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NORTHERN QUEBEC, A NEW MINING AREA, A STUDY OF THE TERRITORY BETWEEN EASTMAIN RIVER AND UNGAVA BAY

PROVINCE OF QUEBEC, CANADA

Department of Mines

Honourable C. D. FRENCH, Minister — A.-O. DUFRESNE, Deputy Minister

GEOLOGICAL SURVEYS BRANCH

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GEOLOGICAL REPORT 56

NORTHERN QUEBEC

A NEW MINING AREA

A STUDY OF THE TERRITORY BETWEEN EASTMAIN RIVER AND UNGAVA BAY

by

J.-E. GILBERT

QUEBEC

RÉDEMPTI PARADIS

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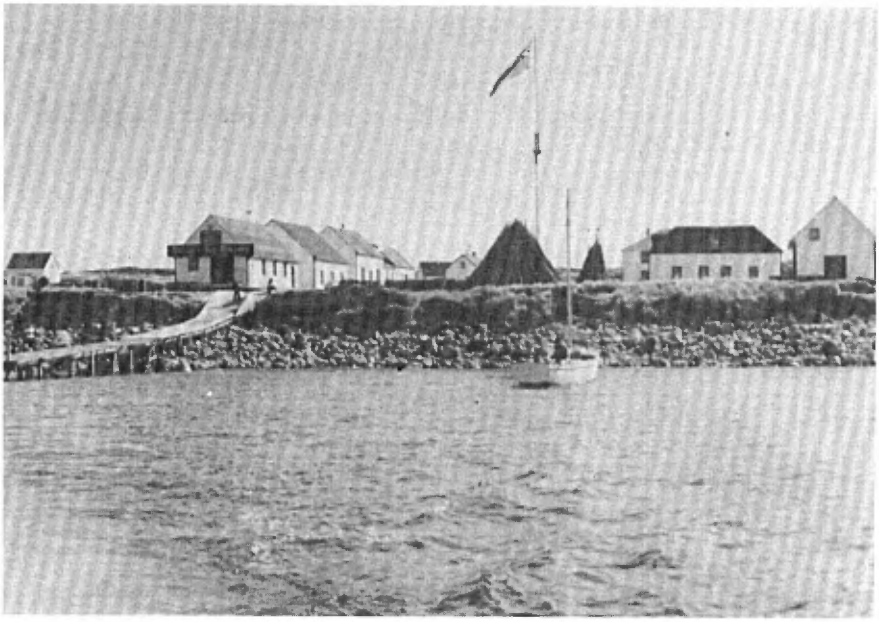


A.- Fort Chimo post on right bank of Koksoak river. Photo, Hudson's Bay Co.

B. - Port Harrison post on Hudson bay. Photo, Hudson's Bay Co.

NORTHERN QUEBEC

A New Mining Area

A Study of the Territory between
Eastmain River and Ungava Bay

by J.E. Gilbert

INTRODUCTION

General Statement

The recent discovery of very large iron ore deposits in the heart of New Quebec qualifies, indeed, as one of the most important events in the history of the mining industry of the whole of Canada. It has aroused world-wide interest and will undoubtedly have a profound effect on our economy as well as on that of the whole of the Western world. It has also brought into light the numerous potentialities of the immense area of the province that is limited to the east and south by Labrador and the gulf of St.Lawrence, and, to the west and north, by Hudson and James bays and Hudson strait.

Concerning those potentialities, our knowledge is very limited indeed. Although the amount of literature that we have about that territory is relatively considerable, its value is extremely variable. Some reports, abundantly detailed, concern only very limited parts whereas others, very sketchy, are related to immense areas, and still others are of a restricted interest on account of their inaccuracy and vagueness.

A large proportion of the information that is presented in this report and on the accompanying map had already been collected in a comprehensive manuscript report prepared by Aubert de la Rüe, in 1949, for the Quebec Department of Mines. About one hundred other pertinent publications, reports, and maps were also consulted. From those sources were gleaned all facts essential to the presentation of a clearer picture of the geography, physiography, climate, and particularly the geology of Quebec's northland. The nature of the subsoil of the territory has been indicated on the accompanying map as described by the different explorers, and no attempt has been made by the writer to correlate the various formations observed in adjacent traverses except when they were relatively close to each other. It was thought preferable to leave in white the unexplored areas and to avoid an interpretation that stood a good chance to be wrong and would

have given the reader the impression that the country is much better known than is the case.

Location and Extent

The territory herein described covers the basins of the rivers flowing into Ungava bay, Hudson strait, Hudson bay, and the part of James bay that is north of Eastmain river.

The area is approximately 330,000 square miles, slightly more than half of the total area of the Province of Quebec.

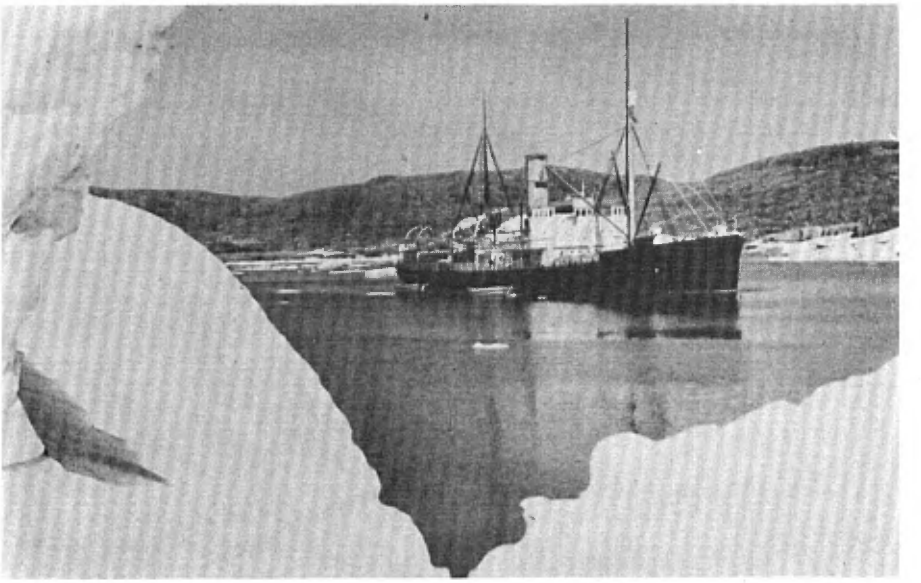
Means of Access

Four or five ships, belonging to the Federal Government, the Hudson's Bay Company, or the Catholic Missions, visit, during the summer months, the different stations and posts scattered along the coast and also Fort Chimo, along the lower course of Koksoak river, approximately 25 miles south of its discharge into Ungava bay.

The fluvial routes in the interior used by the old travellers who entered the territory by canoe from lake Saint John, the north shore of St.Lawrence river and gulf, or from James bay were long and tedious. They were, in the last few years, advantageously replaced by air routes through which one can today reach, in a few hours, almost any part of the country. The considerable number of lakes and wide water-ways of the territory permit an easy setting down almost anywhere of the hydroplanes or ski-equipped aircraft of the various flying companies operating from the Lower Saint-Lawrence, Lake Saint-John, and Abitibi regions.

There are, however, two periods during the year when, with the exception of the three landing strips built and maintained at Fort Chimo, Knob Lake (latitude 54°50'N. and longitude 66°40'W.), and Wacouna (latitude 51°24'N. and longitude 65°35'W.), no aircraft can land. One period is in the spring, between May 15 and June 15, during the "break-up", and the other is between September 15 or 30 (depending on the latitude) and November 30 when the surface of the lakes is not completely frozen.

An easy means of access to the southeastern part of the region will soon be available with the completion of the railroad now being built by Quebec North Shore and Labrador Railway Company, Ltd., to link the iron ore deposits of the neighbourhood of Knob Lake to Seven Islands, a seaport on the north shore of the St.Lawrence.



A.- The "Nascopie" at Port Burwell. Photo, "The Beaver", Hudson's Bay Co.

B.- Port Burwell post, now closed, on Killinek island, Ungava Bay. Photo, "The Beaver", Hudson's Bay Co.

A.- Estuary of Payne river and Payne Bay post. Photo, E. Aubert de la Rüe.

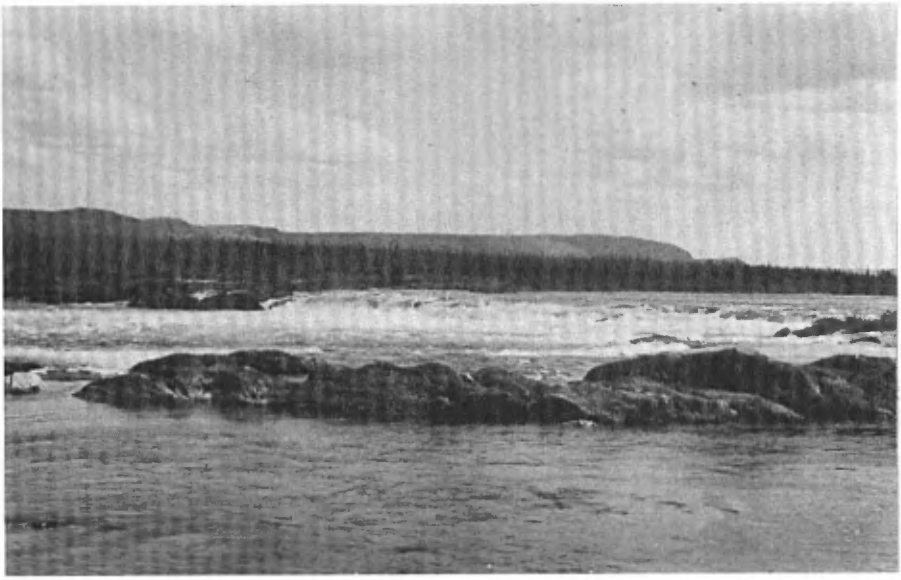
B.- Payne Bay post of Hudson's Bay Co. Photo, E. Aubert de la Rüe.

A.- Tow-line ascension of a rapid on Clearwater river. Photo, Pierre Dagenais, Department of Trade and Commerce, Quebec.

B. - 310-foot waterfall at Richmond gulf, east coast of Hudson bay, Photo, Pierre Dagenais, Department of Trade and Commerce, Quebec.

