geographic origin of the species, the physiognomy of the community remains the same.

Another and much less understood reason why plants are not evenly distributed, although climate and soil may be suitable, is closely connected with the history of the land on which they grow and with their own history which, for many species, may extend into the distant geological past. From the fossil remains of plants and animals preserved in rocks, in coal beds, or in peat bogs, it is known that the climate over large parts of the Earth once was warmer and more uniform than it is today. However, at the beginning of the Pleistocene period, more than a million years ago, a general and gradual decline in temperature caused large masses of ice to accumulate in various parts of the northern and southern hemispheres.† In North America, land ice many thousands of feet thick developed and spread from various centres, destroying all plant and animal life in its path. During the several phases of the Pleistocene period, converging glaciers at one time or another covered nearly all of Canada, excepting parts of central and northern Yukon, the northernmost islands of the Arctic Archipelago, and isolated areas in the Cordillera. It is known that during the Pleistocene there were several "ice ages," separated by interglacial periods lasting many thousands of years, when the ice retreated or perhaps disappeared altogether.

From glacial deposits and scouring marks of various kinds, the direction of ice movement is known, as well as the extent of the last major glacial advance, generally named the Late Wisconsin ice sheet. Less is known about the extent of those that preceded it, except that at least one penetrated much farther south.

As 86 per cent of the area of Greenland is at present covered by a great sheet of ice, conditions there today must be very similar to those that existed in North America during the Pleistocene period. No plant life exists in central Greenland, whereas an ice-free coastal fringe, varying in breadth from a few to 160 miles, harbours a comparatively rich flora comprising more than 450 species of flowering plants and ferns, among them many that are not arctic. Opinions differ as to whether this flora, or parts

† See Plate 15 "Glacial Geology", *Atlas of Canada*, Dept. of Mines and Tech. Surv., Geog. Br., Ottawa, Queen's Printer, 1958.

of it, survived the earlier and more severe glaciation when glacier tongues overran most of the coastal fringe that has remained free of ice during the present interglacial period, or if the entire present flora immigrated and recolonized the island in post-glacial time. Certain analogies, however, may be drawn between conditions as they exist in Greenland today and those that prevailed in Canada during the last ice age. If non-arctic plants and quite complex and specialized plant communities now can exist and prosper in Greenland in close proximity to existing ice caps, elements of the North American flora and fauna that were destroyed by the last advance of the Wisconsin ice sheet could well have survived on ice-free areas known to have existed not only south of the ice, but in the western Cordillera, in Yukon, Alaska and in the Arctic Archipelago. In fact conditions must have been more favourable for the survival of plants and animals in North America, where the mountain ranges are largely oriented north and south, than in Europe where the mountain ranges of central Europe effectively stopped a southward migration of plants in front of the advancing ice.

With the retreat of the ice, the land again became available for plants and animals. In the absence of obstructing mountain ranges or water barriers, the movement of plants, on a broad front northward across the North American plains, must have been uniform, controlled mainly by the different rates of migration of which each species is capable. However, it is known that the ice did not advance or retreat uniformly in a symmetrical pattern everywhere, as topographical features, great and small ice lobes, or entire ice sheets, disrupted the northward movement of plants. In this manner the ranges of some species that formerly were continuous may have been disrupted, causing the formation of disjunct ranges of the type shown in the map entitled "Species with Disjunct Ranges".

Following the retreat of the ice, plants were able to reoccupy northwestern North America from large unglaciated areas in Alaska-Yukon and from similar refuges in the Cordillera; some may even have immigrated from eastern Asia, over the land connection which in Pleistocene times existed across Bering Strait. In addition, some coastal areas fringing the continent during Pleistocene times must also have been important refuges for plants.

RANGES OF PLANTS

When the ranges of the plants of which the flora of Canada is composed are plotted on maps, it at once becomes clear that the species may be sorted into regional groups having similar ranges. Climate, soil and topography affect the local ranges of the species within the groups, but the groups themselves obviously have a common historical background. Certain species thus have a distinctly eastern and some a distinctly western range, others are wide-ranging, whereas still others again are peculiar or endemic to smaller and restricted areas. It may be noted that those of eastern ranges are often common to western Eurasia and North America, and that frequently their main areas are in Eurasia. Because a wholesale transatlantic migration in post-glacial time was impossible, these Eurasian elements must have been present in North America before the ice age. In the same manner, a large number of species that in North America are restricted to the northwest are common also to eastern Asia. Among the flowering plants and ferns nearly half of those represented in the flora of the Arctic are of circumpolar range, as are a great many inhabiting high mountains of the northern Cordillera. More than half of the species that make up the present flora of Greenland are found also in North America south of the Strait of Belle Isle. The reason for this is clearly historical, and is closely bound up with what happened during and after the ice age.

TYPES OF PLANT DISTRIBUTION

Eighteen elementary types of plant distribution have been plotted on the maps included in the Atlas of Canada sheet "Natural Vegetation and Flora" to illustrate the historical background of some of the principal groups or elements in the flora of Canada. Three of these show circumpolar types of distribution; two show the ranges of plants common to eastern North America and western Eurasia; one shows the ranges in northwestern North America of plants of Asiatic affinity, and twelve illustrate the ranges of different groups of plants that are native or endemic to North America. In each map the North American ranges of one or several species have been mapped. The species selected were chosen as representative of certain distributional patterns common to a group of plants. However, owing to edaphic, climatic or historical differences, the distributional patterns of the species belonging in the same group are not always identical or congruent. These differences have been illustrated by superimposing the range of one species on that of another whereby is developed what has been called an "equiformal" pattern.

CIRCUMPOLAR SPECIES (Maps 1-3)

The plants composing this group clearly owe their wide distribution to their extraordinary adaptability and tolerance to the climatic and daylength, and edaphic conditions peculiar to continental arctic regions. Some are strictly high-arctic and in North America are largely confined to the Arctic Archipelago, while many are subarctic or alpine, having ranges extending south to or beyond the polar tree line. Very few are woody, none are treelike, and only few are annual. The wide distribution of the group suggests great age and that the species of which it is composed must antedate the Pleistocene.

In the North American Arctic flora, comprising nearly 900 species of flowering plants and ferns, those having a circumpolar range form the largest single group, contributing almost one-third of the total number of species; in the flora of the Canadian Arctic Archipelago this group alone comprises two-fifths of the flora. Among them are found many of the well-known arctic species besides many that are common in the mountains of eastern and western North America.

Because all members of this group are wide ranging, an attempt to subdivide them must necessarily be somewhat arbitrary. Some, however, are definitely less arctic in their ranges than are others, and on this basis three divisions have been set up within this group.

High-arctic Element (Map 1)

In the flora of the North American Arctic Archipelago 33 are high-arctic, circumpolar species that range north beyond the 80th parallel, and most of them as far as land extends toward the Pole. A few have isolated and widely separated stations in the northern Rocky Mountains and a few are found at sea-level south beyond the 50th parallel on James Bay. With the exception of the creeping arctic willow (*Salix arctica*), all are herbaceous.

As examples of the type of distribution common to the circumpolar high-arctic element, the North American range of the arctic buttercup (*Ranunculus sulphureus*) and that of an arctic member of the mustard family (*Eutrema Edwardsii*) are shown on Map 1

Some other well known arctic plants belonging in this group are alpine foxtail (*Alopecurus alpinus*), scurvy grass (*Cochlearia officinalis* ssp. *arctica*), tufted saxifrage (*Saxifraga caespitosa* ssp. *uniflora*) and bladder-campion (*Melandrium apetalum* ssp. *arcticum*).

Arctic-alpine Element (Map 2)

In the second subdivision of circumpolar species are placed the ubiquitous, wide-ranging, arctic-alpine species that in the North American Arctic nearly all extend to the 80th parallel or beyond, and southward range far into the subarctic taiga. In the flora of the Arctic Archipelago the 42 species belonging in this group all reach Greenland, as well as Yukon and Alaska; in the entire North American Arctic flora, some 100 species may be assigned to this group. Among them are such well known arctic plants as wood-rush (*Luzula confusa*), mountain sorrel (*Oxyria digyna*), purple saxifrage (*Saxifraga oppositifolia*), and the broad-leaved willow-herb (*Epilobium latifolium*), that with many others, appear to thrive equally well near the northern tip of Ellesmere Island, in the Hudson Bay lowlands, in Newfoundland and Gaspé, or in mountains of western North America. Woody species are few, and only the three shrubs, crowberry (*Empetrum nigrum*), arctic white heather (*Cassiope tetragona*) and bilberry (*Vaccinium uliginosum* var. *alpinum*), reach the Arctic Archipelago.

In Map 2 are shown the ranges of three species belonging in this group. The first, alpine bistort (*Polygonum viviparum*) of the buckwheat family, is an example of a plant ubiquitous in open tundra where it is present in all but the wettest plant communities. Its north-south range spans no less than 50 degrees of latitude, from the northern tip of Ellesmere Island to the mountains of southern New Mexico, while in the east it reaches south beyond the Gulf of St. Lawrence to the White Mountains of New Hampshire. *Draba nivalis* of the mustard family is a familiar plant of arctic and subarctic rocky barrens and cliffs. In the east it reaches the northern tip of Newfoundland and Gaspé but in the west is replaced south of latitude 60° by a closely related species. The third range shown is that of the woolly fernweed or lousewort (*Pedicularis lanata*), of the figwort family. It is the most arctic of the three species mapped, a fact that may explain its absence in continental arctic Europe; its absence in eastern Greenland suggests that it has reached Greenland from the west.

Low-arctic Element (Map 3).

In the third and largest subdivision of circumpolar species belong a number of ubiquitous tundra plants but, taken as a group, most have their main range south of the tree-line in the northern coniferous forest. Unlike those of the preceding groups, all have definite northern limits; most of them barely reach the southern fringe of the Arctic Archipelago; a few reach the 70th parallel; and only a few have isolated stations north of a line running through Lancaster Sound-M'Clure Strait. Although some reach far south in the mountains of eastern and western North America, the temperature and daylength amplitude of the group seems narrower than that of the preceding subdivisions, and, in the Arctic Archipelago, many are confined to exceptionally favoured habitats such as south-facing sheltered slopes with abundant snow cover.

Map 3 shows the North American ranges of dwarf scouring-rush (*Equisetum scirpoides*), tufted bulrush (*Scirpus caespitosus* ssp. *austriacus*) and baked-apple or salmonberry (*Rubus Chamaemorus*).

Although the range of *Equisetum scirpoides* extends north of the tree-line, it is pre-eminently a forest species; *Scirpus caespitosus* is at home in most subarctic or alpine bogs; and *Rubus Chamaemorus* is ubiquitous in peat or sphagnum bogs and muskegs.

Among the many common and well known species belonging in this group are several ubiquitous dwarf shrubs such as alpine bearberry (*Arctostaphylos alpina*), purple heath (*Phyllodoce coerulea*), lapland rosebay (*Rhododendron lapponicum*), mountain cranberry (*Vaccinium Vitis-Idaea* var. *minus*) and the net-veined willow (*Salix reticulata*). Many common grass and sedges belong here, as do the mare's tail (*Hippuris vulgaris*) of shallow ponds and sea-lungwort (*Mertensia maritima*) of sandy beaches.

AMPHI-ATLANTIC—AMPHI-BERINGIAN SPECIES (Maps 4-6)

Amphi-Atlantic Element(Maps 4 and 5).

The plants belonging in this group are found on both sides of the Atlantic. Many are found in Iceland and still more in Greenland; in North America they are confined mainly to the east and only a few range west beyond the Hudson Bay region. In Europe they are found chiefly in the highlands of Scotland and Scandinavia. However, some reach the mountains of central Europe, and the ranges of a good many extend across Finland and northern Russia.

The amphi-Atlantic plants may be divided into arctic and subarctic groups. Although in some cases the separation is somewhat arbitrary, each group clearly has a different history. Thus, in North America the plants belonging in the southern group must have survived the Pleistocene in unglaciated areas to the east and south of the ice, whereas the northern or arctic group is thought to have survived in unglaciated parts of the North American Arctic. The affinity of a good many of the northern or high-arctic members of this group is with the Arctic Archipelago endemics (Map 15).

On a percentage basis the plants of the amphi-Atlantic element are better represented in arctic and subarctic than in temperate parts of eastern North America. Thus in the flora of the Arctic Archipelago a total of 48 species, or nearly 15 per cent of the entire flora, belong in this group; 30 species reach the western islands of the Archipelago but only 6 reach eastern Yukon and Alaska.

