CANADA
DEPARTMENT OF MINES
SIR JAMES LOUGHEED, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER,

GEOLOGICAL SURVEY
W. H. COLLINS, DIRECTOR.

MEMOIR 124

No. 106, GEOLOGICAL SERIES

Northeastern Part of Labrador, and New Quebec

BY
A. P. Coleman

OTTAWA
THOMAS MULVEY
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
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Okak, Moravian mission, Labrador. (Page 3.)

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CHAPTER I

INTRODUCTION

The northeastern peninsula of Labrador, between Ungava bay and the north Atlantic, has often been visited by explorers, and has been traversed by missionaries, and thousands of fishermen frequent its shores, but in spite of its relative accessibility and its proximity to Europe it remains one of the least known parts of North America.

In geology and physiography it is very like the northwest of Scotland and parts of Scandinavia and Finland, and yet it is almost uninhabited and, except for portions of its coast, unexplored. Severe climatic conditions are mainly responsible for this.

Northern Labrador has long been famous for its coast scenery; its mountains have been reputed the highest in eastern America, and it has been reported to include geological formations which in other parts of America have furnished valuable economic minerals. Brief reports on its Pleistocene geology suggested that it might afford interesting results on that side also.

That the region was little known and yet seemed likely to supply valuable information as to Precambrian and Pleistocene geology and to present interesting physiographic features induced the writer to visit northern Labrador during the summer of 1915, but the methods of travel available were so dilatory that less than six weeks could be spent in actual field work (July 24-August 31). The results seemed so interesting, however, that the summer of 1916 was devoted to continuing the work, and seven weeks spent in the field (July 22-September 5) enabled more detailed work to be accomplished. In addition to the work done from Mugford to Komaktorvik in the north there was opportunity to visit various points along the coast to the southeast. The reason for the shortness of the working seasons is to be found in ice conditions, which rarely permit of entry to the northern harbours before the third week in July; and in the stormy autumn weather which makes navigation difficult after the beginning of September.

The work was done single handed, with the aid of two Eskimos during the first summer, and of two Newfoundland fishermen during the second, and it will be understood that no elaborate mapping of the region was possible, though two portions of it, one on Komaktorvik bay and the other near Nachvak bay, were covered with sufficient detail to give an idea of the character of the mountains and of their geological features.

There are no accurate maps of the region, the Admiralty chart of that part of the coast being on the whole only a sketch on a small scale, omitting numerous islands and bays and giving vague forms to most of those that are shown. The map of Nachvak bay prepared by Prof. Daly is, however, fairly accurate and proved very useful. Though details of the coast are vague or wanting on the chart, the latitude of the prominent headlands and of the openings of the larger bays seems to have been carefully determined and the topographical sketches in this report have been tied to such points.

The simplest possible methods were employed for the reconnaissance work. Distances were determined by pacing, rough triangulation or time allowance on land, and by time allowance on the water, and directions by prismatic or ordinary compass. The earth's magnetism is feebler in northeastern Labrador than in Ontario and difficulty was found, during the first summer, in bringing the compass needle to rest when taking sights, particularly if high winds were blowing. Before the second summer the prismatic compass used was magnetized as highly as possible and gave much better results.

The variation of the compass is 43 degrees west on Nachvak bay and 45 degrees on Komaktorvik, according to information given by Sir Frederick Stupart, which accords with the statements of the Admiralty chart.

The topographic work resulted in the mapping of two fine mountain areas; the geological work proved the existence of a large area of Grenville rocks, including some which contain graphite; and the boundaries and character of a later group of sedimentary rocks, perhaps best called the Ramah series, have been worked out. In places this series contains large deposits of pyrite. These rocks are Precambrian and may be equivalent to the Huronian.

Between the Precambrian and the Pleistocene no formations are known; but interesting features were discovered in the Pleistocene. A considerable area of tableland has escaped glaciation, and the region as a whole was not covered by the Labrador ice-sheet, which failed to reach the Atlantic along this northern coast. Numerous local glaciers, however, carved the edge of the tableland into a rugged alpine type of scenery far surpassing in grandeur any other mountain areas of eastern America.

Observations were made at numerous points between Hopedale, latitude 55° 20′, and Komaktorvik, latitude 59° 30′, a distance of 300 miles along the coast; detailed work was carried out on and between Nullataktok and Nachvak fiords and on Komaktorvik fiord. The farthest inland point reached was 15 miles west of the end of Nachvak fiord, or 45 miles west of the Atlantic.

MEANS OF COMMUNICATION

The northern Labrador coast is not difficult to reach if suitable methods of travel are employed. The Reid Newfoundland Company visit Nain, 200 miles southeast of Nachvak, and usually a small steamer carries the mail farther north to the fishermen along the coast, reaching Nachvak and points beyond once or twice in the season. Its movements are very erratic. For short distances an Eskimo skiff may be used. A preferable way of reaching northern points is by a fishing schooner. Though often retarded by fogs or storms or ice, these craft are usually staunch and well handled, and make up in safety for their lack of comfort.

The ideal method of reaching the northern coast for geological work is to secure a motor skiff such as the fishermen use, and take a canoe or light boat for shoal water and inland waterways, a supply of kerosene or gasolene being forwarded by a schooner to some central point. In this way much better use can be made of the voyage north than when travelling by schooner, and much time can be saved also while working in the deeper bays. The season is so short that the quickest possible transportation is very desirable.