Plate V

A. - Limestone falls on Caniapiscau river. Photo, Quebec Labrador Development Co. Ltd.



B. - Pyrite Falls on Caniapiscau river. Photo, Quebec Labrador Development Co. Ltd.

Exploration Work

The archives of Hudson's Bay Company contain, in all probability, the first reports of exploration journeys into the territory here under study since that company had already established trading posts here and there in the area before the end of the 17th century. It is also probable that a good number of trappers and French explorers ventured into the southern parts of the territory, since maps of Canada published in France during the first half of the 18th century show a "Maison Française" or "Maison des Dorval" on the southwest shore of Mistassini lake, approximately 100 miles to the south of the upper reaches of Eastmain river. Numerous missionaries undoubtedly also followed the natives into the region during the 18th and 19th centuries, and one of them, Reverend Father Louis Babel, O.M.I., has left a surprisingly accurate sketch map of the southeastern section of the territory which he seems to have visited yearly between 1866 and 1870.

However, it is to A.P. Low, the great explorer and geologist, that we owe the first detailed description of the character of the coastal regions and of the interior of the territory. His exploration journeys, undertaken for the Geological Survey of Canada between 1885 and 1904, enabled him to gather comprehensive information on the topography, the hydrographic system, the geology, the flora, and the fauna of a large section of the territory.

After fifty years, Low's reports still remain the "Bible" of those who are interested in that region. They contain accurate observations of all types. Some of Low's journeys have not yet been retravelled and, consequently, his writings are, in many cases, the only source of first-hand information that we have at our disposal.

Since Low's time, a good number of explorers have published more or less detailed studies of certain sections of the territory they visited. Among the most important of these voyagers may be mentioned Hubbard, Flaherty, Wheeler, Gunning, Gill, Bannerman, Tolman, Shaw, Kranck, Retty, Rousseau, and Aubert de la Rüe.

The bibliographic index at the end of this report contains the list of publications of these explorers and those of many others who visited more restricted areas of the territory.

GENERAL DESCRIPTION

Physical Characters

Coast-line

The coast-line of the territory has an extremely variable aspect depending mainly upon the composition and structure of the underlying bedrock and of the arrangement of the unconsolidated sediments of the littoral.

On the west side, along James bay, the coast-line is low and gently sloping. From Cape Jones, which marks the start of Hudson bay, it forms, to the north, an immense arc widely open to the west. Here, the coast becomes steeper and a large number of elongated islands lie parallel to the shore. North of Portland promontory, the littoral is generally low, the sea is shallow over a wide area skirting the shore, and, although tidal fluctuations are small, navigation is there very difficult even for ships of very shallow draught. The north shore, along Hudson strait, is relatively steep and a good number of islands lie off-shore. Hudson strait is swept by a westward flowing arctic current and navigation is difficult along the coast on account of the heavy tide which increases in intensity towards the east and causes very violent currents in the narrows and over shallows.

In general, the coast-line of Ungava bay is low, but it rises here and there into hills that border the bay at variable distances from the shore, rarely exceeding, however, heights of 300 to 500 feet. Although jagged at certain places, the littoral usually consists of long stretches of grey clay strewn with large erratic boulders. Tidal variations are very considerable and coastal shoals are a serious inconvenience to navigation, even forbidding access to the shore at many places.

Topography

Broadly speaking, the territory forms a gently rolling plateau without any prominent elevations. Its surface is that of a peneplain rejuvenated after an uplift, during the Pliocene, of some 600 feet above the present mean level (Cooke, 1929, 1930, 1931). The glaciation of the Pleistocene epoch was accompanied, according to Cooke, by a sinking of the land masses which was followed, after the disappearance of the ice, by an uneven resurgence varying between 180 and 900 feet from one part of the territory to an other.

Although precise data are still lacking as to the altitudes of the various elevations of the territory, it seems that the highest places lie in the western spur of the Torngats mountains, some 30 miles to the east of the east coast of Ungava bay, at about latitude 59°30'N. and longitude 64°28'W. A federal government map, at 8 miles to the inch, indicates in that section altitudes of 3,640 feet above sea level. However, the map drawn by Forbes (1933) shows that a small area situated at latitude 57°17'N. and longitude 64°34'W. stands at least 4,100 feet above sea level.

It is however between latitudes 53° and 55°N. and longitudes 64° and 71°W. that the widest part of the territory having the highest average altitude is believed to be. Most of the main streams of the territory originate on this lacustrine plateau, the altitude of which varies between 1,700 and 2,000 feet above sea level and in which lies the divide separating the James Bay and Hudson Bay basins from those of Ungava bay and of the Atlantic. The Otish and Wapussakatoo mountains, situated respectively between latitude 52°15'N. and longitude 70°30'W. and between latitude 53°N. and longitude 67°W., border that wide central plateau.

One of the most interesting topographical details of the territory consists of a deep circular depression, approximately 65 miles west of the entrance to Ungava bay, at latitude 61°17'N. and longitude 73°40'W. This depression, apparently photographed for the first time in June, 1945, by a United States Air Corps flyer, is indicated as being a crater in the 1946 and 1949 editions of the Povungnituk River Sheet of the Surveys and Mapping Branch, Department of Mines and Technical Surveys, Ottawa.

Meen, who explored the depression in 1950 and 1951, considers it to be a crater of meteoric origin and he reports that its exterior diameter is 11,500 feet; its circumference, 6.8 miles; and its maximum depth, 1,325 feet. It would therefore be the largest meteor crater discovered to date. The lower part of the depression is filled by a lake, 9,100 feet in diameter, surrounded by a ring of granitic rocks approximately 400 feet high. The inside slope of the crater is at an angle approaching 45 degrees.

Drainage

The area is strewn with a great abundance of lakes of all shapes, dimensions, and depths. In some sections, such as on the central plateau, lakes occupy nearly fifty per cent of surface of the region. In those parts where the bedrock consists of massive rocks, the lakes are haphazardly distributed and have irregular contours.

They show, on the other hand, definitely elongated forms and are arranged in more or less parallel lines where stratified, schistose, or faulted rocks are dominant. In the vicinity of the divides between the different hydrographic basins, many lakes have two outlets, and that increases the already considerable difficulty of tracing the demarkation line between two adjacent fluvial basins.

Rivers are numerous everywhere in the territory except in the extreme northwestern part where the atmospheric precipitation is less. Some of these rivers are of important size. The main streams of the James Bay and Hudson Bay watersheds are, from south to north: the Eastmain, Grande rivière or Fort George, Great Whale, Little Whale, Nastapoca, Kogaluc, Povungnituc, and Kovic. The main rivers of the Ungava Bay water basin, the majority of which have a very large outflow, are, from west to east: the Payne, Leaf, Koksoak, Whale, George, and Koroc.

Climate

Tanner puts forward, in a report on Labrador published in 1947, the hypothesis that the meteorological conditions of the territory are determined by the conflict of two climatic complexes: first, a continental complex from the interior regions with rainy summers and cold winters, and, second, a maritime complex from the eastern border with rainy autumns and mild winters. Continental climatic conditions prevail over the whole territory during the winter, whereas coastal and maritime climate has a major influence for a considerable distance into the interior during the summer months.

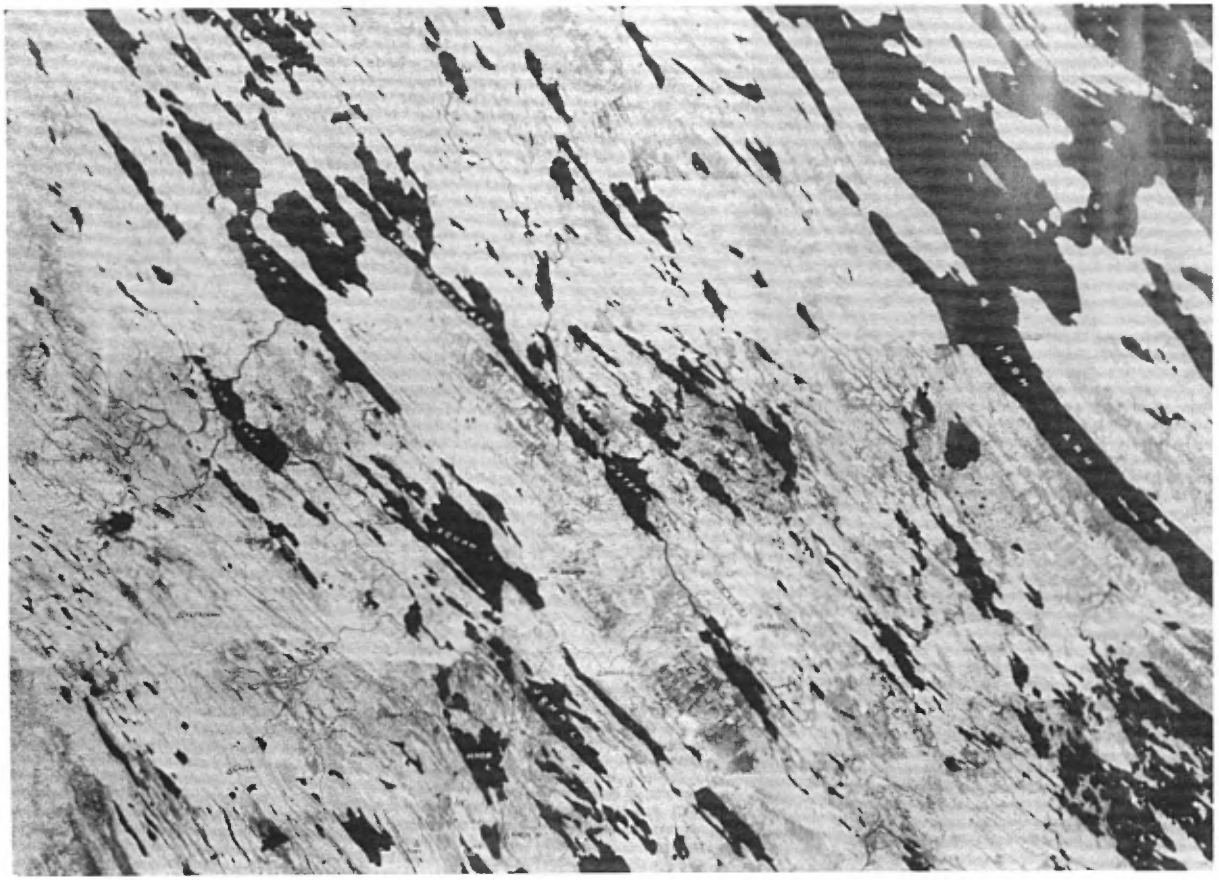
As a result, the main characteristic of the climate of the territory is its great instability. The deeper one enters into the hinterland, the warmer the summers and the colder the winters become. In general, the annual precipitation also decreases from south to north and from east to west.

The territory has thus but two seasons: winter and summer. The farther one travels to the north, the shorter are the summers and the longer, the winters. In general, the average daily temperature of the territory rises above 32°F. only during a period of about four months. The isotherm of 50°F. in July, which is generally considered as marking the limit between a temperate climate and arctic conditions, cuts across the east coast of Hudson bay at approximately latitude 57°N. and makes, toward the interior, a slightly sinuous line in an approximate east-west direction.