Northern or arctic element. Map 4 shows the North American ranges of cotton-grass (*Eriophorum triste*), semaphore grass (*Pleuropogon Sabinei*) and high-arctic chickweed (*Cerastium Regelii*). These, like the members of the southern group of amphi-Atlantic species, are representative of a group of plants occurring on both sides of the Atlantic. Whereas the species in the southern group are oceanic and scarcely arctic, those of the northern group are arctic or high-arctic species of a distinctly continental range. For this reason they occupy a much larger area in North America where, over northernmost Greenland, they extend across the Arctic Archipelago, most of them to the Canadian mainland, and some even into the mountains of interior Yukon and Alaska. In the east a few reach northern Labrador-Ungava and the northern Hudson Bay region. A few species belonging in this group only reach northeast Greenland but not the north coast of Greenland, nor the Canadian Arctic Archipelago. Several are found on the arctic islands of Eurasia but only a few reach the Eurasian mainland. Some other well-known species belonging in this group are the dwarf arctic grass (*Colpodium Vahlianum*), Simmons' draba (*Draba subcapitata*), spider plant (*Saxifraga flagellaris* ssp. *platysepala*), arctic cinquefoil (*Potentilla pulchella*), dwarf willow herb (*Epilobium arcticum*) and pink lousewort (*Pedicularis hirsuta*).

Subarctic or southern element. Map 5 shows the North American ranges of dwarf willow (*Salix herbacea*), diapensia (*Diapensia lapponica*), alpine rock-cress (*Arabis alpina*) and Norway cudweed (*Gnaphalium norvegicum*).

The following are some additional species common to subarctic eastern North America and northwestern Europe: arctic rush (*Juncus arcticus*), three-forked rush (*J. trifidus*), dwarf birch (*Betula nana*), rose root (*Rhodiola Rosea*), yellow mountain saxifrage (*Saxifraga aizoides*), star saxifrage (*S. stellaris*), three-toothed cinquefoil (*Potentilla tridentata*), moss heather (*Cassiope hypnoides*), snow gentian (*Gentiana nivalis*), and arctic eyebright (*Euphrasia arctica*).

A small number of species belonging in this group are found in eastern Greenland but have not reached the west coast of that island nor the Canadian mainland or islands. Examples are: ice buttercup (*Ranunculus glacialis*), creeping draba (*Draba sibirica*), mossy stonecrop (*Sedum acre*) and common milkwort (*Polygala serpyllifolia*). A few non-arctic members of the group are found in eastern Canada or the eastern United States, but not in Greenland. Some well-known examples are: Heath bedstraw (*Galium saxatile*), water lobelia (*Lobelia Dortmanna*), and duckgrass (*Eriocaulon septangulare*).

Amphi-Beringian Element (Map 6).

In the northwest the "amphi-Beringian" element constitutes a counterpart to the amphi-Atlantic element in the eastern flora. Its centre of origin is thought to have been in unglaciated parts of the Bering Sea region or perhaps on the landbridge ("Beringia") that is thought once to have connected eastern Asia to northwestern America. Because of the close proximity to eastern Asia and the easy land connections many species of this group in post-glacial time have spread far into the two continents, using different routes that by themselves may provide a clue to their history and place of origin. In Alaska and Yukon the amphi-Beringian element constitutes about one third of the entire flora. In Map 6 five species have been selected to illustrate some principal range patterns of this group.

Saussurea angustifolia of the composite family belongs in the subarctic continental tundra and over Alaska, Yukon and northern Mackenzie has almost reached the west shore of Hudson Bay but does not range southward into the mountains of Alberta or British Columbia, nor has it been found in the Arctic Archipelago. A similar but more arctic pattern is shown by ragwort, *Senecio atropurpureus*, of the same family, which has reached the western islands of the Arctic Archipelago, but not Hudson Bay. *Lagotis Stelleri*, belonging in an Asiatic genus of the figwort family, represents a group of species that from Alaska reaches only to central and northwestern Yukon. *Lloydia serotina* of the lily family is widespread in northern and central Asia, eastern and central Europe, and even has an isolated station in the Snowdon Range in Wales. It belongs in a group of plants that in western America range through Alaska and Yukon, southward through coastal British Columbia, some of them reaching Oregon, Nevada or even New Mexico. The bellflower, *Campanula lasiocarpa*, from eastern Asia extends through Alaska and Yukon, but barely enters the District of Mackenzie; avoiding the coast it extends southward through high mountains of Alberta and British Columbia to latitude 50°. A number of other alpines have similar ranges. No member of the amphi-Beringian element reaches the Atlantic seaboard or Greenland and in the southern part of their range only a few reach the foothills of Alberta through gaps in the Continental Divide.

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NORTH AMERICAN SPECIES (Maps 7-18)

1. Wide-Ranging Groups

This large and most complex group is composed of species that are peculiar or endemic to North America and, presumably, all evolved there. By far the larger part of the flora of Canada belongs in this group which may be divided into natural subdivisions based on present geographical distribution that, evidently, closely reflects the post-glacial or preglacial history of the groups and that of the land they occupy.

Among the North American plants having the widest ranges are those composing the "Arctic" and "Boreal Forest" elements (Maps 7 and 8). The first is composed of species having their southern limit near the polar tree-line, the second largely of forest species. In Maps 9-18 are shown the ranges of other and less wide-ranging elements, all composed of plants peculiar to North America.

Arctic Element (Map 7).

The species belonging here nearly all range from Greenland to Alaska; a few that reach arctic eastern Asia, and a small number having isolated stations in arctic northwest Europe could be placed with the amphi-Atlantic or amphi-Beringian species but, because their main ranges are in North America, they are best placed in this group. The ranges of the plants illustrated by Map 7 closely resemble those of the circumpolar species (Maps 1-3) and like these must have survived the ice age over a wide front, some south of and some north of the ice. In Map 7 are shown the total ranges of three species representative of the North American Arctic element. Mountain avens (*Dryas integrifolia*) (*see* also map 7A) extends from Bering Strait to Greenland, northward beyond latitude 83°, south through Alaska and Yukon and the northern Rocky Mountains to Jasper Park, and to Great Slave Lake, Hudson and James Bay, Ungava, Labrador and Newfoundland. Outside its main range are isolated stations in eastern Greenland, the Gulf of St. Lawrence, the north shore of Lake Superior, and in high mountains of Montana. Prickly saxifrage (*Saxifraga tricuspidata*) has essentially the same range but does not extend quite so far south in Greenland or eastern Canada. It has a single isolated area in eastern Greenland and one on the north shore of Lake Superior. Richardson's chrysanthemum (*Chrysanthemum integrifolium*) extends from easternmost Asia to western Baffin Island, north across the southern islands of the Arctic Archipelago, south to Hudson Strait and northern Hudson Bay and in the west, south through mountains of the District of Mackenzie to the high mountains of northern British Columbia.

No less than 58 species, or almost 18 per cent of the flora of the Arctic Archipelago, belong in this group which is well represented also in the flora of the treeless tundra or "barren grounds" of the mainland.

An analysis of the extra-American range of the 58 species found in the Arctic Archipelago shows that 21 reach eastern Asia but not northwestern Europe, 7 reach eastern Asia and northwestern Europe, while 5 reach northwestern Europe but not eastern Asia.

Dryas integrifolia M. Vahl (Mountain avens) (Map 7A).

This species has been chosen to illustrate the typical range of a plant belonging (*see* Map 7) in a group of plants that are native and peculiar (endemic) to North America. *Dryas integrifolia* belongs in the circumpolar, arctic-montane genus *Dryas* of the rose family and is one of several members of that genus that are endemic to North America, where its main range is from the west coast of Greenland to the American shores of Bering Strait. It reaches east Greenland but neither Iceland, northwestern Europe, nor northeastern Asia. It is an arctic plant of open tundra and rock desert and as such is intolerant of shade or competition from other species.

The fruits of *Dryas* are large, but well adapted to dispersal by wind owing to their persistent, long and plumose styles that, moreover, readily adhere to the fur of animals. Like other members of the genus, *Dryas integrifolia* is well adapted to unstable or newly exposed soils such as fresh moraines, gravel bars or the erosion fans of glacial streams, and for this reason, and because of its easily wind-dispersed seeds, is very often a pioneer species on new land.

Across North America the southern limit of *Dryas integrifolia* roughly follows the southern boundary of the open tundra (the polar limit of trees) from Newfoundland to Alaska. From the northern edge of the forest its range extends northward to the northernmost islands of the Arctic Archipelago and the northernmost tip of Greenland. Within its main range *Dryas integrifolia* is common wherever conditions are suitable; in some parts of the Arctic Archipelago it is by far the most common and widespread of all flowering plants. Although six other North American species of *Dryas* appear to be equally well adapted to wind dispersal, only *Dryas integrifolia* is now wide ranging north of the tree line. Widely separated and isolated stations far south of the present tree line suggest that during the period of deglaciation it followed closely behind the retreating ice front, and that much of its former range later was invaded by forest.

In Map 7A, dots indicate the actual stations where *Dryas integrifolia* has been collected, the source of information being largely specimens preserved in the National Herbarium of Canada, although the writer's field notes and also the botanical literature have been searched for additional records.

Because *Dryas integrifolia* is such a common and easily recognized species, it has been collected by nearly all professional or amateur botanists who have visited the North. The map showing its known distribution, therefore, serves also to illustrate the approximate extent and coverage of botanical collecting in arctic and subarctic parts of North America. Not so long ago botanical collecting in the North was very largely restricted to the immediate sea-coast and to inland waterways navigable by boat or canoe; but even with the better means of transportation available today, many large areas which are remote from the ordinary routes of travel still remain botanically unexplored.

For the sake of simplicity a uniform size of dot has been used, even when a single dot may sometimes represent a dozen or more separate collections. In the map, a solid line encircles the area which is considered the main range of *Dryas integrifolia.* Within this line some gaps merely indicate absence of botanical collecting, whereas other gaps are due to unfavourable habitats, such as dense forest cover. Outside the main range of *Dryas integrifolia* are shown a number of more or less isolated areas circled by a broken line. Some of these, as for example the isolated stations on the north shore of Lake Superior and on Lake Mistassini, represent local suitable habitats separated from the main range of the species by a broad belt of forest. Along the Continental Divide of the Rocky Mountains, on the other hand, *Dryas integrifolia* is found only on the highest mountains; its disrupted range there may be closely related to the glacial history of the area. In Greenland, again, *Dryas integrifolia* is common and widespread on the west and north coasts. Its absence over large parts of the east coast, where climate and soil are known to be favourable, must be historic in the sense that the species has not yet had time to spread over the entire east coast, or, perhaps, that, in the not too distant past, some parts of its eastern range were destroyed by advances of the Greenland ice-cap.

Although there is as yet no fossil proof, the evidence presented indicates that *Dryas integrifolia* evolved in North America, was widespread in pre-Pleistocene time, and survived the ice age in close proximity to the ice fronts. Following the retreat of the ice, it rapidly reoccupied the land, only to be destroyed again in the southern parts by the advancing forests.

Boreal Forest Element (Map 8).

The ranges of three species representative of the great transcontinental boreal forest are shown in this map. Black spruce (*Picea mariana*) ranges from Newfoundland to Alaska, while mitrewort (*Mitella nuda*) ranges north not quite to the tree-line from Newfoundland to Yukon and southeast Alaska and, like many other species of the boreal forest, extends south beyond the Canadian border. Lindley's aster (*Aster ciliolatus*) is common from the Gulf of St. Lawrence to interior British Columbia and in the west reaches the upper Mackenzie River basin and southeast Yukon.

Comparatively few species of the boreal forest reach Greenland, where they are found only on the west coast. Still fewer reach northwestern Europe or eastern Asia. Those that do are all herbs or dwarf shrubs and although some have left fossil remains, not a single forest tree species is common to the modern floras of the New and the Old World.

Cordilleran Element. (Map 9).