HISTORY OF NORTHEASTERN LABRADOR

The aboriginal inhabitants of the Labrador coast, even as far south as the gulf of St. Lawrence, were Eskimos; the interior was sparsely occupied by Montaignais Indians, who, however, probably never reached as far north as the peninsula between Ungava and the Atlantic. The Eskimos have a tradition that their ancestors came from the northwest.

The first white visitors to the region were perhaps the Norsemen from Greenland or Iceland who landed on Vinland during the Middle Ages, but there is still discussion as to whether "Vinland" was in Labrador or farther south. It is quite probable that their first landings were in northern Labrador and that they then proceeded southwards. In any case their voyages left no impress on Labrador, though the "Skraelings" whom they met on the American shore, seem to have had the character of the Eskimos.

Whether the Cabots in 1497 touched Labrador or not is disputed. There is a strong probability that Corte Real, in 1500, saw Labrador but was prevented by ice from landing. A year or two later Sebastian Cabot must have reached the coast, since he returned to England with three men who "ate raw flesh" and must have been Eskimos.

The early explorers seeking a northwest passage to the Orient touched northern Labrador occasionally. Davis, whose name has been given to the straits separating Greenland from Canada, coasted the shore in 1586, and in the following year gave cape Chidley its name and brought two ships to fish on the coast. From that time onward fishermen of various nations occasionally visited the shore in search of cod, though there is little in the way of positive records of their voyages.

The next important advance was the establishment of the Moravian missions on the coast, the earliest being at Nain, founded in 1771. Since then other mission stations were chosen at Zoar, Hopedale, and Makovik to the south and at Okak, Hebron, and Ramah to the north. Their most northerly mission on the Atlantic coast of Labrador was at Ramah on Nullataktok bay, but it has been abandoned for some years. Still farther to the north, but on the Ungava side, is Kilinek, not far from Chidley.

The establishment of these missions was of immense importance to the Eskimos of the northern coast, most of whom live in winter at one or other of the missions and sell their products and get supplies at stores managed by the Moravian Brethren. The Eskimos of the Atlantic coast are now practically all Christians and most of them can read and write in their own language and can talk a few words of English. It is probable that but for the work of the missionaries this primitive race would have been destroyed by European diseases and strong drink. They are now reported to number about 1,800, and to be holding their own. In early references they are stated to be more numerous, reaching 3,000 or more.

The Hudson's Bay Company, also, has influenced the life of the coast, but its northern post, on Nachvak bay, was abandoned some years ago and there is now no post in the region here described.

For the traveller and explorer of the northern parts of the coast, where the scenery becomes grandest, the missions at Okak (Plate I) and Hebron are havens of rest where supplies may be purchased and a few days spent in the surprisingly comfortable mission houses, which are spacious, and models of cleanliness, in striking contrast with many of the native dwellings.

Since the establishment of the missions the coast has been more and more resorted to by fishermen, mainly from Newfoundland, thousands of whom visit Labrador during the cod fishing season, mostly on the southern coast, though increasing numbers occupy ticklers,[1] and harbours on the north, going even as far as Eclipse harbour and cape Chidley. They make no establishments on the shore in the northern parts but live on board their schooners anchored in some sheltered cove and set their trap nets along the shores of the bays or the open coast. The fishermen are kindly and hospitable and are on good terms with the Eskimos, with whom they do some trading. It is doubtful, however, whether this annual influx of thousands of fishermen has been entirely to the advantage of the original inhabitants.

It is not the province of a geological report to dilate on the general history of a region, interesting though the human history of the Labrador coast undoubtedly is. Those who wish fuller information may consult works by Packard,[2] Gosling,[3] Grenfell,[4] and some of the Moravian Brethren. The general account of the whole Labrador peninsula, by A. P. Low, also contains historical information regarding the northeastern part.[5]

PREVIOUS WORK IN THE REGION

The earliest reference to the geology of northeastern Labrador seems to have been made by two Moravian missionaries, Kohlmeister and Kmoch, in 1814, when they journeyed from Okak to Kilinek, travelling by Eskimo methods. They mention "white grey rocks streaked almost perpendicularly with veins of black stone" and refer to slate, jasper or ironstone, and soapstone as of interest on their travels.[6]

The first geologist to visit the region appears to have been Robert Bell who stopped a short time at the Hudson's Bay post in Nachvak bay while on the way to Hudson bay.[7] His observations were mainly from a distance, since the land was touched only at a few points, near the post and at Skynner cove, the present schooner harbour. He mentions Laurentian gneisses and probable Huronian slates and quartzites, and briefly describes the mountains, pointing out that they show no evidence of glaciation except in the lower parts.

A. S. Packard, in his account of the Labrador coast in 1891, makes numerous references to the geology, especially the Pleistocene, and mentions a number of raised beaches.[8] The most important geological work in northeastern Labrador was that of R. A. Daly, who touched at many points on the way north and spent ten days in Nachvak bay, especially near the Hudson's Bay post.[9] He took soundings of the fiord, corrected the map, and made many observations both on

1 *Tickler*. "A narrow difficult passage or strait on the coast of Newfoundland" (Century Dict.). The word, in Newfoundland, however, is invariably spelled and written "tickle".

2 "The Labrador coast," 1891.

3 "Labrador, its discovery, exploration, and development."

4 "Labrador," by Wilfred Grenfell and others.

5 Geol. Surv., Can., vol. VIII, 1895, pt. L.

6 Kohlmeister and Kmoch, "Journal of a voyage from Okkak on the coast of Labrador to Ungava bay," London, 1814.

7 Geol. Surv., Can., 1882-4, pp. DD 11-17, and also "The Labrador peninsula," Scottish Geogr. Mag., July, 1895, pp. 384, etc.