Plate VI

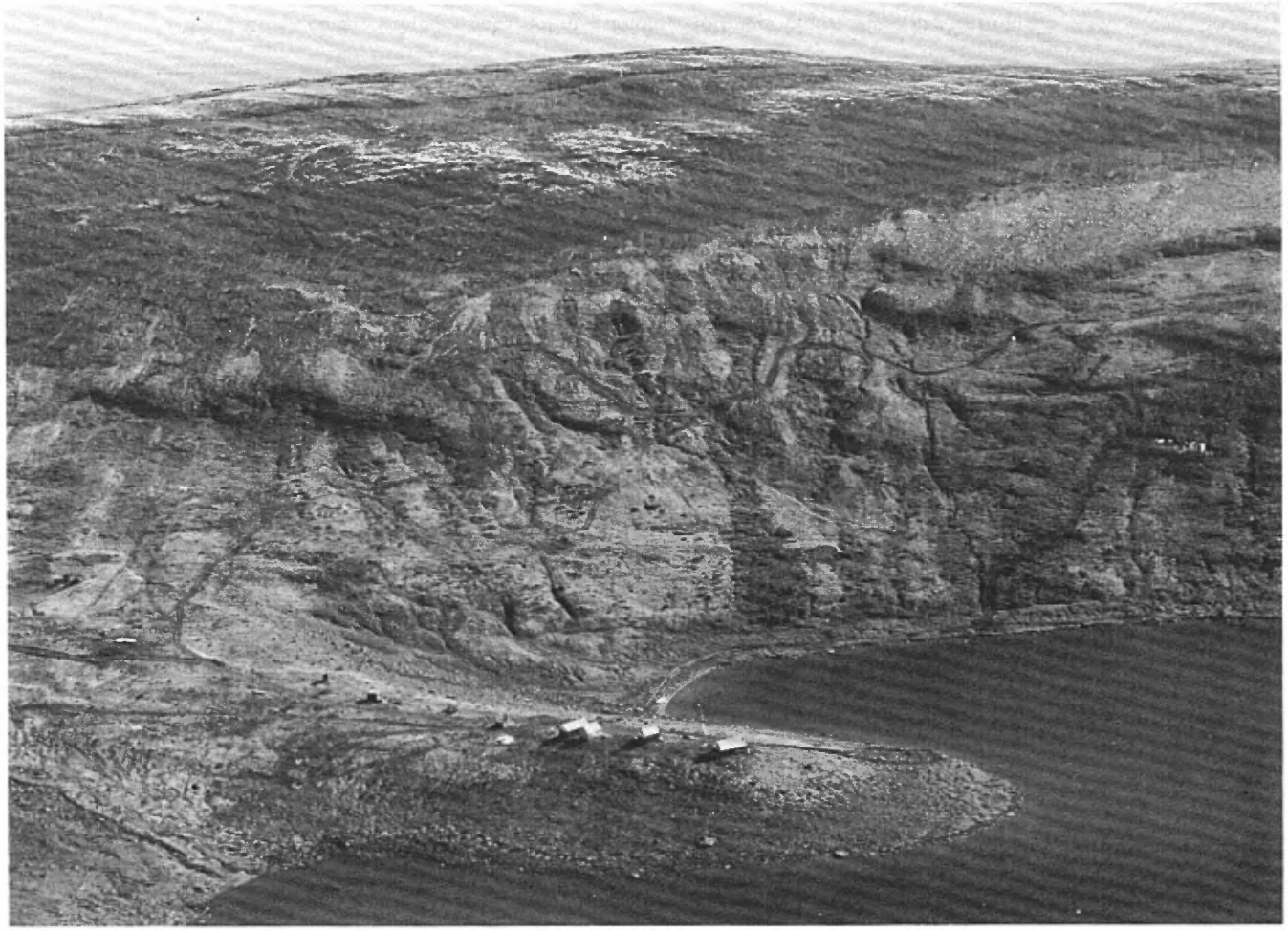
A. - Knob Lake region, Labrador geosyncline. Photo, Hollinger North Shore Exploration Co. Ltd.

B.- Knob Lake. Photo, Hollinger North Shore Exploration Co. Ltd.



Aerial view of Late Precambrian formations of the Labrador geosyncline in the Burnt Creek region. Photo, Topographical Surveys of Canada.

Burnt Creek camp, Labrador geosyncline. Photo, Hollinger North Shore Exploration Co. Ltd.



Eclipse deposits. Property of Hollinger North Shore Exploration Co. Ltd. Photo, Hollinger North Shore Exploration Co. Ltd.

Snow usually melts in the woods during the first two weeks of June and regular night frosts start at about the end of August or early in September. In the hinterlands, daytime temperatures as high as 75°F. are sometimes recorded during the summer. However, the winters are rigorous. Their minimum temperatures easily reach 20°F. below zero and are known to have dropped to 50°F. or 60°F. below zero at various places.

Flora

The territory may be divided into three distinct zones of vegetation, one somewhat overlapping the others. They are from south to north: the taïga, the forest tundra, and the tundra.

Taïga.- The taïga, also known as the forest of subarctic coniferous trees, occupies all of the southern part of the territory up to the vicinity of latitude 54°N. and even latitude 55°N. in its eastern section, near the headwaters of George river.

The taïga does not form a continuous forestry mantle and its aspect changes gradually from one region to another. It is broken by bare rocky ridges and by peat bogs. Depending on the nature of the soil, the predominant trees are either black spruce or white spruce, the former in humid soils and the latter in dry places, where they form the best stands. Grey pine (Pinus Banksiana) is found in the sandy soils of the western part of the territory. Balsam fir is not very common in the taïga, whereas larch forms homogeneous stands in very humid spots. The deciduous trees growing in the territory consist mostly of white birch and poplar.

The stands of coniferous trees of the taïga suitable for industrial exploitation represent a relatively restricted part of the wooded areas. The fact remains, however, that mining enterprises will find, certainly as far north as latitude 57°N. and even farther in some favoured spots, the timber necessary for their current needs.

Forest Tundra.- The forest tundra is nothing else than the northernmost part of the subarctic forest of coniferous trees where these grow in clusters along river banks and in protected valleys. The species are about the same as those in the taïga, except that black spruce forms by far the dominant variety.

Tundra.- The real tundra begins in the territory between latitudes 58° and 59°N. Its southern boundary forms a sinuous line which starts south of Portland promontory, on the east shore of Hudson bay, and passes slightly north of the major part of Leaf river and

crosses it near its mouth. The line then continues southward for a short distance following fairly closely the south shore of Ungava bay, after which it turns to the east and extends to the 59° parallel near the mouth of George river finally to follow the course of Koroc river.

Trees are not totally absent in the tundra, and, along with the very numerous species of arctic herbaceous plants, there are a few bushy varieties of willow, birch, and alder which seek humid and protected regions, such as river valleys and lake shores. These bushes are usually abundant enough along the main water-routes for travellers to find without too much difficulty the firewood necessary to cook their meals and keep warm.

Fauna

Caribou, the animal so precious to the Indian and Eskimo populations and which once thrived in very large numbers in the territory, has become considerably diminished in the last few decades. Several reasons have undoubtedly helped to accelerate its disappearance, but forest fires and the inconsiderate slaughter of the animal by Indians and Eskimos after the introduction of automatic firearms are among the main causes.

The principal fur-bearing animals inhabiting the southern, forested zone of the territory are mink, ermine, marten, otter, beaver, muskrat, linx, and several species of fox. Owing to excessive and irrational killing by hunters, the number of these animals has also been considerably reduced, and hunting reserves for the reproduction of beaver have been established in areas surrounding a few Hudson's Bay Company posts. Black bears are in places fairly abundant in the southern part of the territory.

During the winter, Eskimos of the northern arctic zone capture white or polar foxes and arctic hares. They also hunt seals and kill a few polar bears along the coast.

Flocks of white partridge,duck, and Canada goose inhabit the territory, and various species of sea birds dwell along the coast. Partridge is relatively abundant in the forest-covered regions. It is generally prudent, however, not to rely too much on game resources of the interior of the territory.

Schools of codfish frequent the east coast of Ungava bay and the region of Chidley cape; salmon also ascend some of the large rivers flowing into the southern part of Ungava bay.

Large trout are caught at many places in the coastal waters and fish seems to be plentiful almost everywhere in the interior. The main varieties of fish are grey trout, speckled trout, carp, white fish, pike, and several other species.

Insects are encountered in extreme abundance during the summer months all over the territory. Black flies are active from the thawing season to November and are particularly voracious.

Agriculture

The severity of the climate and the rocky or swampy nature of the soil limit considerably the agricultural possibilities of the territory. Some tillage, however, has produced satisfactory results along the east coast of James bay, where good crops of potatoes, carrots, beets, cabbage, turnips, onions, and rhubarb have been obtained. The growing period is about three months long, and seeding is not practical before June 10. A few cows are raised at Fort George (latitude 53°30'N. and longitude 79°W.) and they are fed during the winter with locally grown hay.

Farther inland, agricultural possibilities are generally very limited.

Water Power

The potential reserves of hydro-electric power of the territory are immense. No sector is short of them, although the largest water falls are situated in the central plateau. To mention only one, the water fall at Eaton canyon, on Caniapiskau river, has a potential energy estimated at approximately 500,000 h.p.

No matter in what part of the territory a mining exploitation requiring a large amount of electricity may settle, it can be assured in advance that within a short distance from the site of its operations water falls of the required height and flow will be found.

Population

There are approximately 4,000 inhabitants in the whole territory. The Eskimo population is the largest, being about 2,500; Indians number approximately 1,250. There are only a few hundred white men living permanently in the region and most of them are Hudson's Bay Company agents, missionaries, government officials, or, more recently, employees of companies exploring the iron ore deposits of the Late Precambrian formations in the Ungava Bay basin.

The Eskimos live on the shores of the arctic part of the territory between Ungava bay and the northern part of Hudson bay. The Indians, of the Montagnais-Naskopi tribe, dwell in the southern and forest-covered part of the country, generally south of the 57th parallel. On the east coast of Hudson bay, they do not live north of Richmond gulf. Approximately 200 of them moved recently to Fort Chimo after the closing of the Fort McKenzie trading post, 90 miles farther south.