In North America this large and important group has its centre in the southern and unglaciated Cordillera, where a high percentage of the flora is endemic. Even in the Canadian Cordillera, partly glaciated in late Wisconsin time, a high percentage of endemism suggests that large areas at one time or another were available for the survival of plants. Southeastern Yukon is connected through the Cassiar Mountains to the Canadian Cordillera and it is only natural that its flora should contain a larger number of Cordilleran species than do other phytogeographic provinces of Yukon, including that of unglaciated central Yukon, where amphi-Beringian species far outnumber those of Cordilleran affinity. Ten Cordilleran species even reach the Canadian Arctic Archipelago, where they form an isolated element with no close affinity to other species or groups in the flora. In Map 9, three different types of ranges of Cordilleran elements are shown: Lyall's saxifrage (*Saxifraga Lyallii*) extends from southwest Alaska over southeast Yukon through mountains of interior Alberta to British Columbia and Montana; heart-leaved arnica (*Arnica cordifolia*) is widespread from southeast Yukon and Alaska through mountains of British Columbia and Alberta to mountains of Montana, South Dakota, central California, Nevada, Arizona and New Mexico, whereas Hooker's mountain avens (*Dryas Hookeriana*) is found only on the Rocky Mountains between latitudes 40° and 50°.

Some other plants belonging in this group are primarily foothill species having ranges extending east to Manitoba and north through the Mackenzie uplands to the Arctic Ocean and even to the western islands of the Arctic Archipelago. Prairie crocus (*Pulsatilla Ludoviciana*) and blue flax (*Linum Lewisii*), the latter reaching both shores of James Bay, are examples of wide-ranging foothill species.

Pacific Coast Element (Map 10).

The Pacific coast region of Canada is characterized by a uniform, moist oceanic climate that, together with the varied topography, has produced a great diversity of plant habitats. The flora is rich and diversified, composed of numerous genera and a multitude of species found nowhere else in Canada. Two of the most important types of distribution are shown in Map 10. To the first, restricted to the Coast Range, belong Sitka spruce (*Picea sitchensis*), yellow cedar (*Chamaecyparis nootkatensis*), Cooley's buttercup (*Ranunculus Cooleyi*) and gold thread (*Coptis aspleniifolia*), besides a host of others that range north to southeast Alaska or beyond, while others, exemplified by broadleaf maple (*Acer macrophyllum*), Oregon alder (*Alnus rugosa*) and amabilis fir (*Abies amabilis*) and a number of others stop short of Dixon Entrance.

The second group shown is not restricted to the Coast Range alone but reappears in the Selkirk and Cariboo Ranges, but does not cross the Continental Divide. Key species of the second group are western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), western yew (*Taxus brevifolia*), besides a number of shrubs and herbaceous species.

Still another important element in the coastal flora belongs in the amphi-Beringian group and is shown in Map 6.

Prairie and Foothill Element (Map 11).

Although Alberta, Saskatchewan and Manitoba are commonly spoken of as the "Prairie Provinces" of Canada, the fact remains that in historic time only the southern one-fifth of the total area of Alberta, the southern two-fifths of Saskatchewan and the southernmost one-sixth of Manitoba were natural grassland or prairie when first settled. Although greatly modified today due to the grazing of domestic animals, cultivation, the introduction of weeds etc., the geographical ranges of most of the species of which the original flora was composed has probably not changed greatly, and it is still possible to subdivide these grasslands according to their soils and original flora. Floristically most species of the western grassland flora have their main ranges in the Great Plains of western United States and few, if any, are endemic to Canada. Among the comparatively large number of species that in Canada are peculiar to the prairie grassland more than half, or nearly 150 species, are grasses or grass-like plants or members of the composite or the pea families. Xerophytic, or drought-resistant, species are particularly well represented in the southern prairie as are halophytic species, adapted to saline or alkaline soils.

In arid southern Saskatchewan and Alberta the bunchgrass or mixed prairie is a northern extension of the brown-earth soil grassland of North Dakota and Montana. To the north of this a more extensive, crescent-shaped belt of true prairie-parkland extends from southern Manitoba to the foothills of Alberta. This so-called mid-grass prairie is composed mainly of sod-forming and tufted species growing on soils of the brown-black or black-earth type in a climate that is cooler and somewhat moister than that of the mixed prairie grasslands to the south. Finally, a transitional zone, also on black-earth soils, of open aspen and poplar forest with "islands" of more or less treeless grassland extends north to the southern fringe of the transcontinental boreal forest. Isolated areas within the boreal forest of this transitional zone are found in the Peace River district and upper Mackenzie River basin, some are found west of the first range of the Rocky Mountains, and some even in southern Yukon.

On Map 11 is shown the Canadian range of grama- or buffalo-grass (*Bouteloua gracilis*) that, together with species of *Stipa*, *Koeleria*, *Festuca*, *Agropyron* and *Poa*, are the dominant grasses of the bunch-grass or mixed prairie. The map also shows the ranges of two members of the composite family, blazing star (*Liatris punctata*) and *Townsendia exscapa* that, with a number of legumes (chiefly of the genera *Astragalus* and *Oxytropis*), dwarf phlox (*Phlox Hoodii*), globe mallow (*Sphaeralcea coccinea*) and various cinquefoils (*Potentilla* spp.) contribute the bulk of the non-grasslike element in the bunch-grass prairie.

Spear grass (*Stipa spartea*) and spike oat (*Helictotrichon Hookeri*), likewise shown, together with fescue (*Festuca scabrella*), meadow grass (*Poa* spp.) and wheat-grass (*Agropyron* spp.), are some of the dominant grasses that, with sedges, form the bulk of the herbaceous cover of the prairie-parkland grasslands.

Southern Hardwood Forest Element Map 12).

Although this floristic element in Canada is confined to a small area in southernmost Ontario, it has a comparatively wide range in eastern and central United States. It is the most temperate element in the flora of Eastern Canada and includes representatives of no less than 10 families and some 40 genera found nowhere else in Canada.

Much of the area to which this element is indigenous in Canada was once covered by rich deciduous forest in which the dominant trees were beech (*Fagus grandifolia*), basswood (*Tilia americana*), maples (*Acer* spp.), hickories (*Carya* spp.) and oaks (*Quercus* spp.). In addition, black walnut (*Juglans nigra*), sycamore (*Platanus occidentalis*), tulip-tree (*Liriodendron Tulipifera*), pawpaw (*Asimina triloba*), mulberry (*Morus rubra*), cucumber-tree (*Magnolia acuminata*) and a number of others, in Canada are confined to southernmost Ontario. Among the large number of non-treelike species peculiar to this area are the prickly pear (*Opuntia Rafinesquii*) and poison sumac (*Rhus Vernix*) of sand dunes and cliffs, yellow nelumbo (*Nelumbo lutea*) of ponds and quiet streams and yellow fringed orchid (*Habenaria ciliaris*) of rich woods. Golden seal or yellow puccoon (*Hydrastis canadensis*) and ginseng (*Panax quinquefolius*), once abundant in rich woods, are now probably extinct there due to commercial collecting for medicinal purposes. Many others are now rare or even threatened with extinction by the clearing of land for agricultural and other purposes, and remains of the original forest are now found mainly on farm woodlots and in two small protected areas, at Point Pelee and Rondeau.

On Map 12 are shown the ranges in Canada and adjoining parts of the United States of four species representative of the southern hardwood forest element. Red Juniper (*Juniperus virginiana*) and prickly ash (*Zanthoxylum americanum*) extend north across southern Ontario approximately to the southern edge of the Precambrian Shield, whereas flowering dogwood (*Cornus florida*) and tulip-tree (*Liriodendron Tulipifera*) are native only to the Niagara Peninsula and the southernmost counties.

Northern Hardwood Forest Element (Map 13).

The northern hardwood forest region includes most of the densely settled agricultural land of southern Ontario and Quebec and extends westward, with a gap on the north shore of Lake Superior, beyond the Rainy River district, into eastern Manitoba. The transition to the southern deciduous hardwood forest to the south, as well as to the boreal forest to the north, is gradual.

The dominant forest species are sugar maple (*Acer saccharum*), white pine (*Pinus Strobus*), hemlock (*Tsuga canadensis*) and in the eastern part red spruce (*Picea rubens*). Some other species of less importance are beech

(*Fagus grandifolia*), black cherry (*Prunus serotina*), bur oak (*Quercus macrocarpa*), red oak (*Q. borealis*) and yellow birch (*Betula lutea*). Commonly mixed through northern hardwood forest are the essentially boreal white spruce (*Picea glauca*), balsam fir (*Abies balsamea*) and white birch (*Betula papyrifera*). In common with the southern deciduous hardwood forest, the main ranges of most of the species belonging in the northern hardwood forest have their main area in eastern and central United States and few if any are peculiar to Canada.

Many of our common spring flowers of Eastern Canada belong in this flora, among them such well-known plants as white trillium (*Trillium grandiflorum*), dog's tooth violet (*Erythronium americanum*), bellwort (*Uvularia grandiflora*), blood-root (*Sanguinaria canadensis*), wild ginger (*Asarum canadense*), spring-beauty (*Claytonia caroliniana*), Jack-in-the-pulpit (*Arisaema triphyllum*), and many others.

Four species with ranges characteristic of the northern hardwood forest are shown in Map 13. Canada yew (*Taxus canadensis*) from southern Newfoundland reaches the southwest corner of Manitoba, and northward, in isolated, favourable spots, extends beyond the transition to the boreal coniferous forest. Yellow birch (*Betula lutea*) has a similar range but does not range quite so far west or north. The range of dog's tooth violet (*Erythronium americanum*) is similar to that of the sugar maple (*Acer saccharum*), while leatherwood (*Dirca palustris*) is confined to southern Ontario, Quebec, New Brunswick and Nova Scotia.

Atlantic Coastal Plain Element (Map 14).

By the Atlantic Coastal Plain element is meant a group of plant species peculiar to acid bogs, sand barrens, savannahs and certain forms of marshland of the coastal plain between the Atlantic Coast and the piedmont, and extending from the Gulf of Mexico to parts of Nova Scotia and Newfoundland. A number of species belonging in this group have isolated stations inland, mainly in the Great Lakes region.

The Atlantic Coastal Plain element is considered to be very ancient; many of the species of which it is composed have no close relatives in North America, and several belong in genera or families otherwise tropical. Of the several hundreds of species belonging in this flora comparatively few enter Canada. The disjunct occurrence of elements of this ancient flora in isolated inland areas chiefly along the Great Lakes is difficult to explain in the light of the glacial history of the Great Lakes region, known to have been submerged in the Champlain Sea or the several stages of ice-dammed glacial lakes.

In Map 14 are shown typical ranges of a group of species that, from the southern main area of the Coastal Plain flora extend north along the Atlantic coast to New Brunswick, Nova Scotia and Newfoundland; the tiny bog fern, curly grass (*Schizaea pusilla*), chain fern (*Woodwardia areolata*), broom-crowberry (*Corema Conradii*), a creeping dwarf shrub of sandy pine-barrens, and *Bartonia paniculata* of the gentian family. Another group having inland stations along the Great Lakes is illustrated by the ranges of yellow-eyed grass (*Xyris montana*) belonging in the South American and South Asiatic genus *Xyris*, and *Euphorbia polygonifolia*, a tiny member of the spurge family, also mainly of temperate and tropical range.

2. Endemic and Disjunct Groups

Arctic Archipelago Endemic Element (Map 15).

Although only a few of the species belonging in this small group of high-arctic plants are completely endemic to the Arctic Archipelago, most of them have their main ranges there. Nearly all range across to northernmost Greenland and south to the arctic coast of the Canadian mainland, whereas only a few extend west of the Mackenzie delta. The group contributes no less than 8 per cent of the entire flora of the Arctic Archipelago and is believed to have survived the Pleistocene somewhere in the Archipelago.

In Map 15 are shown the ranges of four species, each representing a different range pattern within this element.

Draba Bellii, an arctic member of the mustard family, has a more or less continuous range from northern East Greenland to the Mackenzie delta. *Parrya arctica*, another arctic member of the same family, ranges from Boothia Peninsula to Banks Island, with small disjunct areas near the Mackenzie delta in the west, and in Foxe Basin in the east. The dwarf aster (*Aster pygmaeus*) occupies a still smaller area centering around Coronation Gulf, while Drummond's lungwort (*Mertensia Drummondii*) is known only from two stations on either side of Dolphin and Union Strait.

Eastern Arctic Endemic Element (Map 16).

The Eastern Arctic endemics form a northern extension of a larger group of plants peculiar to eastern North America. The centre of distribution for this group appears to be the northern Hudson Bay region, southern Baffin Island, and northern Ungava-Labrador; a good many are found also in west Greenland, but only a few have reached east or northeast Greenland.