8 "The Labrador coast," 1891.

9 "The geology of the northeast coast of Labrador"; Bull. Mus. Comp. Zool., Harvard, vol. XXXVIII, Geol. Ser., vol. 5, No. 5, 1902.

Archæan and Pleistocene geology, paying particular attention to glacial phenomena and raised beaches.

On the western side of the northeastern peninsula little geological work has been done except by Low, who visited George river near its mouth.[1] Much more work was done by him along Koksoak river farther to the west, and it is probable that his account of its geology gives a good general idea of conditions to the eastwards, since most of the rocks described are very like those occurring from 40 to 150 miles farther east. Of much interest is his account of widespread sedimentary gneisses containing garnets, etc., in that region, evidently a continuation of the large Grenville areas found at various places, and extending, at Nachvak, 45 miles inland.

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[1] Geol. Surv., Can., vol. VIII, 1895, pt. L, pp. 221-222 and 309-310. Ibid., vol. XI, 1898, pt. L, pp. 27 and 44.

CHAPTER II

GENERAL CHARACTER OF REGION

PHYSIOGRAPHY OF NORTHEASTERN LABRADOR

The region here described is a part of the great Archæan shield of Canada, often referred to as the Laurentian plateau or tableland. In reality the shield scarcely rises to the elevation of a table land except near its margin toward the south, southeast, and northeast. In a general way it is highest near the edge and inclines gently inwards, sinking to a low plain around Hudson bay. The most elevated parts of the shield rise abruptly from St. Lawrence river, gulf of St. Lawrence, and the north Atlantic, the highest points of all rising in the northeastern peninsula of Labrador between Ungava bay and the Atlantic.

The Canadian shield is usually described as a peneplain which has been more or less elevated, renewing the activity of the rivers, thus increasing the inequalities of the surface. Even before this renewal of river-action it was far from being a true plain, since it had an undulating surface of rounded hills and valleys showing considerable relief, often amounting to hundreds of feet. This relief is due to the disordered basement structures of an ancient mountain system in which more resistant rocks stand up as hills or ridges, whereas softer rocks have been completely removed, forming valleys. These features of the peneplain seem to have been in the main produced by weathering and stream work in far past times, the operations having been nearly complete before the Huronian, since slightly tilted or folded Huronian rocks rest at several points upon an entirely similar surface.

The loftier parts of this tableland rise near the coast from mount Thoresby (2,733 feet) near Nain to Ryan bay near Eclipse harbour (four peaks said to be from 5,000 to 6,000 feet in height), with a length of about 230 miles from southeast to northwest. It must not be supposed, however, that these higher points form a distinct range of mountains. In most cases they are merely a mountainous fringe on the seaward side of a somewhat narrow tableland, and they are broken up into shorter or longer sections separated by lower areas. From southeast to northwest may be seen the Kiglapaits, north of mount Thoresby; the Kaumajets, near Okak and Mugford, and the highest portion of all, named the Torngats by Daly and others, extending from Saglek bay to Ryan bay, with a length of nearly 100 miles.

Most of the work reported on here was devoted to the central part of the Torngats.

The Torngats may be looked on as a fringe of mountains carved from the elevated edge of a tableland which is highest toward the Atlantic and sinks to lower levels on the side toward Ungava bay. In the seaward part, where valleys have been sunk most frequently and profoundly, the mountains are often sharp-edged ridges—"razorbacks" on the chart—or even isolated horns with steep cliffs and adventurous forms. Westward from the Atlantic front the mountains grow more massive in character, with steep sides, often several thousand feet in height, the upper portions nearly vertical, but with gently rolling summits, parts of the ancient elevated peneplain. Farther west the valleys still cut deeply into the tableland, but no longer intersect so as to make separate peaks or mountain masses. So far as observed none of these deep valleys cut right through the tableland, which is here rather narrow, but run out into wide and shallow depressions between rounded summits lower than the highest points toward the eastern edge.

The coast itself is one of the most bold and rugged in the world with grand promontories rising from 1,000 to 3,000 feet above the sea, often with nearly vertical cliffs (Plate II) 1,000 or 2,000 feet in height. Many rugged islands, occasionally reaching a height of 2,700 feet, are separated from one another and the mainland by narrow and deep channels—the "tickles" of the Newfoundland fishermen. Narrow and deep bays or fiords run inland every few miles along the coast, some, like Nachvak, reaching 30 miles from the open sea, or even 40 miles if the chart be correct in its delineation of Saglek fiord. This shoreline, tattered and deeply indented with its high cliffs and mountainous background, suggests the coast of British Columbia or of Norway, excepting only that it is devoid of trees and in most parts uninhabited.

The fiords, usually, run nearly west and are often continued inland by profound and steeply-walled valleys of the sort referred to above; the longer fiords may give off branches of the same kind or may have tributary valleys as steep-walled as they are themselves, the whole system of valleys and fiords having U-shaped cross-sections due to the action of powerful valley glaciers.

The main valleys are cut down nearly to the level of the sea and often rise only gently for several miles inland; but the minor depressions are commonly hanging valleys (Plate III A), with outlets hundreds, or even a thousand, of feet above the floor of the main valley or the waters of the fiord. Nachvak fiord, with depths reaching 110 fathoms, according to Daly's soundings, and with walls rising at the west end to 4,000 feet, is the deepest trough of all. It has a general width of about 1½ miles, runs a little south of west for 13 miles, then due west for 11 miles, and extends southwest with less regularity for 6 miles farther. About 21 miles from its mouth a bay extends for 6 miles in a direction east of south, with features similar to the main fiord. Nachvak may be considered the most typical fiord on the coast. In addition to the valleys ending among the mountains or in the tableland, there are "through" valleys cutting off isolated peaks.