Permanent Establishments

Apart from the mining camps of the companies working on the iron-bearing deposits mentioned earlier in this report, the main permanent establishments of the territory are the following:

Cape Hopes Advance (Ungava bay) - Department of Transport radio and meteorological station

Fort Chimo (lower valley of Koksoak river) - Detachment of the Royal Canadian Mounted Police, Hudson's Bay Company post-office*, Anglican mission, air base, and meteorological station

Fort McKenzie (Caniapiskau river) - Department of Transport radio and meteorological station

George River (Ungava bay) - Hudson's Bay Company post

Big Whale River (Hudson bay) - Hudson's Bay Company post and Anglican mission

Payne Bay (Ungava bay) - Hudson's Bay Company post

Port Harrison (Hudson bay) - Detachment of the Royal Canadian Mounted Police, post office, Department of Transport meteorological station, Hudson's Bay Company post, Anglican mission

Povungnituc (Hudson bay) - Hudson's Bay Company post

Richmond Gulf (Hudson bay) - Hudson's Bay Company post, Catholic mission

Sugluk (Hudson strait) - Hudson's Bay Company post

Wakeham Bay (Hudson strait) - Catholic mission

Eastmain (mouth of Eastmain river) - Catholic mission

Fort George (mouth of Grande rivière) - Catholic mission

Ivugivik (northern tip of Hudson bay) - Catholic mission

Koartac (Cape Hopes Advance, Hudson strait) - Catholic mission

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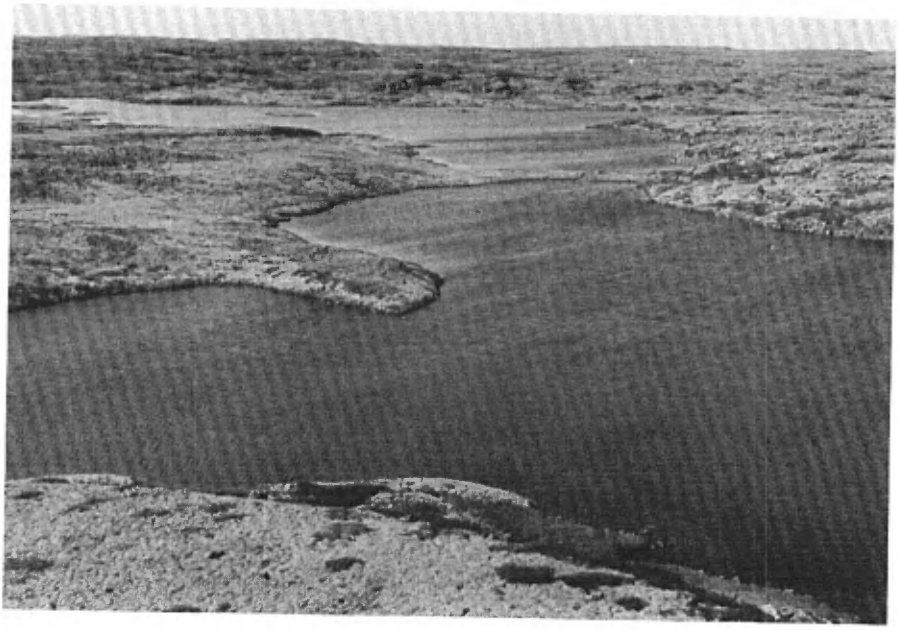
*Every post of this company also has a private transmitting radio station.

Plate X

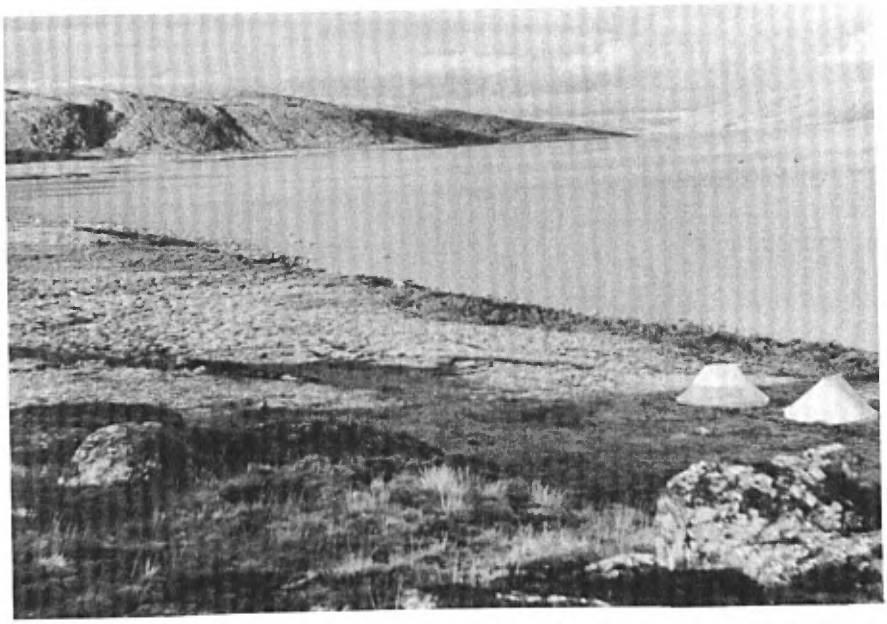
A.- Lacustrine plateau between Leaf and Payne rivers. Photo, E. Aubert de la Rüe.



B.- Lacustrine plateau, southwest of Payne lake. Photo, E. Aubert de la Rüe.

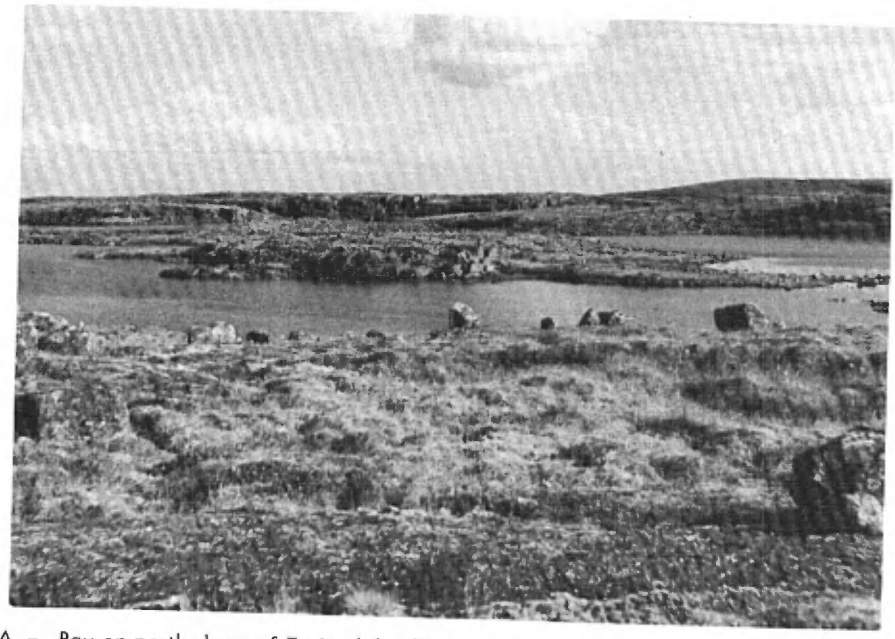
Plate XI

A.- Middle valley of Payne river, upstream view. Photo, E. Aubert de la Rüe.

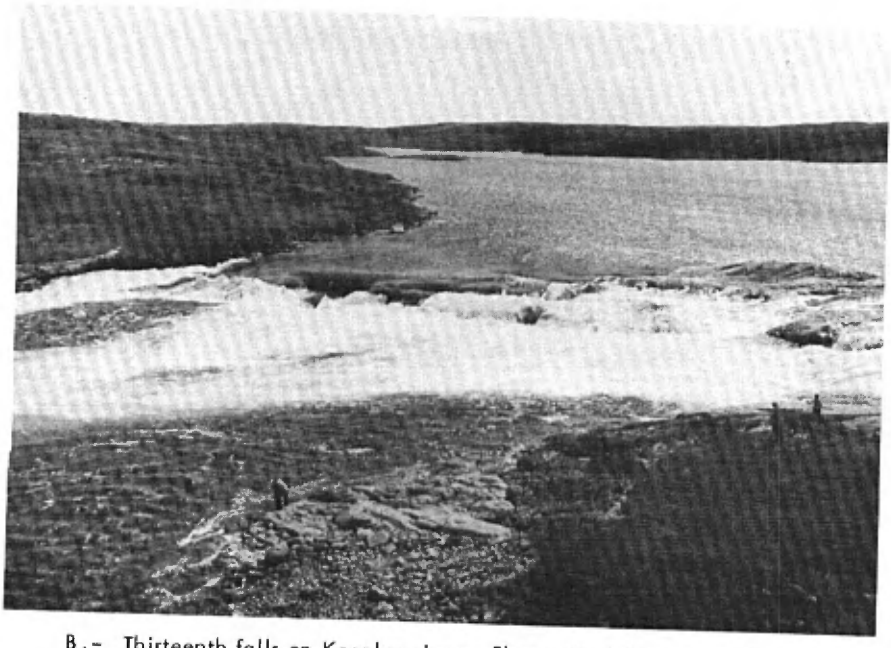


B.- Payne river, just above its junction with Flaherty river. Photo, E. Aubert de la Rüe.

Plate X11



A.- Bay on north shore of Tasiat lake (Kogaluc River basin). Photo, E. Aubert de la Rüe.



B.- Thirteenth falls on Kogaluc river. Photo, E. Aubert de la Rüe.

A.- East coast of Ungava bay. Photo, Alexander Forbes; Northernmost Labrador, published by the American Geographical Society of New York.

B.- East Coast of Ungava bay. Photo, Alexander Forbes; Northernmost Labrador, published by the American Geographical Society of New York.

GENERAL GEOLOGY

The geology of the territory here under study is only very broadly known, except for a few relatively small areas. However, the long traverses of Low and the field work of the few geologists who subsequently visited different parts of the territory make it possible at least to speculate in general terms on the geological character of the sections that have not yet been visited and to outline broadly the distribution of the main formations underlying the area.

All these formations, except for the surficial unconsolidated sediments of the Cenozoic period and possibly a few rare Palaeozoic outliers suggested by the presence of fossil-bearing erratics, belong to the Precambrian. Almost nine-tenths of the territory is underlain by Early Precambrian rocks, whereas the Late Precambrian formations, although presently much more important from the economic point of view since they contain the large iron ore deposits of the central plateau, occupy only relatively limited areas.

Early Precambrian

Gneissic Complex

The Early Precambrian basement rocks of the territory seem to consist essentially of a granite-gneiss complex mainly of composite origin. The descriptions that we have of them agree that pure and homogeneous granites in distinct masses are rarely found. On the contrary, the rocks are heterogeneous, gneissic, commonly banded and seem to consist mainly of orthogneiss rich in basic inclusions and containing, in places, large zones of sedimentary or volcanic material more or less metamorphosed and granitized. The contacts between those still recognizable zones of metamorphic rock and the adjacent orthogneisses are not clear cut but the formations show gradational transitions from one variety of rock to the other.