In Map 16 are shown three types of ranges peculiar to Eastern Arctic endemics: Arctic hairgrass (*Deschampsia pumila*) represents the most wide-ranging members of the group. A more southern range pattern is illustrated by the skeleton willow, (*Salix Uva-Ursi*), widely distributed from southwest Greenland, over southern Baffin Island and Ungava-Labrador south to alpine areas of the Gulf of St. Lawrence and Newfoundland, with isolated stations on mountains of northern New England and northern New York.

A still more limited range is illustrated by Bell's loco-weed (*Oxytropis Bellii*), confined to the northern Hudson Bay region.

Western Arctic Endemic Element (Map 17).

A small group of species, endemic to arctic northwestern America, form a link between the Arctic Archipelago endemics to the north, and the Cordilleran endemics to the south. The range of Richardson's cress (*Cardamine digitata*) is typical of a few species that from Keewatin reach Bering Strait; their affinity, however, seems to be with American rather than with Asiatic species. The ranges of some others, illustrated by those of northern wormwood (*Artemisia hyperborea*) and the sedge-like *Kobresia hyperborea*, extend from Coronation Gulf west only to the Alaskan boundary or slightly beyond, and from Banks and Victoria islands south to Great Bear Lake.

Species with Disjunct Ranges (Map 18).

Various reasons have been advanced to explain the peculiarly disjunct and isolated occurrences of some scores of Canadian plants which have been illustrated in Map 18 showing Canadian ranges of five selected species. These plants are thought once to have had a more continuous range which was destroyed or broken up during the Pleistocene and to have survived the ice age in or fairly close to the areas where they are now found. Some may now be isolated in these areas because they lost the ability to compete with species which are genetically better equipped to cope with the vicissitudes of migration and resultant changes in environment.

Large-leaved sandwort (*Arenaria machrophylla*) in the east occupies a fairly large area, on basic or magnesian soils, in northern Ungava and Labrador, has local areas in Gaspé, northern New England and on the north shore of Lake Superior; in the west it has a fairly large area, mainly on volcanic rocks, extending from eastern Great Slave Lake to the upper Churchill River near the Saskatchewan River on the Manitoba border, and also a small area in southern British Columbia; south of the United States border it extends to mountains of Colorado, New Mexico and southern California.

Some tundra species such as the mountain avens (the range of *Dryas integrifolia* is shown on Map 7A), although pioneering on freshly exposed floodplain gravel bars or sand- and gravel-plains in front of retreating glaciers, are intolerant of shade. They were some of the first plants to colonize the land freed by the retreating glaciers but were unable to compete with the rapidly advancing boreal forest. Yellow mountain avens (*D. Drummondii*) is further restricted owing to its requirement of calcareous, well-drained soils. It now occupies several large areas from central Alaska, over southern Yukon and central and upper Mackenzie basin, and extends south through the Rocky Mountains to Montana. Like *Arenaria macrophylla* it has a single station on the north shore of Lake Superior besides occupying small areas in Gaspé, Anticosti Island, western Newfoundland, northern New England and New York State. The bedstraw (*Galium kamtschaticum*) is found in isolated areas from Eastern Asia over the Aleutian Islands, southeastern Alaska and southern British Columbia to northern Washington, but in the east it is narrowly localized in western Newfoundland, Gaspé and in mountains of northern New York and New England States. *Oxytropis podocarpa* is an alpine member of the pea family. Its only known stations in the east are in southern Baffin Island and northern Labrador, 1,800 miles from its nearest station in the west, where several widely separated areas are known from northern British Columbia to Colorado. Mignonette-leaved ragwort (*Senecio residifolius*) from Novaya Zemlya extends east along the arctic coast of Asia to Alaska, Yukon and northwestern Mackenzie, and in the Gulf of St. Lawrence area has a few isolated stations in Gaspé and western Newfoundland.

RÉSUMÉ

La planche du nouvel Atlas du Canada intitulée "Flore et Végétation naturelle" contient dix-huit cartons montrant la répartition géographique et l'historique de quelques-uns des principaux groupes et éléments de la flore canadienne.

Dans l'introduction de cet article, l'auteur précise que les facteurs de température, d'humidité et de pédogénèse gouvernent la distribution des plantes. Les divers groupements de plantes ayant les mêmes exigences pédologiques, climatiques et la même tolérance ont tendance à croître dans un même milieu, répondant le mieux à leurs besoins. Cependant, même

parmi des espèces semblables, les traits physiques locaux sont souvent à la base de certaines variations sur le plan régional. De plus, la considération du passé géologique et notamment l'avènement des glaciers sont parmi les facteurs les plus importants dans l'analyse de la répartition géographique des plantes en Amérique du Nord.

Les dix-huit principaux éléments représentés sur la carte sont étudiés ici dans le détail sous les titres suivants: espèces circumpolaires, espèces amphi-Atlantiques—amphi-Béringiennes ainsi que celles de l'Amérique du Nord subdivisées en groupes universels, endémiques et isolés.

SORTED CIRCLES AT RESOLUTE, N.W.T.

*By Frank A. Cook**

Sorted circles are one type of patterned ground characteristic of polar environments and have a rather wide distribution in the Canadian north. They are especially well developed at Resolute on Cornwallis Island, Northwest Territories. Previous studies have discussed sorted "mud" circles in the area in considerable detail.[1,2] Sorted circles are also present at Resolute with stone rims surrounding central areas consisting of fine material, although they are much less common. In the summer of 1955 the writer excavated several of these sorted circles and a short note on their geometry and composition is presented here because of an almost complete lack of quantitative field data on patterned ground in Canada.

The area under study, several hundred feet square, contained over twenty almost perfectly symmetrical sorted circles. It was situated in a swale between two old beach lines, sloping gently toward a fresh-water lake. The ground was very wet, and holes dug during excavation filled with water within minutes of being opened. The constituent material was beach gravel with small quantities of reworked glacial material, although many larger fragments of shattered limestone were present. Some vegetation (mosses and lichens) was present both within the circles and outside the pattern in pits and in small drainage channels. The sorted circles occurred both singly and in groups, and varied between 2 and 3 feet in diameter. Where they occurred on flat ground they tended to be perfectly circular. On sloping ground they were normally elongated downslope. An example of a circular sorted stone circle is shown in Figure 1.

Two contiguous sorted circles were chosen for detailed study. The smaller of the circles had inside measurements of 25 and 40 inches, the larger circle was 31 by 44 inches. They were elongated down a 5° slope (Figure 2a).

The rim of each circle was approximately 6 inches wide; the common rim shared by the two circles was up to 15 inches across. The stones in the border around the circles ranged in size from very small pebbles to shattered

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[1] Cook, Frank A.: Additional notes on mud circles at Resolute Bay, Northwest Territories. *Can. Geog.*, No. 8: 9-17. 1956.

[2] Mackay, J. Ross.: Fissures and mud circles on Cornwallis Island, N.W.T. *Can. Geog.*, No. 3: 31-37. 1953.

Figure 1.

A sorted circle, Resolute, N.W.T.

limestone fragments several inches in length. The size of the individual particles tended to increase with depth in the border (Figure 2a).

There was a slight difference between the upslope and downslope rims of the two circles. The upslope rim (profile M-N, Figure 2c) was 4 inches high; the downslope rim (profile R-S, Figure 2c) stood 7 inches above the surrounding rock and gravel (Figure 2b). Upslope the rim overrode an inner clay pocket without apparent gradation between the two materials. However, downslope a fine gravel layer separated the coarse, shattered material from the fines, and at the extreme point downslope there was a concentration of much larger shattered limestone fragments.

The clay pocket of the smaller circle extended downward to a depth of about 12 inches, whereas that of the larger circle extended below permafrost at 20 inches. As the excavation took place early in the season the frozen soil encountered would not represent the true permafrost table which is several inches lower at Resolute. One interesting point was that the border between the circles extended only 4 inches below the surface, being underlain by the fine material common to the centres of both circles, and joining them as tangent or siamese-twin circles (Figure 2b).

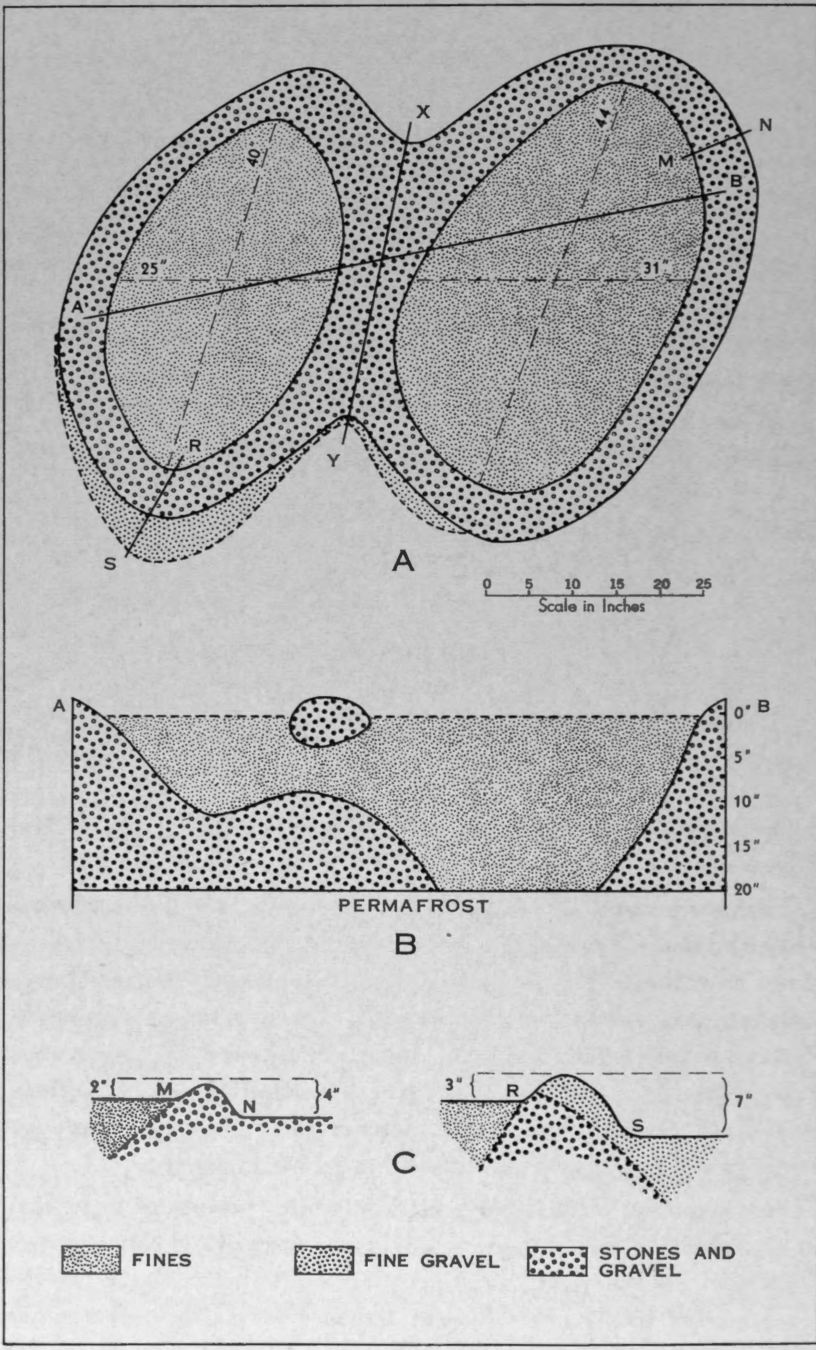

Figure 2.

(a) Measurements of two sorted circles. (b) Plan at depth along profile A-B. (c) Profile at depth across the outside rims. M-N is upslope; R-S is downslope.

The fine material inside the stone rim abutted sharply against the rim, there being no apparent gradation in size of particle toward the periphery. A mechanical analysis† of the fine clayey material showed that a large percentage of the fines was of small size. In this sample 96 per cent by weight was less than 10 mm., 70 per cent less than 1 mm., 53 per cent less than .1 mm., 27 per cent less than .01 mm., and 7 per cent was less than .001 mm., in diameter. Thus a comparatively large percentage of the fine material was in the colloidal size range.

Temperature readings were taken at 5-inch intervals to the permafrost at 20 inches. The temperature profile on the day of excavation, July 26, 1955, was linear, ranging from 54°F. at the surface to 32°F. at the frozen soil layer.