Though all the deeper valleys are U-shaped, some are long and others short, and the shortest of all, with armchair-like forms, are properly cirques (Plates III B, IV A), or corries. It will be understood, of course, that the regularity of the U-shaped cross-section is interfered with by frost work on the cliffs heaping up talus blocks along their base, and by rivers cutting canyons where the slope is steep and aggrading their valleys and flattening their floors where they are at base level.

The contrast between the rolling tableland floored with loose blocks weathering in situ and the steep-walled, glaciated valleys with talus slopes and flood-plains at the bottom is very marked.

HYDROGRAPHY

There is, usually, no surface water to be found on the rolling tableland or the flattened mountain tops except where snowfields are melting, but every deeper valley has its brook or river, often with striking canyons and fine falls, particularly where hanging valleys enter a main valley. Some large falls of this kind have a rapid descent of hundreds of feet, and in some cases white cataracts fall

1,000 or even 2,000 feet, as on the south side of Nachvak lake. Most valleys contain lakes due to overdeepening during the ice age or to moraine dams formed during the retreat of the valley glaciers. A few lakes, such as Nachvak lake, are dammed by cones of debris brought in by a side torrent. The waters are usually crystal clear with a pale bluish-green colour; but some small lakes fed by glacial waters have intense turquoise blue or clear green colours.

Each fiord or inlet has its own river, which flows from the extension of the valley inland, and may take the name of the fiord itself; and each side valley has its brook or river, often of considerable size. None of these rivers has been mapped far inland and in most cases they are unnamed on the map. They doubtless have Eskimo names, but there was no opportunity to find out what they are.

The largest river explored by the writer is that entering Nachvak bay. One mile above its mouth is Nachvak lake which occupies the straight, steeply-walled valley for 7½ miles. Above this the river occupies the same valley with a rapid flow and large volume of water for 3 miles farther, where it forks. The main stream comes from the northwest with rapids and a small canyon, and 3 miles up there are two falls with a steep drop of 50 feet or more. From a point above the highest falls there is a descent of about 500 feet to sea-level.

For this distance the river flows through the usual deep, U-shaped valley, growing narrower, however, inland. Above the falls the valley widens and turns to the southwest. Beyond this it was not followed, but from the top of a cliff 800 feet high, it could be seen flowing through a wide shallow valley with relatively low surrounding mountains.

Views from mountain tops near the end of Nachvak fiord show another valley of a similar kind to the north, and probably most of the larger rivers pass through the mountains near the coast and the higher edge of the tableland by means of deep, glaciated valleys and have their headwaters among the residual mounds of the lower western edge of the tableland.

The lowland of the Ungava shores begins probably not far from the comparatively low, rounded summits visible to the west of the areas mapped.

GLACIAL FEATURES

Evidence of ice action on a large scale is found in every valley, and in the higher and deeper valleys and cirques within 20 or 25 miles of the coast numerous small glaciers still live. These have small névé fields and a correspondingly short glacial tongue crevassed and with lateral and terminal morainic material; two or three earlier terminal moraines are found lower down the valleys, often with a lake behind each of them.

Besides the actual glaciers, fourteen of which have been seen, only a few of them, however, at close range, there are numerous permanent ice-sheets or snow fields which appear to be entirely stationary and, therefore, cannot be considered glaciers. A number of these are on the rolling tops of the higher mountains, and accumulated snow drifts occur in ravines on the sides of hills or cliffs away from the sun. Such magnified and permanent snow banks are to be seen at many points along the coast far to the south of the region here described.

The description given above applies more particularly to the region from around Nachvak to Nullataktok bay, but in most respects the Komaktorvik region, 35 miles to the north, is similar.

CLIMATE

The climate of northeastern Labrador is more nearly arctic than its latitude, between 57° 30′ and 60° 30′, suggests. This is particularly striking when its rigour is contrasted with the relative mildness of Scotland and southern Norway just across the Atlantic. In a general way winter lasts for eight or nine months. Only July, August, and September are without snow, and even these months may have an occasional fall. On August 25, 1915, there was 4 inches of snow which remained for several days. At the mission settlements to the south seeds are not sown before June, and at the northern stations most vegetables must be protected against frost on clear nights even in July.

During the field work of 1915, temperature readings throughout August ran from 33 degrees to 67 degrees; in the summer of 1916—the warmest known to fishermen who had frequented Nachvak bay for eighteen years—the extremes recorded between July 26 and September 1, were 36 degrees and 68 degrees. Although the lowest reading was 36 degrees, on the morning of August 23 there was ice on pools of fresh water, and frazil ice on the seashore, showing that the temperature had been lower during the night.

The average temperature for August, 1915, was—morning 43 degrees, noon 51·2 degrees, evening 45·8 degrees. In 1915 the average for the somewhat longer period mentioned above was morning 47 degrees, noon 55·3 degrees, and evening 52·6 degrees, showing a rise of nearly 5 degrees, and causing a marked diminution in the snowfall.