Easily identifiable paragneisses, commonly containing garnet, sillimanite, and, less frequently, graphite, occupy wide areas of the complex. Large masses of them are found in various parts of the country, particularly east and southeast of Ungava bay. Elsewhere, these gneisses are associated with amphibolites or quartzites, and Low even observed in them inclusions of crystalline limestone. Both types of paragneisses, the ones much injected with granitic material and changing gradually into migmatites and the others, less altered and containing interbeds of quartzite or of metamorphic limestone, are strongly reminiscent of the gneisses of

the Grenville series that crop out abundantly in southwestern Quebec and southeastern Ontario.

Greenstones

Belts of more or less metamorphosed greenstones, in which are commonly found still identifiable former basic to intermediate lavas, their associated tuffs, and sills of diabase containing inclusions of schistose sedimentary rocks or of greywackes, crop out in widely scattered parts of the territory. Their distribution and extent suggest that many more areas of them will still be discovered throughout the region.

It appears obvious from observations made in various parts of the territory that most of these rocks derived from ancient lavas are older than the adjacent granites. They are, like their associated sedimentaries, more or less metamorphosed, and it is probable that a certain amount of the paragneisses of the gneissic complex owe their origin to them. However, it seems that some greenstones of the territory are more recent than the main granitic occurrences, as will be indicated later.

The largest areas of greenstones so far discovered in the territory crop out at the following places: cape Smith and the upper reaches of Kovic river, near latitude 61°N.; along and in the vicinity of Eastmain river; along the eastern edge of part of the Late Precambrian sedimentary formations of the Ungava Bay basin.

The zone of greenstone exposed at cape Smith and at the head of Kovic river trends N.60°E. and has been traced for approximately 150 miles. Its known width is about 40 miles. It is very probable that it crosses the whole peninsula, as similar rock types are found, although more metamorphosed, along the coast of Hudson strait, over 200 miles from the east coast of Hudson bay.

These greenstones consist of greenish grey to dark green lava flows containing some sedimentary rocks and invaded by generally concordant dioritic intrusions. They thus look like the series of Keewatin-type greenstones that are found in abundance in the region southwest of Eastmain river and they are, similarly, more or less schistose. The lavas are commonly ellipsoidal and the sedimentary rocks are tufaceous and feldspathic. The entire series is older than the granitic gneisses that border it.

The greenstones of Eastmain river cover a large tract of ground along the lower course of the river and form seven other,

much smaller, zones along its upper reaches. Six of these are to the north and the remaining one is more to the east of the river. Each of these zones is surrounded by intrusive granitic rock into which they grade after gradually passing through gneisses, which themselves become more and more acidic towards the granite.

The main zone of greenstone forms an assemblage of andesitic lavas and sedimentary formations lithologically and stratigraphically resembling that of the Opemisca region farther to the south. The volcanic flows and the sedimentary formations are invaded by intrusive basic rocks similar to those found farther south in the Temiscamian sub-province. The zone is approximately 125 miles long and has a very variable width.

The other zones of greenstone of the Eastmain River region consist mostly of lavas, with various amounts of sedimentary rocks, invaded by acidic injections related to the granitic bodies over which they lie.

Greenstones, made up of lavas and basic to intermediate intrusive rocks, form the eastern border zone of the Labrador geosyncline. Their contact with the granitic-gneissic complex to the east and with the ferriferous formations to the west is apparently marked by faults. Lavas are, however, found interstratified with sedimentary rocks in the western part of the geosyncline, and it is probable that volcanic rocks of several ages are present throughout this zone of stratified rocks. The greenstones of the east side are, however, more metamorphosed than their equivalents to the west, and it is possible that they are Early Precambrian in age.

Late Precambrian

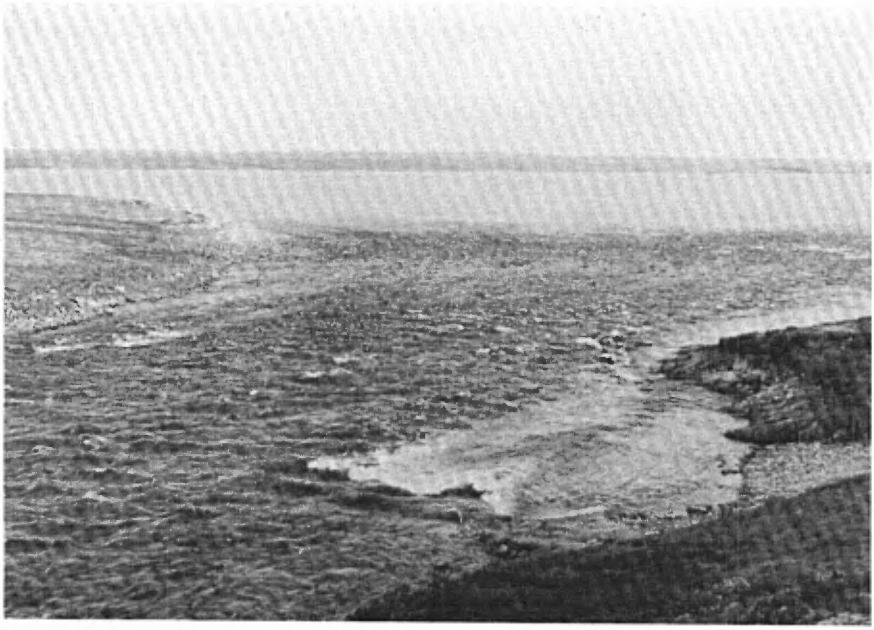
Late Precambrian sedimentary and volcanic formations lie unconformably, in certain parts of the territory, on the peneplained surface of the much folded and deformed Early Precambrian rocks. The subsidence of this peneplain during Late Precambrian time permitted the accumulation, at various places, of sedimentary deposits of variable thickness. A subsequent uplift of the depressed peneplain brought the sedimentaries into their presently exposed position. The two main Lake Precambrian basins of deposition of the area were the Labrador geosyncline, a zone averaging 45 miles in width and extending southward and southwestward for nearly 500 miles into the interior of the territory, and the Richmond Gulf basin, situated along the east coast of Hudson bay.

The Late Precambrian formations of the Labrador geosyncline are made up of a series of sedimentary and volcanic rocks invaded by generally concordant, intrusive masses of basic to intermediate composition. James and Gill (1929) gave this large geological unit the name of "Caniapiskau Series". It contains the major part of the formations of the Labrador geosyncline. The Caniapiskau series lie unconformably along the southwestern border of the geosyncline on the crystalline basement rocks of the Early Precambrian. To the northeast, it is in contact with an important series of schists containing massive lavas and basic to intermediate intrusions to which was given the name "Nachikopi Series". This series is apparently in faulted contact with the Caniapiskau series and, because it is more metamorphosed than most of the other formations of the Labrador geosyncline and because of the presence, within the series, of granitic intrusions that are not found in the Caniapiskau series, some geologists are inclined to consider the Nachikopi series as Early Precambrian (Keewatin).

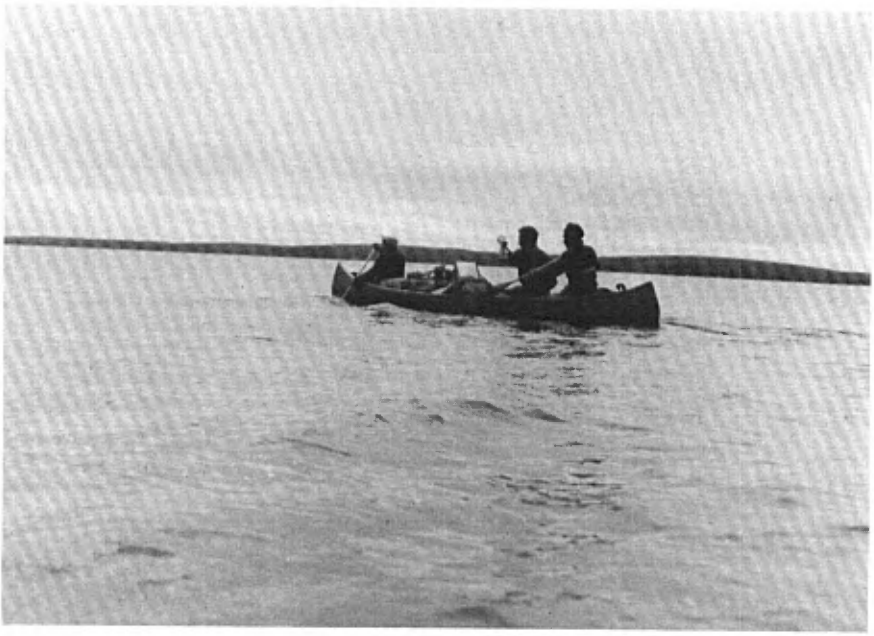
The outstanding interest of the Caniapiskau series lies in the presence, within its members, of the iron-bearing formations containing the important iron ore deposits presently being explored in the Labrador geosyncline. These ferriferous formations, which consist mostly of beds of jasper, hematite, siderite, and chert, constitute, however, only a minor element of the series, the thickness of which is believed to approximate 2,000 feet. Sandstones, slates, quartzites, calcareous dolomites, and interflows of lava of variable thicknesses are also found within it.

The Late Precambrian formations of the Labrador geosyncline were subjected to tangential pressures, especially from the northeast, which produced a series of folds and thrust faults the axial planes of which are oriented toward the northwest with dips generally to the northeast. These tectonic movements caused frequent repetitions of the same beds, that, more or less resistant to the action of atmospheric agents, have given the surface of the geosynclinal area its crenulated aspect characterized by elongated and parallel lakes separated one from the other by ridges rising to as much as 1,000 feet above the floors of the intervening valleys.

In the Late Precambrian basin of Richmond gulf, on the east coast of Hudson bay, the sedimentary strata, the thickness of which is at least 4,000 feet, form a border zone seldom exceeding seven miles in width over a distance of 90 miles along the coast. The same formations crop out in the string of coastal islands of the archipelagos of Nastapoca, Manitounuc, and Long Island. This sedimentary zone has thus a total length of over 200 miles.



A.- Discharge of Kogaluc river into Tesek lake. Photo, E. Aubert de la Rüe.