Regarding the origin of these sorted circles, Washburn[3] has shown that the origin of patterned ground is probably polygenetic but an adequate explanation must await more detailed study. Detailed field data are required on a great number of examples in order to understand the origin and mode of development of patterned ground. The purpose of this paper, then, is to give quantitative field data on one type of patterned ground in the hope that others may be encouraged to examine the internal structure of the numerous forms that may be encountered in the field.

The writer acknowledges helpful criticisms of this note from Drs. A. L. Washburn and J. Ross Mackay.

† The mechanical analysis of the fines was made by the Soil Mechanics Laboratory, Division of Building Research, National Research Council.

[3] Washburn, A. L.: Classification of patterned ground and review of suggested origins. *Bull. Geol. Soc. Amer.*, Vol. 67, No. 7: 823-866. July, 1956.

UNE ENQUÊTE INTERNATIONALE SUR L'ENSEIGNEMENT DE LA GÉOGRAPHIE*

par Benoît Brouillette

Introduction

La Commission de l'U.G.I. que j'ai l'honneur de présider s'est vue chargée, au dernier congrès international de Rio de Janeiro, de poursuivre les travaux entrepris en 1952, après le Congrès de Washington, sous la direction du doyen Neville V. Scarfe (Université de Colombie Britannique). Ce dernier a publié un rapport qui fut discuté à Rio et jugé assez utile pour être réédité aux frais d'un mécène, la maison *Desnoyer-Geppert* de Chicago. L'exécutif de l'U.G.I. approuva les directives de la nouvelle Commission selon les termes suivants: "Elle devra en l'espace de quatre ans compléter le travail entrepris antérieurement, en ce qui concerne principalement le contenu géographique de la matière qu'il faudrait enseigner aux étudiants, selon leurs divers niveaux d'âge et selon les méthodes qui paraissent les mieux appropriées". La Commission se compose de six membres actifs et d'un nombre indéterminé de membres correspondants. En voici la liste:

Brouillette, B. (Canada), président,
Clozier, R. (France), secrétaire,

Barbag, J. (Pologne), Brown, T. W. (Grande-Bretagne), Gonzalez, Sa J. (Uruguay), et Scarfe, N. V. (Canada). Membres correspondants: Hickman, Miss G. M. (Grande-Bretagne), Iwata, K. (Japon), Kalesnik, S. V. (U.R.S.S.), Khalaf, J. M. (Irak), Kohn, C. (É.-U.), Lehovec, O. (Allemagne), Migliorini, E. (Italie), Spate, O.H.K. (Australie) et Singh, R. L. (Inde).

Plan de travail

Le 3 janvier 1957, j'ai pu tenir une réunion restreinte des membres actifs, à Paris, au siège de l'Unesco. Nous avons établi un plan préliminaire devant être distribué à tous les membres et personnes intéressées à notre travail. Son objet est de fixer les idées sur le sujet et de donner certaines directives à ceux qui entreprendront les enquêtes. Celles-ci tenteront d'établir quelles devraient être les connaissances géographiques normales pour la formation des élèves en vue d'en faire des citoyens bien informés. Les trois étapes de l'enseignement envisagées sont la fin des études primaires, le milieu des études secondaires et la fin des études secondaires. Par

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* Communication présentée au congrès de l'ACFAS, le 2 novembre 1957, à Québec.

suite des différences qui peuvent exister entre les pays, il nous a paru utile de formuler un schéma très général d'un programme de connaissances géographiques fondamentales et de communiquer ce schéma à nos correspondants, les priant d'exposer leurs opinions et critiques.

La matière est partagée selon les rubriques principales: géographie physique, humaine, économique et régionale ou locale, et nous demandons à nos correspondants de discuter en outre l'emploi du matériel didactique, des méthodes pédagogiques et la formation des maîtres. Ils doivent nous faire parvenir leurs suggestions fin 1957. A la lumière de ce premier sondage, un plan définitif de travail sera élaboré durant le premier semestre de 1958, dont l'objet sera de préciser les programmes et les méthodes en usage ou à recommander. Ce plan définitif sera distribué à nos correspondants au cours de l'été 1958 et leurs réponses sont prévues pour l'année suivante. En février 1960, le rapport de la Commission devrait être prêt pour l'impression, afin d'être distribué au Congrès de Stockholm, en août de la même année.

Réalisation

Entre la planification et la réalisation d'un projet de cette envergure, il existe une marge que connaissent tous ceux qui font des enquêtes. On imagine facilement les difficultés qui peuvent surgir, lorsqu'on travaille à l'échelle mondiale. Toutefois, nous pouvons compter sur la collaboration effective de plusieurs de nos correspondants. Les principaux groupes à l'œuvre actuellement sont:

—ÉTATS-UNIS. Un comité spécial a été établi par le *National Council of Geographic Education*, sous la présidence du professeur Clyde Kohn (Northwestern University). Il s'est réuni le 15 juin 1957, et ses membres ont travaillé individuellement durant l'été. Plusieurs réunions sont prévues durant l'automne, et un premier rapport sera présenté et discuté durant le Congrès du *National Council* qui se tiendra à St. Louis, le 29 novembre prochain. Ensuite le rapport sera rédigé de nouveau et me sera remis en janvier 1958. C'est le travail le mieux organisé à propos de notre enquête.

—GRANDE-BRETAGNE. Le professeur Tom Whitting Brown (Gloucester) est la cheville ouvrière du travail qui s'effectue dans son pays. Il est en contact avec ses collègues, en particulier avec M. J. M. Hickman, qui a une longue expérience de l'enseignement géographique. Ils ont suggéré un programme d'ensemble pour nos enquêtes et rédigent en ce moment un mémoire concernant les pays anglo-saxons.

—SUISSE. M. l'abbé Émile Marmy (Fribourg) s'est chargé d'établir un rapport sur les bases psychologiques de l'enseignement de la géographie dans les écoles primaires et secondaires, soit de l'âge de 6-7 ans jusqu'à la fin de l'adolescence. Ce rapport, d'environ 6,000 mots, sera terminé en janvier 1958. M. Marmy est un psychologue de réputation internationale qui participa au Stage de l'Unesco à Montréal en 1950.

—FRANCE. M. L'inspecteur général René Clozier (Paris) s'occupe de réunir la documentation disponible sur les principaux pays d'Europe. Il a obtenu des réponses d'Allemagne, d'Italie, d'Espagne, et des promesses de contribution de Yougoslavie, du Brésil, de Suisse, du Portugal et de Belgique. Il espère toucher en outre la Pologne et l'U.R.S.S.

—MOYEN-ORIENT. Le professeur Jassim M. Khalaf (Bagdad) fera un rapport sur son pays et les voisins, après avoir pris contact avec le professeur C. Alagoz (Ankara), ancien participant au Stage de Montréal.

—AUSTRALIE. Mme C. D. J. Stimson (Sydney), participante du Stage de Montréal, s'intéresse à notre enquête et sera en mesure de nous fournir des renseignements.

—JAPON. Le professeur Kozo Iwata (Tokyo) nous donnera des détails sur les tendances actuelles de l'enseignement de la géographie dans son pays. Il remarque que depuis l'après-guerre, la géographie est trop associée aux sciences sociales.

—INDE. Nous n'avons pu entrer en communication avec le professeur R. L. Singh (Bénarès) qu'en septembre de cette année, faute de connaître son adresse exacte.

—CANADA. Nous pourrons avec nos collègues de l'Université Laval rédiger un mémoire sur l'enseignement de la géographie dans la province de Québec. Nous avons demandé au doyen Neville V. Scarfe de s'occuper du reste du pays.

Rôle de l'Unesco

L'Unesco a joué un rôle important dans l'amélioration de l'enseignement de la géographie à travers le monde. Le Stage de Montréal, tenu au Collège Macdonald, est une preuve de l'intérêt profond que cet organisme des Nations Unies entretient à l'égard de notre discipline. Responsable de l'organisation matérielle de ce Stage, je ne regrette qu'une chose, à savoir le peu d'utilisation et de diffusion des nombreux documents rassemblés et issus de ce colloque international. C'est pourtant grâce à l'Unesco que notre Commission fut créée à Washington en 1952 et qu'elle fut prolongée à Rio de Janeiro en 1956.

J'ai cru bon d'informer de nos projets le Directeur général de l'Unesco, après notre réunion de janvier. Il me fit répondre le 19 mars que l'Unesco s'intéresse spécialement à l'adaptation psychologique des matières du programme scolaire aux divers niveaux d'âge des élèves. Après une longue correspondance, le département de l'Éducation offrit à notre Commission, le 29 juillet, de rédiger un rapport sur "le contenu de la matière géographique dans les écoles élémentaires et secondaires et sur son adaptation aux différents niveaux d'âges". Ce rapport aura une vingtaine de mille mots et doit être remis en mai 1958.

La rémunération affectée à ce travail, quelque faible qu'elle soit, m'a permis d'offrir une petite somme à ceux qui, mentionnés ci-dessus, travaillent effectivement à la réalisation de notre programme.

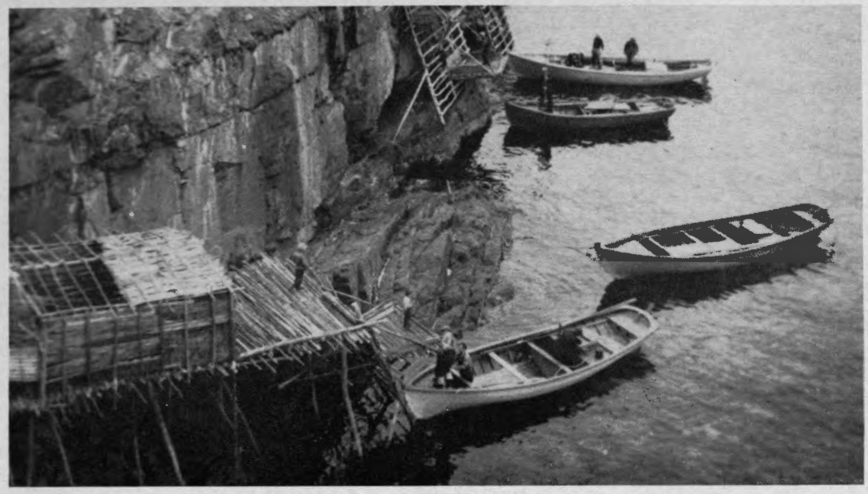
NEWFOUNDLAND FISHING AND COASTING VESSELS

Charles N. Forward

Recent changes in the fishing industry of Newfoundland have greatly influenced shipping along the coast. The Labrador and Grand Banks schooner fishery in which scores of vessels participated several years ago has now virtually ended, and the remnants of this fleet have been adapted for full-time coastal freighting. Inshore fishing from small boats has also declined, whereas long liners and draggers have assumed an important role in the fishing industry.

The coasting trade is of vital importance to Newfoundland because many settlements depend upon water transportation as their principal link with other communities. This situation is likely to continue for many years owing to the great expense of road construction and the scattered distribution of small settlements along the jagged and deeply indented coastlines of the island. Vessels engaged in the coasting trade comprise schooners of various sizes, Canadian National Railways steamships, and other vessels designed for freighting service. The C.N.R. steamships provide regular service to a large number of coastal points, but are restricted as to the type of cargo that can be carried. The schooner is the real work-horse of the coastal waters.

Submissions by the Newfoundland government to the Royal Commission on Coasting Trade in the summer of 1955 expressed the deep concern of Newfoundlanders over the declining number of vessels engaged in the coasting trade. In 1955 there were 214 vessels operating in this trade and the average age of these ships was 18 years. The smaller vessels in the 10 to 40 gross tons bracket had an average age of 14 years, and those in the 60 to 80 gross tons bracket, 22 years. The virtual termination of the Labrador schooner fishery and Grand Banks dory fishery ended the necessity for the construction of new schooners, and the source of ships that can be diverted to the coasting trade has disappeared. Consequently, when old schooners are wrecked or retired from service they are not being replaced. From 1950 to 1954 there were 69 coasting vessels taken off the register for various reasons and only 20 vessels added. The present need is for new vessels designed exclusively for the coasting trade, but the cost of construction of such ships is almost prohibitive, considering the expected future earnings at prevailing freight rates.