Meteorological records are kept at the mission, Hebron, 60 miles to the south, and, by the kindness of Sir Frederick Stupart, the readings for temperature have been compiled from the reports of the Deutsche Seewarte for the seven years from 1905 to 1911, the last reports available. For these years the average monthly temperatures are as follows:

January	−6·0°	Fahrenheit
February	−5·5°	
March	5·1°	
April	18·9°	
May	31·6°	
June	36·8°	
July	44·6°	
August	46·9°	
September	41·3°	
October	32·0°	
November	23·1°	
December	6·0°	

The average annual temperature is 27·1 degrees. The highest temperature recorded was 83·5 degrees, in August, 1909, and the lowest was −32·4 degrees, in February, 1906, and in the same month, 1907. The fact that Hebron is on the sea probably accounts for the comparatively moderate winter temperatures, which are often exceeded in the interior of North America. On the other hand the table shows frost in every month of 1905 and that July, August, and September escaped frost in only one year of the seven (1909), when the minimum temperatures were 32·7 degrees, 34·7 degrees, and 35·2 degrees respectively. White frost occurs more frequently than the minima indicate and it is probable that no month is entirely free from hoar frost.

[1] A good account of the climate of Labrador, especially the southern part, may be found in Grenfell's "Labrador, the country and the people."

PRECIPITATION

Rainfall was not determined, but there were many light showers, few days passing without a sprinkle, though heavy rains were infrequent. The vegetation of the inner valleys suggests a dry climate like that of the ranch country of Alberta.

The Hebron statistics record rainfall for five of the seven years, the average being 12·31 inches; but this rainfall occurs only in the summer months and the amount of snow is not given, so that the total precipitation is uncertain.

Fog is very frequent along the seashore and in the bays and fiords, occurring almost invariably when the wind is northerly or easterly. These fogs do not seem to go far inland, particularly when mountains intervene between valleys and the sea. From a mountain top in bright sunshine a grey sea or fog may often be seen filling the valleys and piling up as billows against the mountain sides.

WINDS

The Labrador coast is justly accused of being stormy, particularly in September when the fishing fleet is on its way home. The coast is little frequented by fishermen except in July, August, and September, and they can give no information as to weather conditions during the rest of the year. In the fiords and bays with mountainous shores, gales often plunge down upon the waters as very dangerous gusts and squalls, particularly around headlands. In such a squall last summer several schooners dragged their anchors and one went ashore and was wrecked in Rowsell harbour, which has mountains on each side and seems perfectly protected on the north and west, the direction from which the storm came.

In the deep and narrow valleys and fiord basins of northern Labrador it is difficult to determine the true direction of the wind, since the lower movements of the air are compelled to follow these channels. As the larger fiords and valleys trend about east and west one gets the impression that the winds are all from the east or west. The motions of clouds often give information as to the true direction and show that it is really diagonal to the valleys. Occasionally, however, when a fairly brisk east wind was blowing on Nachvak bay the clouds overhead were seen to be moving rapidly from the west, showing that the lower current was a sort of eddy. Twice under these conditions a film of fog kept coming and going at about 1,500 or 2,000 feet up, where the two layers of air met.

The wind relations observed in 1915 differed widely from those of 1916. In 1915 steady winds laden with fog came from seaward for more than half the time, providing very chill and dreary conditions on the coast and even in fairly sheltered fiords and valleys, as unlike August in the rest of America as could be imagined. These endless east or northeast winds must have been caused by the updraft of the heated interior of Labrador after the manner of the monsoons of tropical regions. The occasional southwest winds felt almost sultry in contrast with the ice breath from the waters of the Arctic current and gave clear evidence that the summer climate 100 or 200 miles inland was very different from that of the coast.

These northeasterly monsoonal winds are customary in summer according to the fishermen, who are naturally keen observers of wind and weather. In 1916, however, conditions were greatly changed and westerly winds and gales predominated. Cyclonic storms swept one after the other across the peninsula with only a day or two of quiet weather between during the latter half of July, most of August, and the first part of September. As a result of the more frequent west or southwest winds there was little fog and the mean temperature was raised about 5 degrees as compared with the former summer. The cause of the striking difference between the two summers is not certain, but may be connected with the unusual heat of the latter part of the summer of 1916 in the interior of America.

CHINOOK EFFECT

It was repeatedly noticed that after a depression had passed and the barometer began to rise there were fierce winds or gales from the west giving rise to a peculiar set of conditions somewhat like those of Alberta in chinook weather. The moist air rising from the level of Ungava bay to the crest of the narrow tableland on the eastern side of the peninsula, reaching an average height of about 4,000 feet, had its moisture condensed as driving mists or clouds, very raw and piercing when encountered on a mountain top. In deep and wide, north and south valleys, like those running south from Nachvak fiord, the stream of cloudy air suddenly plunges down to levels 3,000 or 4,000 feet below the crest and is condensed and warmed in this way, quickly absorbing the vapour and appearing as warm, dry air. In these valleys during gusty westerly gales the clouds can be seen constantly pouring over the edge of the mountains to the west like a wide cataract which vanished less than half-way down the cliffs. The eastern side of the valley may be in constant warm sunshine while the opposite side is in grey shadow with sudden spits of rain. On top of the eastern mountain wall the clouds may be seen reforming and driving onwards again, so that there is a bank of blue sky separating two belts of heavy clouds in spite of the fact that both belts of clouds are hurrying from west to east.

Because of the conditions just mentioned the deeper north and south valleys seem to have a climate quite different from the rest of the country, with less moisture and more warmth. In Ivitak valley, the third inland on the south side of Nachvak and 15 miles from the open sea, this climatic effect is perhaps best seen. In late August the grassy floor of the valley grows sere and brown or yellow, suggesting certain wide valleys among the foothills near Bow river at the same season.

A little above the valley flat, on the east side, berries ripen much earlier than at Hebron, 60 miles south; and the arctic bramble, which seems not to ripen at all at Hebron, was red and delicious in the third week of August.