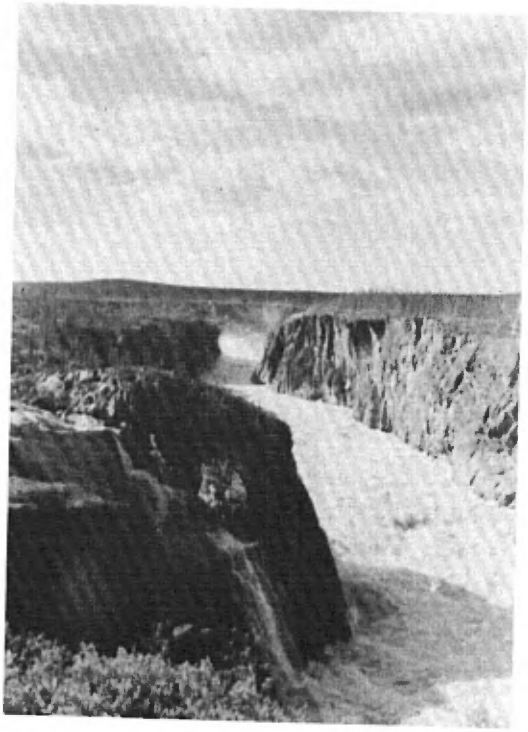


B.- Low, rolling hills surrounding Payne lake. Photo, E. Aubert de la Rüe.

A. - Northward view of George river at 57° 29' North lat. Photo, Jacques Rousseau.

B. - Cascade and forest tundra on the west bank of George river at 57° 48' North lat. Photo, Jacques Rousseau.

Plate XVI



A. - Eaton canyon along the upper course of Caniapiscau river. Photo, Hollinger North Shore Exploration Co. Ltd.

B. - Eaton canyon along the upper course of Caniapiscau river. Photo, Hollinger North Shore Exploration Co. Ltd.

A.- Upturned Early Precambrian paragneiss, Fort Chimo. Photo, E. Aubert de la Rüe.

B.- Falls on Kogaluc river. Photo, E. Aubert de la Rüe.

The strata of this zone lie unconformably over Early Precambrian gneissic granite and consist of gently dipping beds of conglomerate, quartzite, chert, and limestone, covered by a layer of fine crystalline basalt. The calcareous formations contain concretions that are similar to those found towards the southeast, in the Mistassini Lake basin, and that probably represent a form of rudimentary life that existed at the time of deposition of the sediments.

Glacial and Post-glacial Phenomena

The ice cap that covered the territory during the Pleistocene epoch left everywhere evident traces of its presence. The erosive action of the ice was, however, not considerable and virtually limited itself to a sweeping of the peneplain it invaded, removing unconsolidated material from its surface, scraping off the disintegrated and altered surficial parts of the rocks, and leaving behind monotonous, polished, and striated rocky surfaces. However the removed débris were not generally transported far and most of them were left almost at or near their places of origin, especially in the depressed parts of the territory.

The arrangement of glacial striae shows that the centre of the ice cap was in the central plateau area of which mention has been made and that the ice moved in different directions from there over the surrounding peneplain. However, the orientation of the striae observed near the border of the peninsula that lies between Ungava bay and Hudson bay indicates the possible existence in this sector of a secondary centre of glaciation that developed probably towards the end of the glacial period when the main centre was farther south.

Every form typical of constructive glacial action can be seen in the territory. Glacial clays are very abundant although ordinarily in relatively thin layers. Numerous eskers are present mainly on the central plateau, but also here and there throughout the entire area. Drumlins are numerous in the northwestern part of the territory and in the region of Portland promontory, on the east coast of Hudson bay.

The retreat of the ice sheets, towards the end of the Pleistocene period, was followed by an invasion of the coastal areas by the sea. This invasion was very uneven, and of variable extent, depending on the topography of the coastal region. Present data are still too sketchy and uncertain to trace even approximately the maximum limit of this post-glacial immersion. It nevertheless

appears that the extreme inland points reached by the sea were not more than a few tens of miles from the coast-line, except along the valleys of the large streams.

One of the consequences of the post-glacial marine invasion was the cleaning of the periphery of the peneplain which is, accordingly, more rocky and more bare along its border zone than in the interior where the bottom moraine is more or less still intact.

The territory has risen unevenly since the end of the post-glacial marine invasion, as evidenced by the presence of raised marine beaches all along the coast-line. The elevation of those beaches varies between 180 and 900 feet above the present sea level.

ECONOMIC GEOLOGY

Iron Deposits of the Labrador Geosyncline

The Labrador geosyncline, which appears today as the most promising part of the whole territory, has recently become known to the general public on account of the immense deposits of iron ore that have been discovered within its limits in the last few years.

Low recognized the presence of ferriferous formations in this vast sedimentary basin in the course of his exploratory voyages between 1892 and 1895, but it was only more than 30 years later, in 1929, that the first large scale exploratory work for economical purposes was undertaken in that part of the territory by New Quebec Company, Ltd. James and Gill, who took part in the expedition, recognized the presence of three deposits of high-grade iron ore and suggested the possibility of other major interesting occurrences of the same material in the 1,000-square-mile area occupied by the Caniapiskau series to which the ferriferous formations belong.

In 1936, Retty launched for Labrador Mining and Exploration Company, Limited, a programme of systematic geological exploration in the upper basin of Hamilton river for precious or base metal occurrences. This search soon revealed the existence, at numerous places in the Labrador geosyncline, of large deposits of high grade iron ore. The discoveries aroused the interest of a number of companies and intensive prospecting was soon going on along practically the whole zone of Late Precambrian formations south of Leaf river.

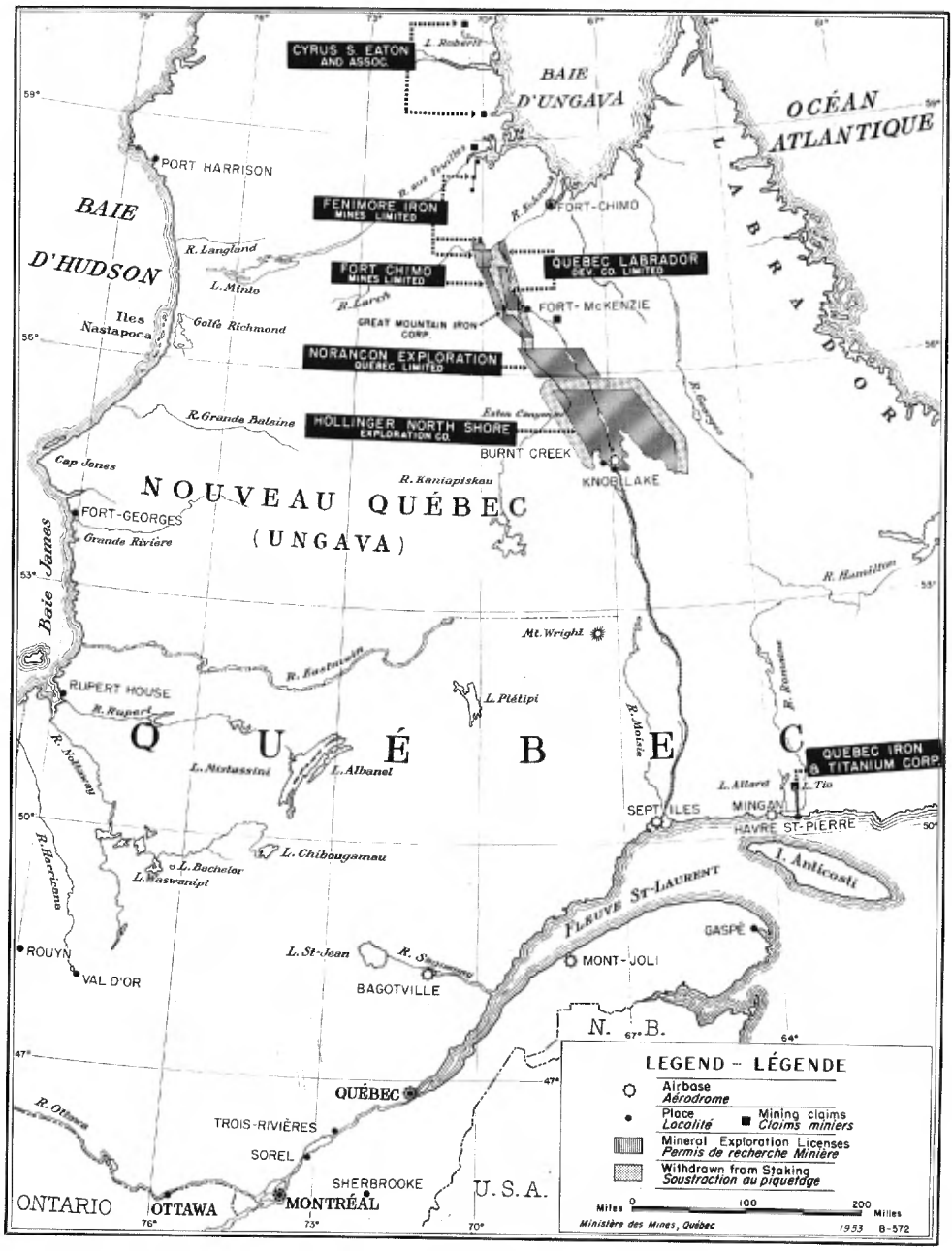


Figure 1.-Mining Properties of New Quebec.

Deposits of Hollinger North Shore Exploration Co., Ltd., and of Labrador Mining and Exploration Co., Ltd.

These deposits, the most important discovered to date, occur in the southeastern part of the Labrador geosyncline, in the vicinity of the divide between Hamilton and Swampy Bay rivers. They number about thirty and their importance, structure, and mineralogical composition vary considerably from one deposit to the other. The total length of the productive formation, in which occur the deposits to date discovered, is at least 90 miles on the properties of the two companies. The deposits presently under development form discontinuous zones in the ferriferous formations.

With few exceptions, the bodies of iron ore so far discovered crop out at the surface. The trenching, drilling, and geophysical surveying that was later done on them aimed mostly at a better knowledge of their grade and tonnage. The unconsolidated overburden is rather thin, except in the valleys where a large number of ore bodies may still remain to be discovered.

The iron ore is blue, red, yellow, brown, or black, depending upon the proportion of the various iron-bearing minerals present. The brown variety is the most common. A certain percentage of the ore contains an appreciable amount of manganese. The most common impurity in the ore is silica, which, for a good commercial ore, should not exceed ten per cent. A large proportion of the iron ore is of the Bessemer type, which means that it contains less than 0.045 per cent phosphorus.

The two companies have already proven the existence of more than 400 million tons of iron ore and the plans are to start production in 1954. A new company, the Iron Ore Company of Canada, Ltd., was formed in 1949 for that purpose. The ore will be mined from open pits, and an annual production of ten million tons is being planned for 1956. A standard gauge railroad, to be completed in 1953, will be used to move the iron ore over a distance of approximately 360 miles to the sea-port of Seven Islands, on the north shore of the St-Lawrence river.