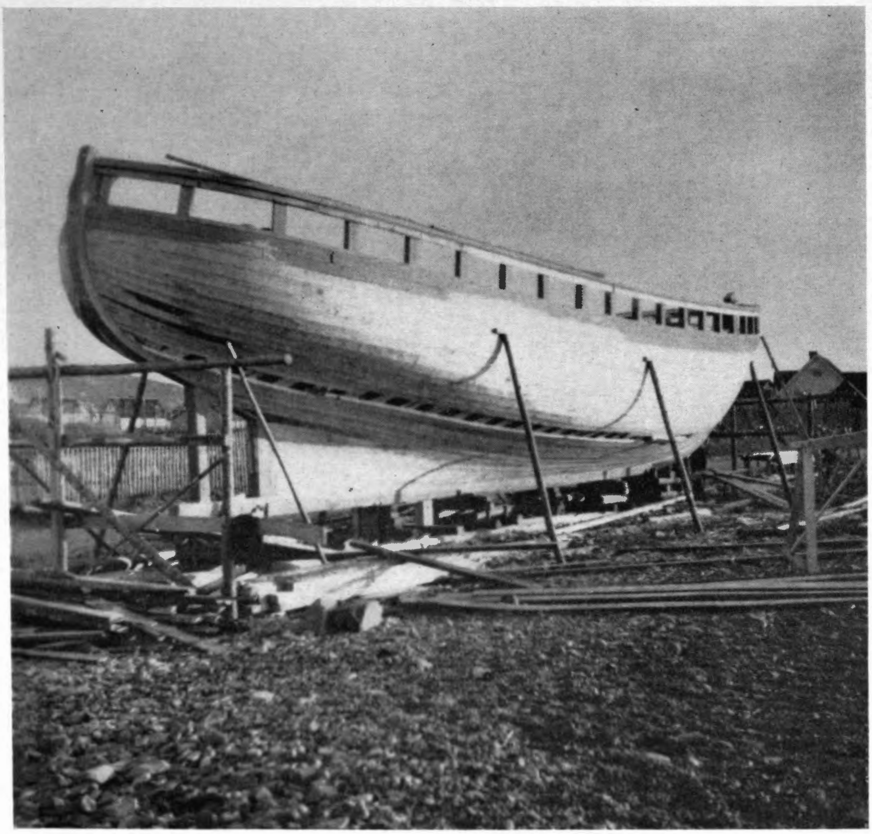


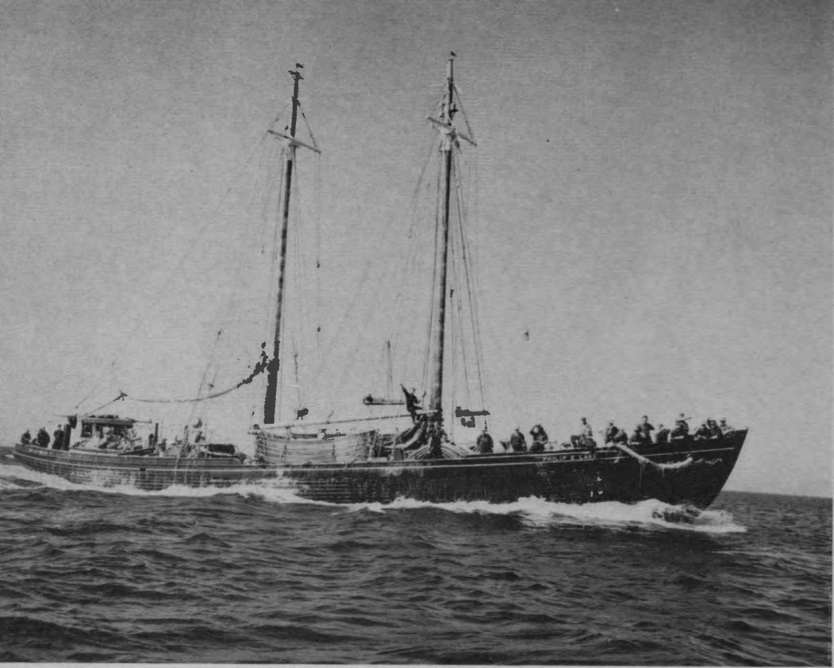
Geog. Br. Photo

Motor-boats used by inshore fishermen, especially on the northeast coast of Newfoundland. Boats of this type are used to set cod traps, cod nets, and salmon nets, as well as for line fishing and jigging. They are designed for short daily runs and are small enough to land in shallow or rocky coves. They are powered by low-horsepower gasoline engines that can be operated cheaply.

Geog. Br. Photo

A long liner being built at Bonavista. This type of vessel has been advocated in recent years as most suitable for the long lining method of fishing that has been encouraged as part of the modernization program. The aim of this program is to reduce the number of small boats engaged in inshore fishing and increase the number of large vessels operating on the offshore banks. In this manner it is hoped that the productivity per man will be raised from the present low general level. The long liner carries a crew of 3 or 4 and often remains out of port for several days.





N.F.B. Photo

The PHILIP E. LAKE is one of the large banks fishing schooners that were so numerous a few years ago. It has a gross tonnage of 134. The changing technology of the fishery has seen these vessels mostly replaced by draggers. The banking schooners carry dories that are launched at the fishing grounds with one or two men in each. The dories return to the mother ship when they have obtained their catch by line fishing methods. The great advantage of the dory is that it combines seaworthiness with a design that enables nesting of as many as a dozen boats on deck.

Geog. Br. Photo

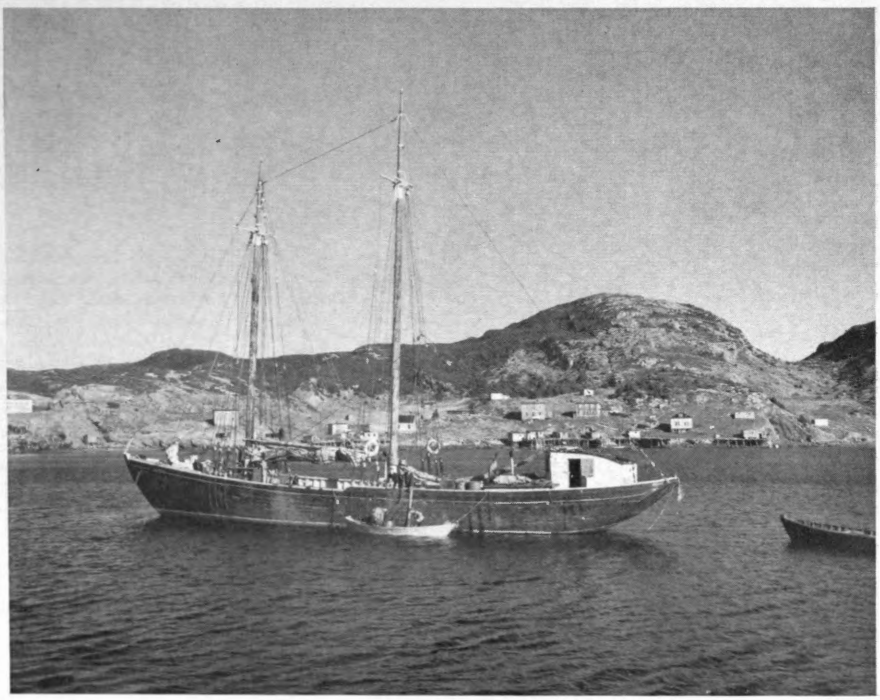
The dragger BLUE WAVE, docked at Burin, is typical of the class of vessel now widely used to supply frozen filleting plants. This type of ship operates on the Grand Banks and other offshore banks with great success. Ranging in length from 75 to 140 feet, draggers of this class carry a crew of 10 to 20 men. The productivity per man is remarkably high. A great variety of fish, including cod, halibut, rosefish, and flounder, are procured by the drag net method of fishing. In addition, these vessels are more seaworthy than smaller boats, and therefore can operate more regularly.

The small schooner, JAMES YOUNG, 37 gross tons, was built in 1926 along traditional lines. It has a bowsprit and schooner rigging. Although equipped with an engine, sails are still used occasionally for additional speed. Vessels of this type were designed primarily for fishing, and were used to carry freight in the off-season

VESSELS ENGAGED IN THE COASTAL TRADE

N.F.B. Photo

The CLARICE ANDREWS, 102 gross tons, is an example of a medium-sized schooner. The schooner rigging and sails are still maintained for emergency use. A bulk commodity is being unloaded by the use of a hogshead on the end of a line, a traditional method.



N.F.B. Photo

Several schooners of different sizes are shown moored in Grand Bank Harbour. The vessel at centre foreground is engaged in banks dory fishing. Those on either side are employed in the coasting trade. The small schooner on the left is the MARION M. BRUCE, 42 gross tons, built as recently as 1947. On the right the MARION MOSHER (approximately 130 gross tons) is being unloaded. Small two-wheeled carts drawn by ponies are still in use for carrying goods to and from the wharf.

N.F.B. Photo

Along the busy waterfront of Grand Bank are vessels engaged in either freighting or fishing. Most are of fishing schooner design. One exception is the STUDENT PRINCE (left foreground), 285 gross tons, built in 1943 as a cargo carrier.

N.F.B. Photo

One of the C.N.R. coastal steamship fleet, the SPRINGDALE is shown docked at Herring Neck, Notre Dame Bay. Built in 1948, this vessel has a gross tonnage of 1,138. It makes regular calls at numerous settlements and carries mainly general cargo. By regulation, certain commodities cannot be carried by these vessels, such as explosives, matches, coal, petroleum products, and other inflammable materials. These commodities are carried chiefly by schooners.

N.F.B. Photo

Where C.N.R. steamships cannot approach the wharf because of shallow water, loading and unloading is carried out by motor-boats or dories. These small craft are the chief means of transportation in many Newfoundland settlements.

MAP NOTES

CANADA, PRINCIPAL MINING AREAS. (Map 900A, 7th ed.) 1:7,603,200. Canada, Department of Mines and Technical Surveys, Mines Branch and Geological Survey of Canada, Ottawa, 1957.

The latest edition of this map is similar in type and content to its predecessors, and shows the physiographic divisions of the country with mineral information overprinted. Metallic and non-metallic mineral properties, mining areas, oil and gas fields and pipelines are shown. The route followed by the Trans-Canada pipeline is indicated to the point reached by the end of 1956.

Seven insets show the distribution of metallic and non-metallic minerals in addition to important potential producing areas. Two useful tables show the value of mineral production of Canada for 1956 (metallic and non-metallic), and the value of mineral production by provinces.

CANADA, WATER POWERS OF CANADA. (rev. ed.) 1:6,336,000. Canada, Department of Northern Affairs and National Resources, Water Resources Branch, Ottawa, 1957.

This is a revision of the 1956 edition. Developed and undeveloped water power sites are shown by circles in proportion to the horsepower capacity of the sites, graded from "1,000 h.p. or under", to "above 2,000,000 h.p.".

PROVINCE DE QUÉBEC. RÉGIONS ÉCONOMIQUES. 1:1,267,200. Québec, Ministère de l'Industrie et du Commerce, Service de la cartographie économique, Québec, 1957.

Carte en couleur indiquant les dix régions économiques de la province. Au moyen de symboles circulaires, la population approximative des principales cités et villes est clairement indiquée. Une subdivision des grands centres de la vie économique du Québec, telles les villes de Québec et Montréal, est indiquée dans la légende.

MINERAL MAP OF THE PROVINCE OF ONTARIO, (1957A, rev. ed.) 1:1,267,200. Ontario, Department of Mines, Toronto, 1957.

This is a multicolour map that shows both geological formations and structural features, in addition to the distribution of metallic and non-metallic minerals. Pipelines are also indicated, together with the mining divisions of the province. A series of eleven insets give a detailed description of the principal mining areas of Ontario and the location of offices of the Department of Mines, the distribution of natural gas and oil fields, and the sites of metallurgical works. Tables demonstrate the value of mineral production and the metal production by principal mining areas. A graph also shows the growth of mineral production from 1890 to 1956.

OIL AND GAS FIELDS IN WESTERN CANADA. 1:2,534,400. The Canadian Bank of Commerce, Petroleum and Natural Gas Department, Calgary, 1956-57.

This recent map is printed in four colours. Oil fields are represented on the map in green and the gas fields in red. Pipelines are also shown in colours, and proposed pipelines are indicated by broken lines. An inset shows the principal oil and gas pipelines throughout the country.

MANITOBA, ISOGONIC CHART, 1955.0 1:1,267,200. Canada, Department of Mines and Technical Surveys, Dominion Observatories, Division of Geomagnetism. Ottawa, 1957.