Even in such relatively favoured valleys, however, agriculture is out of the question. The gardens so assiduously tended at the Moravian missions to the south are purely artificial in their conditions, the vegetables grown, such as cabbage, cauliflower, turnip, and lettuce, being started usually in the house and transplanted to garden beds, or better to cold frames, toward the end of June. Delicious lettuce and cauliflowers are raised even at Hebron, but practically under glass. The only garden vegetables capable of growing unprotected except by high walls are rhubarb and turnip.

At Nain, 180 or 190 miles south of Nachvak, a few potatoes are grown in beds between low walls of boards and with frames over which strips of canvas may be drawn to protect the plants from the frosts which frequently occur even in July and August.

Agriculture is, then, out of the question, and the only possibility of supporting a population apart from the harvests of the sea is through a mining industry or by the keeping of reindeer. As the reindeer moss, or lichen, is widespread, and as caribou, practically of the same species as the domesticated reindeer, thrive in the valleys, it may be supposed that herds of reindeer might support a limited pastoral population but, before this can take place, the Eskimos must be persuaded to part with their dogs. Dr. Grenfell's interesting experiment with reindeer at St. Anthony in Newfoundland may perhaps solve the problem for Labrador also.

RELATION OF SEA TO LAND

The sea and its phenomena have a more profound effect upon the land in northeastern Labrador than in most other parts of the world, except possibly some oceanic islands. Nowhere is the land more intricately penetrated by the sea, nowhere are there more striking evidences of the destructive action of the sea upon its shores nor of its control of the climate and of the life on the land along its margin.

The three varieties of motion of the sea, its tides, currents, and waves, all have their effects on the shore and its inhabitants.

The tides may be referred to first. Along most of the Labrador coast the tidal range is not great, perhaps from 3 to 6 feet; but at cape Chidley and in the channels separating its islands from the peninsula to the south the spring tides increase to heights of from 30 to 50 feet and sweep as powerful and dangerous currents, sometimes of seven knots an hour, into the fiords and through the ticklers. They seem unsurpassed in magnitude even by the famous tides of the bay of Fundy.

Along parts of the coast where the change of tide is not great, as in Nachvak fiord, there are sometimes anomalies hard to account for. It was found in early August, 1916, that the two diurnal tides were of very unequal magnitude, one rising about 2 feet higher than the other. The difference was so marked at the end of Nachvak bay that a camp set well above full tide had to be removed at the next full tide, which swept right over the camp ground. This difference was observed several days in succession and was equally marked at the third cove on the south side of Nachvak, where a convenient camp ground was reached without difficulty through shoal water at one high tide, but the boat was left high and dry at the next one. At the third high tide, however, embarking was as easy as on arrival. These peculiarities were observed for a week with no special cause, such as winds or varying barometer, to account for them.

The current which affects the conditions in northern Labrador so powerfully is variously named the Labrador, Davis Strait, or Arctic current. It is a fairly steady set of the surface water southeastward along the coast with a rate of 1 or 2 knots an hour as reported by the fishermen, who because of it, find it easier to go southeast than northwest. The movement of the water is very apparent when watching the slow, majestic march southwards of icebergs, which pay no heed to the wind and little to the tides. The fishermen speak of this current generally as a tide, using the term incorrectly.

This current has been accounted for as restoring the balance for the warm waters which pass northward through the eastern part of the north Atlantic—the Gulf Stream, as it is usually called. If this explanation be correct the movement must pass entirely round Greenland, since the cold return current comes down through Davis strait, picking up on its way the icebergs calved from the western Greenland glaciers and also a large amount of floe ice.

The icebergs carried south by the current have an infinite variety of shapes, with peaks and pinnacles and cliffs, and not infrequently, sea caves and even tunnels. They may rise from a few feet to 150 feet above the sea and may be hundreds of feet in length and breadth. The largest seen by the writer was estimated at a quarter of a mile long. Its breadth also was great, and its height was estimated at from 100 to 150 feet. It was nearly flat, but with an uneven surface, and appeared to be a portion of glacier which had drifted off on an even keel, as the great tabular bergs of the Antarctic are said to do.

Bergs may be seen to lose pieces by wave action and roll over because of the disturbance of their equilibrium; it is probable, therefore, that most of them are no longer in the attitude which they occupied in the parent glacier, Frequently they are seen to be stained with earth in places or to carry blocks of stone. In this way portions of Greenland are carried southward and distributed over the sea bottom 1,000 miles or more to the south where the icebergs melt.

The smaller bergs sometimes enter bays and fiords, urged by tidal currents, and sweep away trap nets that lie in their course. Other bergs get aground in shoal water in the bays and slowly thaw. Many of them reach the straits of Belle Isle and enter the gulf of St. Lawrence or pass the east coast of Newfoundland and reach the Grand Banks or go even farther south into the track of steamers between New York and Liverpool. The warmer air and water in the more southern latitudes causes them to melt rapidly.

The greater part of the bergs and of the floe ice comes south in the spring, so that by the latter part of July schooners can enter the northern harbours. On July 24, 1915, there was difficulty in getting into Hebron, however, because of floe ice through which the motor boat had to wind its way cautiously. In a few days most of it had disappeared, partly by thawing and partly by drifting out again by a change of wind. Though floe ice is strongly affected by winds and tides the greater icebergs move on their way serenely unaffected by such superficial forces.

EFFECTS OF FLOATING ICE

The presence of such large amounts of ice on and in the water of the Labrador current lowers its temperature to—or even below—the freezing point of fresh water and keeps it at that temperature as long as it passes south in quantity.