Other Companies Working in the Labrador Geosyncline

Five other companies are presently carrying out important exploration work in the Labrador geosyncline. They are from south to north: Norancon Exploration Quebec, Limited; Great Mountain Iron Corporation; Fort Chimo Mines, Limited; Quebec Labrador Development Company, Limited; and Fenimore Iron Mines, Limited. In addition, interests led by Cyrus Eaton have also recently (1952) revealed that

A.- Big Falls, Caniapiscau river; Late Precambrian sedimentary formations. Photo, "The Beaver", Hudson's Bay Company.

B. - Little Falls, Caniapiscau river. Photo, "The Beaver", Hidson's Bay Company.

Plate X1X

A. - Rapid on George river at 55° 41' North latitude. Photo, Jacques Rousseau.

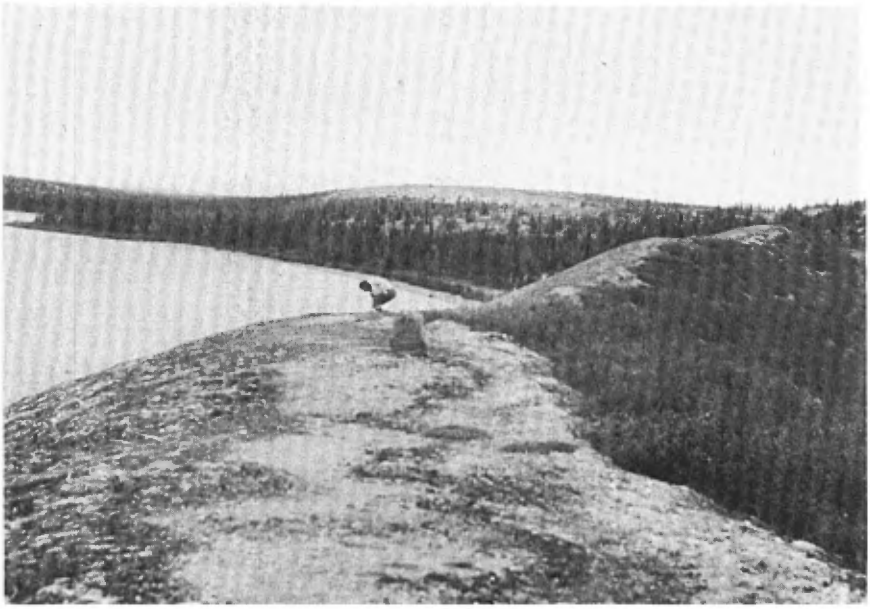
B. - Falls on George river at 55° 26' North Latitude.
Photo, Jacques Rousseau.

Plate XX

A.- Junction of Payne (left) and Flaherty (background) rivers. Photo, E. Aubert de la Rüe.

B.- North shore of Payne river estuary at low tide. Photo, E. Aubert de la Rüe.

Plate XXI



A. - Esker along George river, 55° 09' North latitude. Photo, Jacques Rousseau.

B. - Banded paragneiss cut by veins of aplite, George river, approximately 55° 45' North latitude. Photo, E. Aubert de la Rüe.

they are planning a considerable programme of exploration in the northernmost part of the geosyncline, in the vicinity of Hopes Advance bay and Payne bay, along the west coast of Ungava bay.

The search in these northern sections has been directed to ferriferous formations similar to those in which important iron ore deposits were discovered farther to the south. Methodical geological studies are being made on many occurrences of possible ore material.

Manganese Minerals

Besides iron, the most abundant economic metal so far discovered in the territory is manganese. It is practically everywhere present as oxides and in variable amounts in the iron ore. Approximately 45 million tons of iron ore discovered on the properties of Hollinger North Shore Exploration Company, Limited, and Labrador Mining and Exploration Company, Limited, have a tenor in manganese of between 7.5 and 8 per cent.

This mineral also occurs as a carbonate (rhodocrosite) and is one of the constituents of the rock containing the lead and zinc sulphides of the Richmond Gulf region.

Deposits of wad containing between 10 and 35 per cent manganese have also been discovered around Wilson lake (56°20'N.: 68°50'W.), a short distance east of Cambrian lake. These deposits lie over bog iron (goethite and limonite) formations and are included in a zone measuring approximately a mile and a quarter in length by three-quarters of a mile in width. Samples of them were taken at various places down to a depth of five feet.

Undoubtedly, surficial deposits of wad of the same type occur in other parts of the territory, and their profitable extraction could be expected in the event of larger deposits of manganese being mined in the vicinity.

Sulphide Mineralization

Impregnations and concentrations of pyrite and pyrrhotite, here and there containing sulphides of copper, lead, zinc, and nickel, as well as a little gold and silver, have been found in most of the greenstone zones and in some Late Precambrian sedimentary formations of the territory under consideration. The main greenstone zones were described earlier in this report, and only the principal deposits of the metallic minerals in them will be very briefly discussed here.

Deposits of pyrite containing galena, sphalerite, and a little chalcopyrite and marcasite are disseminated between Richmond gulf, along the east coast of Hudson bay, and the lower course of Little Whale river. They generally consist of impregnations and replacement deposits in highly silicified, Late Precambrian limestones. Assays have indicated that these sulphides contain lead, zinc, copper, and a little silver, as well as cadmium and a little gold. The deposits were recently explored by the Consolidated Mining and Smelting Company of Canada, Limited, and Gulf Lead Mines, Limited. The results obtained by the latter company through stripping, trenching, and drilling, suggest that the region may one day become a base metal producer.

Sulphide mineralization is also found in small bodies or in quartz veins in the greenstone zone of the Cape Smith (Hudson bay) region. A part of this zone was prospected between 1931 and 1933 and sulphide masses were found at many places. A careful sampling of the showings in the vicinity of the shore has revealed traces of copper, nickel, and gold, but the areas so far examined represent only a restricted part of the Cape Smith greenstone zone. The little encouragement obtained from these few efforts confined to the coastal region should not be considered as indicative of the possibilities of the whole area without much further exploration of all the zone being done.

Another zone of sulphide mineralization lies slightly to the east of Attikamagen lake, a large body of water in the central part of which is the intersection of the 55th North parallel and the 66°30' West meridian, in the eastern part of the Labrador geosyncline. This zone is included within the limits of the territory being explored by Hollinger North Shore Exploration Company and, to date, at least three different deposits of iron, zinc, lead, and copper sulphides containing a little gold and silver, have been found. One of these deposits, which is 660 feet long and averages 13 feet in width, yielded an average tenor of about 6.75 per cent zinc, 1.4 per cent copper, 0.5 per cent lead, and from $2 to $3 in gold and silver per ton. Exploration for nickeliferous mineralization is also being carried out in this zone.

Farther north in the same zone, other sulphide deposits were also discovered on the property of Norancon Exploration (Quebec), Limited. One of them, situated half a mile to the west of Norancon lake, 15 miles east of the discharge of Swampy Bay river into Otelnuc lake, consists of a small body of massive sphalerite, 6 to 8 feet wide, associated with a calcite vein in slaty schists. The average tenor is about 19.3 per cent zinc.

The sulphide mineralization of the Reider Lake region (56°53'N.:68°40'W.) consists mostly of pyrite and pyrrhotite, with small amounts of chalcopyrite and sphalerite. This relatively abundant mineralization ordinarily occurs along synclinal structures in black slaty schists associated with diabase and ellipsoidal greenstones. Iron gossans are very abundant throughout the whole area of mineralization.

Similar conditions also occur in the region of Cameron and Boyes lakes, approximately 80 miles to the northwest of Reider lake. This similarity between the rocks and the mineralization of these two sections seems to indicate a continuity of formations.

Four prominent bands and smaller masses of iron sulphide containing a low content of copper and zinc were also found in the schists in the vicinity of Koksoak river, south of and along the southern bank of the river. The deposits have been prospected, but their tenor in useful metals was found too low to warrant further exploration work.

The presence of small quantities of molybdenite was reported in the vicinity of the mouth of Big Whale river, along the east coast of Hudson bay. Flakes of this mineral, up to half an inch in diameter, were also noted in a small pegmatite dyke that cuts the greenstones of Paint Hills bay, at latitude 53°N., along the east coast of Hudson bay.

CONCLUSION

The list of the known mineral resources of the territory is as yet neither long nor varied. Except for the very large iron deposits of the Labrador geosyncline and the manganese minerals associated with them, the inventory of the mineral resources of New Quebec is definitely nothing to stir up popular imagination. This perhaps is surprising for a territory of such a large extent and containing abundant rock formations similar to those that, to the southwest, have proved very favourable to the existence of a great variety of mineral deposits.

This inventory has, however, barely started. Extensive tracts of the territory are still totally unexplored; the total extent of the few areas that have been the object of geological surveys and systematic prospecting represents a very small fraction of the immense territory. Individual prospectors have not as yet been attracted to these remote lands, notwithstanding the recent discovery of iron ore deposits that are among the richest and the largest of our time, and,

to a large measure, it is on the prospector that the discovery of new mining fields depends.

More abundant and detailed explorations will certainly reveal the existence of hitherto unsuspected mineral deposits in this vast sector of the Canadian Shield. Their development will demonstrate the abundance of the mineral riches of this extensive territory and their extraction will one day be a considerable asset to the general economy of the Province as well as of the country as a whole.