ALBERTA, ISOGONIC CHART, 1955.0 1:1,267,200. Canada, Department of Mines and Technical Surveys, Dominion Observatories, Division of Geomagnetism. Ottawa, 1957.

Both maps show lines of equal magnetic declination and equal annual change. Red lines (isogones) denote the declination or variation of the compass in degrees. The declination chart was compiled from all available observations made from 1907 to the end of 1955, representing values at approximately 6,650 stations. All results were reduced to the common epoch 1955. Broken blue lines (isopors) denote the annual change of declination in minutes of arc.

SASKATCHEWAN. FIRE CONTROL SERIES. 1:253,440. Saskatchewan, Department of Natural Resources, Regina, 1956.

This is a new series of maps published by the Government of Saskatchewan, in an effort to secure more coordination in preventing and fighting forests fires. This series shows the provincial parks and forests, the Indian reserves, and the administrative divisions of the province. Conventional symbols indicate the location of fire-towers and their respective radius of detection, fire caches, buildings, radio stations, marshes and rivers. The regional and conservation officers' headquarters are shown. The road network is also shown, and classified according to the following categories: all weather, improved road not gravelled, bush road or trail. Railway lines, are also indicated.

SASKATCHEWAN AND WESTERN MANITOBA, SHOWING OILAND GAS FIELDS AND OIL AND GAS DISCOVERIES. (Map. 1044A). 1:1,267,200. Canada, Department of Mines and Technical Surveys, Geological Survey of Canada, Ottawa, 1957.

ALBERTA AND NORTHEASTERN BRITISH COLUMBIA, SHOWING OIL AND GAS FIELDS AND OIL AND GAS DISCOVERIES. (Map 1039A) 1:1,267,200. Canada, Department of Mines and Technical Surveys, Geological Survey of Canada, Ottawa, 1957.

Both maps show oil and gas fields, potential areas for oil and gas, and oil and gas pipelines. Areas of bituminous sands are indicated and refineries are located.

PROVINCE OF ALBERTA. 1:760,320. (2 sheets, north and south). Alberta, Department of Municipal Affairs, Edmonton, 1956.

This is a general map of the Province of Alberta published in three colours. In addition to showing administrative divisions it also shows the provincial parks and reserves. The main roads and railroads are indicated together with principal airports and sea plane bases, and other related cultural features.

BRITISH COLUMBIA—THE INTERIM FOREST COVER SERIES AND THE FOREST INVENTORY AREA REFERENCE SYSTEM. 1:126,720. British Columbia, Forest Service, Forest Surveys and Inventory Division, Victoria, 1956.

This coloured series, classified according to the National Topographic System, is a comprehensive record of the forest conditions in British Columbia. Boundaries of each type of forest classification are shown with a comprehensive legend. In addition, the boundaries of the forest inventory area are indicated.

[J.P.C.]

BOOK NOTES

ROYAL COMMISSION ON CANADA'S ECONOMIC PROSPECTS.

On June 17, 1955, a Royal Commission was established to inquire into and report upon the long-term prospects of the Canadian economy. The results of this inquiry will be presented in 33 volumes on various aspects of the economy. In most cases, although the technical literature contains a great deal of detailed information, little attempt has been made in the past to discuss the subjects in broad economic terms. This series, therefore, of which 5 volumes are noted below, is a most valuable contribution to the literature on Canada's economy.

TRANSPORTATION IN CANADA. By J. C. Lessard. Royal Commission on Canada's Economic Prospects. Ottawa, Queen's Printer, 1957. 160 p., tables, appendices. Price $2.50.

Five different years have been selected for a statistical analysis of transportation in Canada; 1928 as the year of peak activity in the 1920's, 1936 as a normal low year of the 1930's, 1945 as the last year of the war, 1949 as a postwar year unaffected by the Korean War, and 1953 as the last year for which complete statistical data is available. The data have been analyzed under four headings: direct and indirect costs of transportation; transportation costs as a percentage of the gross national product; competitive elements in the transportation field, and future technological developments; new facilities and services in the transportation field. Since the future can only evolve from the present, the first three sections form a basis for predictions as to the shape of future technological progress, a topic interestingly developed in the fourth section. Already the commercial application of radar, television and electronics have made an impressive beginning and will play an important role in improving the efficiency of carriers in the future. Nuclear energy, too, will make a contribution in time, although the writer foresees that perhaps it will not have much impact within the next quarter century.

CANADIAN ENERGY PROSPECTS. By John Davis. Royal Commission on Canada's Economic Prospects. Ottawa, Queen's Printer, 1957. 392 p., maps, tables, graphs, appendices. Price $4.00.

The multiplicity of demands which the nation's fuel and power industries serve are described in this volume in a general way in an attempt to provide factual information concerning the changing market for energy in Canada as well as to explore the possibilities which further development of the nation's fuel and power resources hold out for the rest of the economy. Each of the individual commodities—coal, oil, natural gas, hydroelectricity and the promise of nuclear power are considered in detail. The greater contribution of this volume, though, is likely the discussion of energy generally, and its implications in broad economic terms. Many of the predictions for development in the future are revealing. For example, Canada's dependence on external sources of supply may be reduced to about 25 per cent of the nation's overall requirements in 1980. Exports, by then, may exceed imports by a ratio of two to one. Employment in the nation's energy industries is forecast as rising from 157,000 in 1955 to 350,000 in 1980. Relative to the nation's total employed labour force this also means an increase from around 3 per cent to closer to 4 per cent of Canadians working in these industries 25 years from now. The forecast indicates that combined value of output of the various energy industries in Canada will increase from 7 per cent of the gross national product in 1955 to 13 per cent in 1980. Finally, with the exception of water power, no serious supply problems are anticipated.

THE COMMERCIAL FISHERIES OF CANADA. Prepared by The Department of Fisheries of Canada and The Fisheries Research Board. Royal

Commission on Canada's Economic Prospects. Ottawa, Queen's Printer, 1957. 193 p., tables, appendices. Price $2.50.

The fishery resources available in Canada are remarkably extensive and varied. More than 150 kinds of fish have commercial significance, and during the next 25 years demand for these products should increase markedly. This publication is chiefly concerned with assessing that future demand. After a brief historical review it presents an illuminating description of the current resources, followed by a discussion of the utilization of fish products, and marketing and prices.

The question of future demand for fishery products is examined with reference to two major factors: (a) population growth and (b) disposable income. The analysis is based on the period from 1949 to 1955, which, though rather short for statistical operations, does have the advantage of conforming, in respect of the nature of prevailing economic conditions, with assumptions for the next 25 years.

In Canada there appears to be a fairly good correlation between population and consumption of most products consumed in any volume, and the demand for fishery products with a wide price range is relatively inelastic. For the very important United States market, projections have been made on the basis of average exports plus 43 per cent, which is the median increase among the current projections of U.S. population.

These two calculations provide a first approximation to the demand which might be expected in 1980, estimated at 2.1 billion lb., or 800 million lb. more than is required to meet the demand for these products in 1955, an increase of 60 per cent.

CANADA'S IMPORTS. By David W. Slater. Royal Commission on Canada's Economic Prospects. Ottawa, Queen's Printer, 1957. 222 p., tables, graphs, appendices. Price $3.00.

Many pertinent questions are raised in this volume on Canada's import future. For example, what have been the recent trends in the level, content, geographical source and state of manufacture in Canadian imports? Have there been marked trends of change in the comparative advantage of Canadian manufacturing activity vis-a-vis foreign sources of supply? What are the prospects of Canadian imports, in the aggregate, in content, and in geographical sources? In particular, what are the prospects of a substantial increase in the U.K. share of Canadian imports? The study uses a comparison of two war-free periods on which to base its predictions. They are the late 1920's, and the recent period 1951-1955, both times of prosperity sufficiently far removed in time from major wars to be free of the worst of the war-induced disruptions to international trade. Very little change in the present pattern is envisaged. Imports, as in the past, should increase somewhat less rapidly than the gross national product. Minor increases in the heavy industrial goods group, such as machinery and equipment, household consumer durables and chemicals are to be expected, with a corresponding decrease in foods, textiles, alcoholic beverages, and materials for construction. The most significant change will probably be in the petroleum industry, with Canada's rapid development of her petroleum resources reducing import of fuels. Very modest changes in the geographical source of Canada's imports are expected. The United States fraction should increase slightly, but no increase in the proportion coming from the United Kingdom is seen.

CANADA—UNITED STATES ECONOMIC RELATIONS. By Irving Brecher and S. S. Reisman. Royal Commission on Canada's Economic Prospects. Ottawa, Queen's Printer, 1957. 344 p., tables, appendices. Price $4.00.

The inclusion of a study of Canada-United States economic relations appears logical as the United States stands out as the preponderant external influence shaping the course of Canada's economic affairs. The subject is such a vast one, however, that a report such as this one must select only certain topics for analysis, and again only some of the facets of these major topics can be discussed. Five major topics have been given special consideration: business cycle transmission from the United States to Canada; non-resident ownership and control of Canadian industry with special reference to United States investment; some aspects of Canada-United States commercial relations; trade union links between Canada and the United States; and the dimensions of economic growth in Canada and the United States.

[F.A.C.]

TEMPERATURES OF NORTHERN NORTH AMERICA. By Donald W. Hogue. Research Study Report RER-9, Regional Environments Research Branch, Environmental Protection Research Division, Quartermaster Research & Development Center, Headquarters Quartermaster Research & Development Command, U.S. Army, Natick, Massachusetts. June, 1956, 62 p., maps, tables, biblio.

This report was prepared to provide data required in connection with a Signal Corps problem of storage and issue of batteries. Data were obtained from selected weather stations in Alaska, Canada, Greenland and Iceland. Tables record location of stations, mean temperature, mean daily maximum temperature, absolute maximum temperature, absolute minimum temperature and temperature frequencies. Maps show the location of the climatic stations and isotherms of mean temperature for each month.

[W.H.]

SOME RESULTS OF THE SNOW SURVEY OF CANADA. By L. W. Gold and C. P. Williams. Canada, National Research Council, Div. of Building Research, Research Paper No. 38, Ottawa, Queen's Printer, June 1957. 8 p., maps, photos, tables, diags. Price 25 cents.

The purpose of this paper is to present preliminary results of a survey of the physical characteristics of the snow cover across Canada. Comparisons of snow hardness and density data are made between selected stations, and on the basis of this analysis the country is divided into five main snowfall regions:—(1) The Arctic region; (2) The northern treeline region; (3) The Prairie region; (4) The western mountain and coastal region; (5) The region classified as a freeze-thaw region in Eastern Canada. The trafficability of snow is discussed for each of these regions.

[W.E.H.]

CANADIAN ICE DISTRIBUTION SURVEY. Publications of the Geographical Branch, Ottawa.

GULF OF ST. LAWRENCE AREA

"A preliminary Report on Ice Conditions at Cacouna Island, Quebec", by B. Robitaille. *Geographical Paper No. 10*, 1957 (bilingual).

The possibilities of continuing navigation throughout the winter months in the immediate vicinity of Cacouna Island led to this investigation. The major physical factors affecting ice distribution are considered and the conclusion is reached that navigation is generally possible within a restricted area during the winter. The report is published in both French and English.

"Ice Distribution in the Gulf of St. Lawrence During the Break-up Season", by C. N. Forward. *Geographical Bulletin, No. 6*, 1954, pp. 45-84.

This study of ice distribution and its behaviour during March, April and May is based on a 13-year period of aerial ice observations. The limits of the main ice areas at periodic intervals during each of the 13 years is shown cartographically. The relative influence on the ice of the physical factors of the environment is investigated. Variations from year to year in patterns and rates of break-up are indicated and the close relationship between temperature, wind, and ice conditions is demonstrated. An attempt is made to define average ice conditions, with the reservation that a longer period of record may in future permit a more accurate definition.

"An Illustrated Glossary of Ice Types in the Gulf of St. Lawrence", by W. A. Black, *Geographical Paper No. 11*, 1957.

A great variety of ice types that occur under different physical conditions are identified and displayed with explanatory notes. The physical processes, including meteorological conditions and water movements, that give rise to various ice types are indicated.

"Gulf of St. Lawrence Ice Survey, Winter 1956", by W. A. Black and C. N. Forward, *Geographical Paper No. 12*, 1957.

"Gulf of St. Lawrence Ice Survey, Winter 1957", by W. A. Black, *Geographical Paper No. 14*, 1957.