From mountain tops at such times the surface of the ocean can often be seen ice covered for long distances out—not less than 20 or 30 miles in some cases; but usually there are open-water leads, and a certain arrangement of the ice in great swirls is apparent, perhaps caused by shoaling and deepening of the water. Widespread ice was seen reaching far out to sea on August 10, 1915, from the top of mount Tetragona.

It is evident that the almost constant presence of ice in the coastal waters of Labrador, and the fact that the water itself is commonly at freezing point, or a little below, must have a most chilling effect on the shores, particularly when the wind is from any seaward point. Even on sunny days in late July and early August, the warmest period of the year, a wind from the north, northeast, or east, chilled by its contact with ice and water, causes low temperatures for miles inland. In most cases, of course, such winds are laden with fog that blots out the sunshine.

Often such winds drift the floe ice far into the fiords and ticklers, thus lowering the temperature of the inland waters also.

It is not surprising then that the region of the Torngats, though between the latitudes of Christiania and Glasgow, has an Arctic climate, an Arctic fauna, and a treeless flora like that of northern Lapland.

Though the main current influencing northern Labrador is of the kind just described there appear to be other currents also playing a part in the conditions observed. Driftwood in blocks of some size is found on the shores of Komaktorvik fiord even to its inner end. The wood appears to be spruce and could not have come from any point to the north, either in Labrador or Greenland, since spruce does not grow so far north. It must have come either from Hudson bay or more probably Ungava bay, since George and Whale rivers flow through spruce forests near their entry into Ungava bay. This means a journey of at least 150 miles northeast, 80 miles southeast, and 6 miles west. The northeastward journey may be accounted for by southwesterly winds, and the 6 miles to the head of the fiord by occasional easterly storms, so that only the Labrador current is necessary to complete the voyage.

In July 1915 the harbour of Hebron was filled with floe ice, as mentioned above; and the Rev. Mr. Simon stated that the floes were not from Greenland but from Ungava, his reason being that they were not so large and heavy as floes coming from Greenland. If this be correct it furnishes additional evidence that either a current or southwesterly winds can transport anything that floats to the open sea east of cape Chidley, where the Labrador current will carry it southeast along the coast ready to enter the inlets when a storm blows from the east.

WAVE ACTION

The Labrador coast is proverbially a stormy one, and gales from the northeast or east, not infrequent even in the two summer months, are common and violent in other months, particularly September. During the autumn storms of 1915, at Black tickler and other exposed shores the billows piled up more than 50 feet above sea-level and hurled spray more than 100 feet up the sides of cliffs (Plate IV B). The returning waters rushed down as torrents and waterfalls that must have been powerful abrading forces. Everything loose on the beach, including large boulders, is set in motion by such waves, furnishing battering rams and smaller missiles as well as plentiful scouring materials on parts of the coast where a beach exists. At many projecting points, however, the cliffs seem to go down into water so deep that abrasion of this sort can hardly take place. No doubt frost action and a certain amount of chemical attack help the destruction. It may be observed that basic dykes are deeply cut into at the foot of cliffs, making caves or deep narrow ravines between the less vulnerable gneisses on each side; though the same dykes withstand weathering on land better than the gneisses and often rise as low ridges above the general level of gneiss blocks. Sea water seems to have a specially destructive effect on such dykes.

The lofty cliffs are very striking, reaching at Mugford and near Nachvak 2,000 feet or more and extending for miles with the constant roar of the surf at their feet.

Beginning at the southern head of Nachvak bay, cliffs extend for nearly 4 miles southeasterly with an average height of nearly 2,000 feet. After a break of a mile of low ground, where a U-valley comes in, cliffs almost as high stretch for 1½ miles. With two interruptions the cliffs reach to Gulch cape, 11 miles from the south head. This nearly straight row of steep cliffs extending with only three breaks for 11 miles with elevations never below 1,000 feet and sometimes reaching 2,500 is not easy to account for, as the direction does not correspond with any known structural feature of the rocks themselves and cuts diagonally across the trends of the deep, glacially carved valleys which here come out to the sea. A similar wall of cliffs extends almost unbroken for 5 miles or more northwards from the north head of Nachvak, and is equally hard to account for, since the two directions make nearly a right angle.

Wave action is the most important destructive work now going on in Labrador, since the small glaciers are doing little, the clear water rivers are cutting but slowly, and general weathering must be going on very deliberately in a region where snow lies for eight or nine months and the summers are cool and comparatively dry.

Shore forms show clearly that the marine attack is making rapid headway in some places, since the cliff faces truncate sharply the land forms left by the great valley glaciers of the last ice age. There are examples where U-shaped valleys are cut across by the shore cliffs leaving hanging remnants which imply former valleys of greater length; and there is an example of such a valley truncated at both ends just south of Ramah, one end by a northwest and southeast cliff, and the other by one running about north and south.

Instances of the sort almost suggest faulting, but no positive evidence of any geologically recent faults has yet been found in the region. It is true that a submarine shelf extends out from the foot of the cliffs for an unknown number of miles, with depths varying from 54 to 97 fathoms, as shown on the Admiralty chart, the greater depth being found about 70 miles east of Gulch cape, south of Nachvak. It is of interest to note that Daly found greater depths in Nachvak fiord itself, his deepest sounding being 110 fathoms 10 miles from the mouth of the fiord.

It has been suggested that Labrador, Greenland, and Scandinavia were once parts of a continuous Archæan continent broken asunder by the dropping of great, faulted blocks where the seas now extend between them. There is no visible evidence of such a catastrophe on the Labrador coast, where the plane of faulting, if it exist, must lie beyond the submarine shelf just mentioned, because the nearly vertical cliffs face the sea in all directions—even on the western side of islands—though there, cliff-cutting is less marked because of partial shelter from the strongest wave action.