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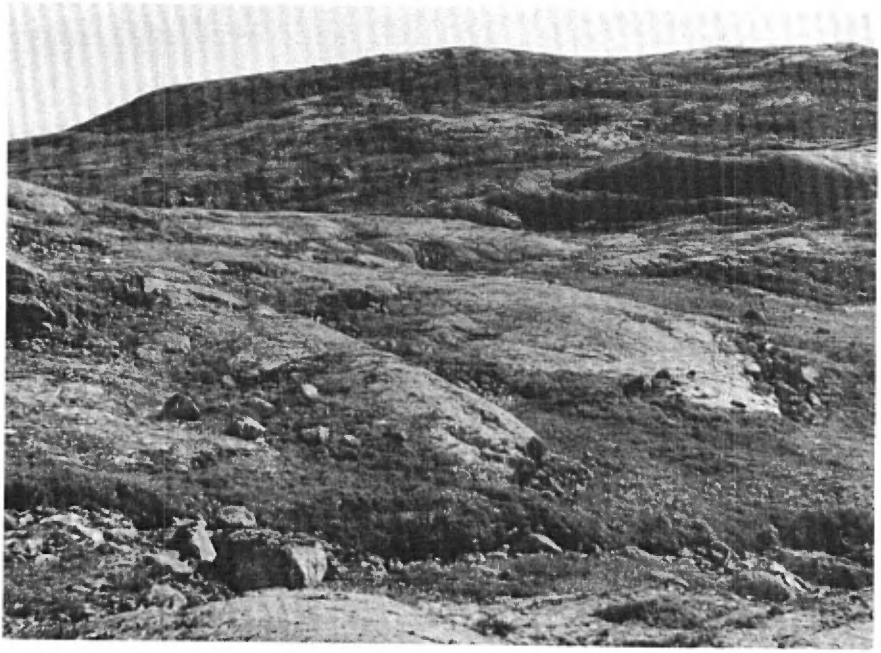
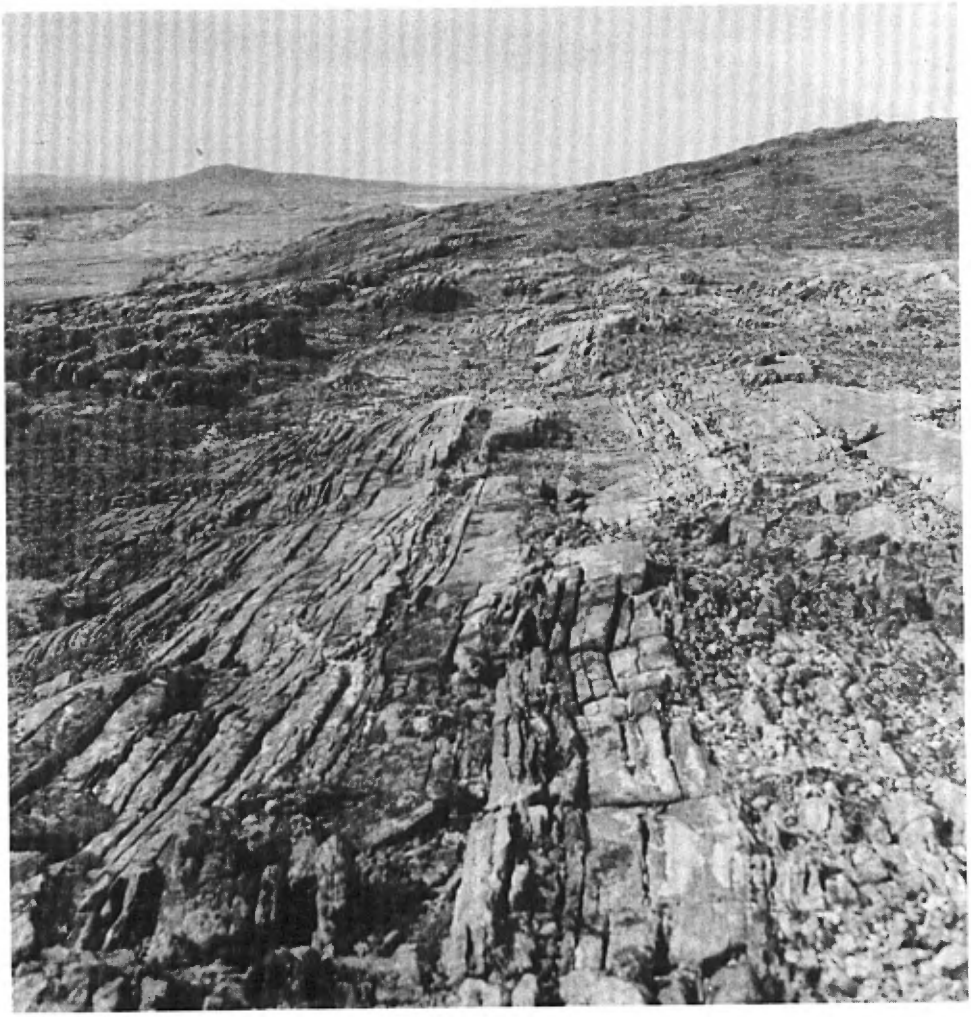
Plate XX11



A.- Greenstone "moutonnée", estuary of Payne river. Photo, E. Aubert de la Rüe.

B.- Polygonal soil, lower valley of Payne river. Photo, E. Aubert de la Rüe.

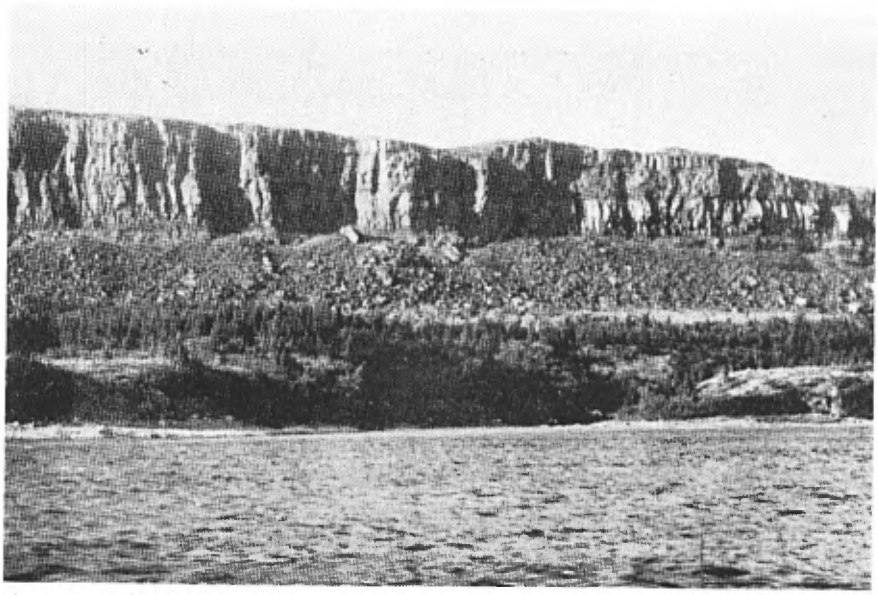


Upturned beds of iron formation (quartzite containing hematite), Late Precambrian, Kayak bay, west shore of Ungava bay. Photo, E. Aubert de la Rüe.

Plate XXIV

Pegmatite dyke cutting paragneiss on the left bank of Koksoak river, Fort Chimo. Photo, E. Aubert de la Rüe.

Plate XXV



A.- Stratification along the north bank of Little Whale river. Photo, Gulf Lead Mines, Limited.

B.- Limestone formations south of Little Whale river. Photo, Gulf Lead Mines, Limited.

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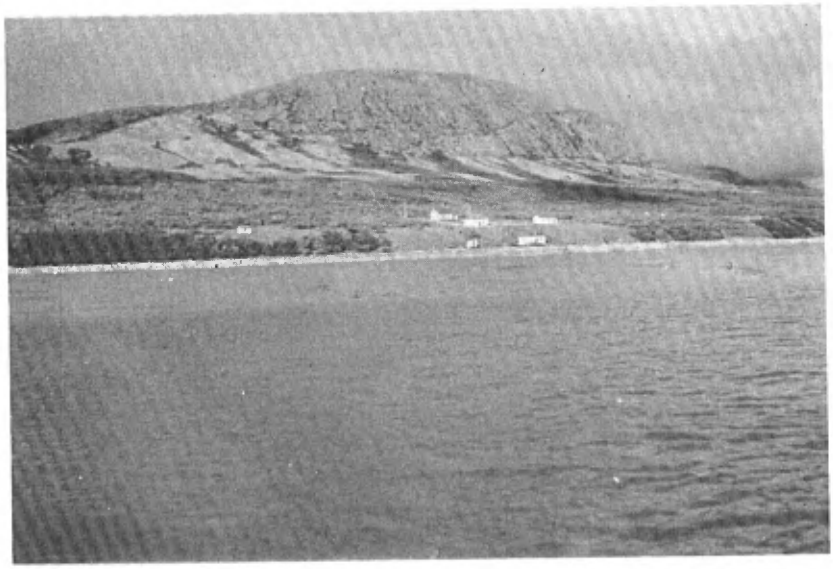
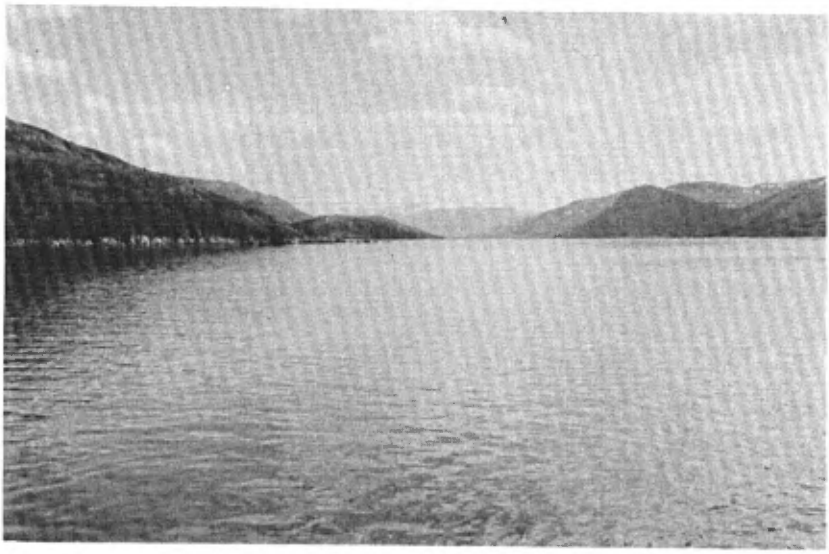
A.- Princess falls (164 feet), Little Whale river. Photo, Gulf Lead Mines, Limited.

B.- Lower falls of Little Whale river (24 feet). Photo, Gulf Lead Mines, Limited.



A.- George River post of Hudson's Bay Company, at the mouth of George river. Photo, M.M. Ritchie.

B.- Abloviak (Adloylik) fiord, westward view, east shore of Ungava bay. Photo, M.M. Ritchie.



A.- Abloviak (Adloylik) fiord, eastward view; part of Torngats mountains in background. Photo, M.M. Ritchie.

B.- East shore of Ungava bay, northward view from the mouth of Koroc river. Photo, M.M. Ritchie.

Plate XXIX

A.- Koroc river, eastward view from the mouth of Sukaliuk brook; mountains are 2,000 feet above level of river. Photo, M.M. Ritchie.

B.- "Arctic cotton" (Eriophorus Scheuchzeri) at small lake near junction of Sukaliuk brook and Koroc river; artist René Richard. Photo, M.M. Ritchie.

C.- Camp of National Geographic Society and Royal Ontario Museum expedition, two miles north of New Quebec crater, 1951. Photo, M.M. Ritchie.

Aerial photograph of the New Quebec crater. © National Geographic Society, U.S.A.

Plate XXX

Fort Chimo, Hudson's Bay Company post on the banks of Koksoak river, from Ungava bay. Photo, P.E. Imbault.

ALPHABETICAL INDEX