These reports present the results of aerial ice surveys carried out during the period from February to March in each year. The 1956 survey represented the first detailed investigation of winter ice conditions ever conducted in this area. The reporting techniques devised by the United States Navy Hydrographic Office were employed in an effort to introduce standardized methods of procedure into the Canadian ice research program. The ice conditions encountered during each of the periodic flights are depicted on maps accompanying the text.

Eastern Arctic Area

"Sea Ice Conditions Along the Hudson Bay Route", by C. N. Forward, *Geographical Bulletin, No. 8*, 1956. pp. 22-50.

Although it is similar in approach to the Gulf of St. Lawrence ice study, this investigation is based primarily on shipboard and land observations because regular aerial ice surveys have never been conducted. The various ice types encountered in the area and the physical factors affecting ice are indicated. Ice conditions are traced month by month throughout the year in order to show the steps in the cycle from initial formation to break-up. Limits of the main ice areas in average, favourable and unfavourable years are shown on a series of maps covering the period from July to October.

"A Report on Sea Ice Conditions in the Eastern Arctic, Summer 1956", by W. A. Black, *Geographical Paper No. 9*, 1956.

"A Report on Sea Ice Conditions in the Eastern Arctic, Summer 1957", by W. A. Black, *Geographical Paper No. 15*, 1958.

These ice surveys were carried out from the C.G.S. "d'Iberville" during the annual re-supply mission to northern stations. Ice conditions were observed from the ship's helicopters and from land based aircraft as well as from the ship. The availability of meteorological and oceanographic services on the icebreaker provided an opportunity to investigate the causes of observed changes in ice conditions. Thus, daily heat accumulative temperatures of air, surface water and sub-surface water are related to ice conditions to indicate the progress of thawing. Ice distribution is described systematically for different sections of the ship's route to Eureka and changes occurring between observations are indicated. A number of maps showing ice concentration by size of floe and other characteristics of the ice graphically illustrate the changing conditions.

[C.N.F.]

Atlantic Provinces Agriculture. By E. P. Reid and J. M. Fitzpatrick. Canada, Dept. of Agriculture, Marketing Service, Economics Division, Ottawa, Queen's Printer, 1957. 42 p., maps, tables.

This report presents a concise statement on the agricultural industry in the four Atlantic Provinces and concerns both production and marketing. In the section on production, types of farming are analyzed, and each province is illustrated by a map showing the farming regions for livestock, cash crop, and combination cash crop and livestock areas. The report is well-documented with statistical tables.

[C.W.R.]

Newfoundland Report of the South Coast Commission, 1957. St. John's, Newfoundland, 1957. 170 p., maps, tables.

The Royal Commission was appointed to examine the economic and social conditions on the south coast of Newfoundland and to recommend a program for improvement of these conditions. That the south coast is a depressed area has been recognized for some time. The report of the commission is divided into three main parts dealing with different aspects of the study. The first part sets forth the physical, social and economic background with particular reference to natural resources and resource utilization. A systematic consideration of development possibilities by districts is presented in part two; part three contains the recommendations of the commission.

[C.N.F.]

PROJET D'AMÉNAGEMENT DE QU BEC ET DE SA R GION: RAPPORT. Par Roland Bédard, Jacques Gréber, Édouard Fiset. Service d'Urbanisme Municipal de Québec, 1956; 71 p.; plans, graphiques, photos, illus.

Ce rapport n'est qu'une étape dans l'étude des problèmes majeurs, rencontrés dans la réalisation du projet d'aménagement de Québec et ses environs (de Notre-Dame-de-Lorette à la rivière Montmorency, Lévis et Lauzon exclus). La première partie du rapport est consacrée à l'analyse des zones industrielles et résidentielles et de leurs affectations territoriales, ainsi qu'à l'examen des problèmes du réseau routier, du zonage, et de l'aspect administratif et juridique du projet. La seconde partie du rapport suggère certaines améliorations à apporter aux réseaux des voies publiques et ferroviaires, par l'extension et le détournement de ceux-ci. Ensuite, on passe au problème de l'habitation et de la répartition des zones résidentielles et des espaces libres, pour en arriver finalement à la question de la préservation des monuments historiques et de la valeur esthétique et architecturale de la vieille capitale.

[J.A.R.]

SOIL SURVEY OF ONTARIO COUNTY. By A. B. Olding, et al. Canada, Dept. of Agriculture, Experimental Farms Service, and Ontario Agricultural College, Ontario Soil Survey Rept. No. 23, c. 1957. 60 p., map, illus.

This report covers an area of approximately 853 square miles that stretches in a long, relatively narrow band from Lake Ontario northward, along the eastern shore of Lake Simcoe, and into the Muskoka district. As such it gives a good cross-section of the various soil types found on the shale and limestone tills and glacial lake bottom deposits in that section of the province lying between Lake Ontario and the Laurentian Shield.

In addition to a most useful and interesting soils map (scale 1:63,360), the report provides a brief general description of the area, a clear cut analysis of the parent materials with appropriate maps, a detailed description of profile and land use for the various soil series, and a series of crop adaptability rating tables.

A noteworthy feature of the most recent soils reports of the Ontario Survey is the illustration, in colour, of the profiles of the Great Soils Groups.

[C.W.R.]

POPULATION TRENDS IN CANADA, BRITISH COLUMBIA, ALBERTA AND SASKATCHEWAN, 1956-1975. By C. C. Walden, et al. British Columbia Research Council, Victoria, 1957, 42 p., tables, graphs.

For the purpose of this study, population statistics of Canada, British Columbia, Alberta and Saskatchewan have been projected to 1975. With a basic assumption that "population is one of the most important factors affecting market demand" and as an aid to business in long-term planning, the statistics have been broken down into selected age groups, birth rates, death rates, migration trends, immigration, age, and sex.

[B.C.]

REPORT OF RECONNAISSANCE SOIL SURVEY OF ROSSBURN AND VIRDEN MAP SHEET AREAS. By W. A. Ehrlich, et al. Canada, Dept. of Agriculture, Provincial Dept. of Agriculture and Soils Dept., Univ. of Manitoba, Manitoba Soil Survey Rept. No. 6. 1956. 121 p., maps, illus.

The object of this report, as stated in the preface, was to obtain the essential facts about the soils, to ascertain their characteristics, problems and possibilities, and to define their distribution. In addition to a long section describing the soil associations of the various sub-zones, the report includes a general description of the area, and sections dealing with land classification, analytical and experimental data, and agriculture and land use.

[B.C.]

RECONNAISSANCE SOIL SURVEY OF THE GRANDE PRAIRIE AND STURGEON LAKE SHEETS. By Wm. Odynsky, et al. Canada, Dept. of Agriculture and University of Alberta, Department of Extension, University of Alberta Bulletin No. 60, Research Council of Alberta, Rept. No. 74, Alberta Soil Survey Rept. No. 18. 1956. 111 p., maps, illus.

The bulk of this report consists of a description of each soil series which includes extent and occurrence, topography, drainage, native vegetation, profile description, soil rating and agricultural use. This is supplemented by a general description of the area, including relief, drainage, climate and vegetation, soil development and agricultural problems. [B.C.]

NATURAL GAS RESERVES OF THE PROVINCE OF ALBERTA AND OTHER RELATED DATA. Alberta, The Petroleum and Natural Gas Conservation Board, Edmonton, 1957, 55 p., map, graphs, tables.

The bulk of this report consists of tables of "Established Reserves of Natural Gas in the Province of Alberta, September 30, 1956" and "Trends in Wildcat Drilling and Growth of Disposable Gas Reserves in the Province of Alberta." Present and future requirements of natural gas are discussed on a basis of population growth projected to 1981, domestic, commercial and industrial requirements, and estimates of reserves. The one map in the report shows locations of fields and areas containing important gas reserves.

[B.C.]

ARCTIC CANADA FROM THE AIR. By Moira Dunbar and K. R. Greenaway. Canada, Dept. of National Defence, Defence Research Board, Ottawa, Queen's Printer, 1956. 541 p., maps, illus., biblio. Price $8.00.

"This book is intended for use as an aid to map reading and as a source of general information which may be of value or interest to airmen flying in the vast and frequently monotonous expanses of the Canadian Arctic." The islands or island groups in the Arctic Archipelago are described separately and divided into physiographic regions. The Canadian Arctic mainland is dealt with in a separate chapter, as are sections on the Canadian Arctic in general, the Arctic Ocean, Canadian arctic waters, weather, and arctic aviation. Appendices include a chronological list of the principal expeditions, references, and a glossary of geographic and ice terms. The book is illustrated with 506 aerial photographs and 50 maps. [J.K.F.]

ILLUSTRATED FLORA OF THE CANADIAN ARCTIC ARCHIPELAGO. By A. E. Porsild. Canada, Dept. of Northern Affairs and National Resources, National Museum of Canada, Bull. No. 146. Ottawa, Queen's Printer, 1957. 209 p., maps, illus. Price $2.00.

This publication "is intended as a guide or manual to the 340 species and major geographical races of flowering plants and ferns that comprise the vascular flora as it is known at present of the Canadian Arctic Archipelago." It contains keys to families, genera and species, brief descriptions and line drawings, and maps showing North American distribution of all species. A useful glossary of special botanical terms supplements the descriptions which include brief notes on local occurrence, soil preferences and world distribution. [J.K.F.]

GEOLOGICAL NOTES ON SOUTHERN DISTRICT OF KEEWATIN, NORTHWEST TERRITORIES. By C. S. Lord. Canada, Dept. of Mines and Tech. Surv., Geol. Surv. of Canada, Ottawa, 1953, Paper 53-22, 11 p., maps. Price 35 cents.

GEOLOGICAL NOTES ON CENTRAL DISTRICT OF KEEWATIN, NORTHWEST TERRITORIES. By G. M. Wright. Canada, Dept. of Mines and Tech. Surv., Geol. Surv. of Canada, Ottawa, 1955, Paper 55-17, 17 p., maps. Price 50 cents.

GEOLOGICAL NOTES ON EASTERN DISTRICT OF MACKENZIE, NORTHWEST TERRITORIES. By G. M. Wright. Canada, Dept. of Mines and Tech. Surv., Geol. Surv. of Canada, Ottawa, 1957, Paper 56-10, 23 p., maps. Price 50 cents.

These reports present the results of reconnaissance surveys by helicopter in 1952, 1954 and 1955. Each includes sections on Pleistocene features, general geology and economic geology and is accompanied by end-pocket maps showing general geology and Pleistocene features.

[J.K.F.]

RECONNAISSANCE SOIL SURVEY OF THE SLAVE RIVER LOWLANDS IN THE NORTHWEST TERRITORIES OF CANADA. By J. H. Day and A. Leahey. Canada, Dept. of Agriculture, Experimental Farms Service, Ottawa, Queen's Printer, 1957, 44 p., illus., map.

This report describes the suitability of this area for potential agricultural development. The survey is based on air photograph interpretation, mechanical and chemical soil analyses, and vegetation cover. Soil series and land types commonly found together are presented on the map as associations. The difficulties of irrigation from available water sources are discussed.

[W.H.]

YUKON TERRITORY, SELECTED FIELD REPORTS OF THE GEOLOGICAL SURVEY OF CANADA, 1898 to 1933. Compiled and annotated by H. S. Bostock. Canada, Dept. of Mines and Tech. Surv., Geol. Surv. of Canada, Mem. 284, Ottawa, Queen's Printer, 1957. 650 p., tables, maps. Price $3.00.

A collection has been made of the best reports resulting from 35 years of exploration and field work by the Geological Survey of Canada in Yukon Territory. Although designed particularly for the mining industry, modern scientific libraries and educational institutions, this compilation has broad appeal. Not only are some of the original reports out of print, but others are of areas that have not been revisited and which are still almost unknown. The reports contained here should be of value as areas of economic interest become more easily accessible.

[B.C.]

THE BIRDS OF BANKS ISLAND. By T. H. Manning, et al., Canada, Dept. of Northern Affairs and National Resources, National Museum of Canada, Bull. 143, Ottawa, Queen's Printer, 1956, 144 p., map, tables, illus. Price $2.50.

Observations on bird life on Banks Island in 1952 and 1953 form the basis of this publication. There is a discussion of the 62 species recorded on the island, supplemented by measurement tables and estimates of bird population per square mile. Summaries of weather conditions, topography and vegetation add to the geographical interest of this publication.

[J.K.F.]

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