Though the coast appears straight on a small scale map or chart its seaward front, often of majestic cliffs, trends in all directions between south and north, with east and northeast faces the most common, and gives no suggestion of a great and continuous line of faulting.

At many places the cliffs rise out of fairly deep water, any talus being below the sea; the marine shelf, therefore, could not have been cut back by wave action at the present sea-level. The long and patient sapping and destruction of the hard Archæan gneisses for a width of at least 70 miles must have demanded an enormous time of marine attack at a level perhaps 50 fathoms below the present level. Was this great work accomplished during the ice age when the ocean was lowered by the removal of water sufficient to form millions of cubic miles of ice? It is, of course, possible that the work was mainly or entirely pre-glacial when the continent stood higher than now.

FLORA[1]

The vegetation of the southern part of Labrador is a continuation of that of the province of Quebec, with evergreens and birch and poplar as forest growths, and the usual flowering plants, ferns, mosses, and lichens, in open or swampy places; but on the shore of the Atlantic the trees disappear or dwindle to low bushes. The actual Atlantic coast from the strait of Belle Isle northwestwards is treeless from end to end. The inlets, however, extend into more sheltered regions where, except on cliffs or rocky summits, the surface is covered by the usual boreal Canadian forest.

As the coast is followed northwestward the trees at the head of inlets become smaller and of fewer species until timber-line is reached. At Hopedale, latitude 55° 30′, sheltered by hills to the northeast and an island to the east, there is a small grove of spruces (*picea*) and tamaracks (*Larix laricina*), more or less stunted and seldom thrifty, a few rowan bushes (*Sorbus*) also occur in the garden protected by spruces; but at the end of Udlatuk bay, 20 or 25 miles to the west, are large spruces and tamaracks (locally called "juniper") as well as small birch (*Betula*) and poplar (*Populus*) trees, locally named "aps" trees.

The grove of spruce and tamarack forming the well known park at Nain (Plate V A) is fairly well sheltered by lofty islands to seaward. At Okak (latitude 57°30′) which is somewhat protected from the Atlantic storms, the spruces are scarcely more than bushes and are few in number, though fairly thick stumps nearby indicate larger growth in the past. Wood sufficient for fuel is found at the inner end of Black Duck bay north of Okak, but at Hebron (latitude 58 degrees) no trees grow and even bushes are low and often creeping. Fuel comes from farther south. From Hebron to cape Chidley even the longest bays and fiords do not go far enough inland to reach timber of a larger kind than bushes, though Joe Lane of Hebron, well known as guide and interpreter, states that spruce is found about 30 miles west of the end of Saglek bay and about the same distance southwest of Nachvak. No timber is visible from an outlook point 15 miles west of the end of Nachvak, but Low mentions that "the tree line skirts the southern shore of Ungava bay and comes close to the mouth of George river, from which it turns south-southeast, skirting the western foothills of the Atlantic coast range, which is quite treeless southward to the neighbourhood of Hebron".[2] The northeastern peninsula of Labrador is then practically beyond the timber-line and belongs to what is usually called the "barren grounds." The soil in the valleys is, however, often fertile enough and covered with a low-growing vegetation forming a continuous turf, and—in sheltered valleys—including bushes which may form small thickets. No conifers are found, even as bushes, beyond the timber-line, the woody plants being mainly willows (*Salix*), alder (*Alnus*), and Arctic birch (*Betula nana*).

Four types of vegetation may be distinguished; a narrow zone of shore plants, marshy growths in poorly drained valleys and plains, a bushy growth on the dried sloping sides of valleys with grasses, etc., on well-drained lower ground, and the meagre growth of rocky slopes and hilltops at higher levels.

On the lower, fairly well-drained ground at Hebron there were in bloom early in August buttercups (*Ranunculus* sp.), two kinds of vetches (*Astragalus* sp. and *Oxytropus* sp.), the low fireweed (*Chamaenerion latifolium*), dandelion

[1] Thanks are due to Prof. R. B. Thomson and Miss Norma Ford for determining the plants collected, for advice as to the names employed in this report, and for the preparation of the list of plants published as an appendix.

[2] Geol. Surv., Can., vol. VIII, p. 31 L.

(*Leontodon taraxacum*), broad leaved sorrel (*Oxyria digyna*), Arctic bramble (*Rubus arcticus*), blueberry (*Vaccinium uliginosum*), rock cranberry (*Vitis-Idæa* sp.), crowberry (*Empetrum nigrum*), and red bearberry (*Arctostaphylus uva-ursi*). A little higher up were rhododendrons (*R. canadensis*), white cassiope (*Cassiope tetragon*), red mountain heather (*Phyllodoce coerulea*), trailing willow (*Salix herbacea*), and alder bushes with mosses and lichens. On rock slopes mosses and lichens were the chief plants, but a few flowering plants, such as the moss campion (*Silene aculis*) and a pale yellow Arctic poppy (*Papaver nudicaule*), occurred on the top of Johannesberg at 2,100 feet. In the swampier parts there were mainly grasses and sedges. In addition to the plants thus far given a pyrola and ferns should be mentioned.

On Komaktorvik bay (latitude 59°30′) in the second and third week of August there was a thin fringe of maritime plants in bloom including seabeach sandwort (*Honkenya peploides*), dandelions, coarse sand-bind grass (*Elymus arenarius*), etc.; and on the dry, stony plain above there were meagre grasses, tiny berry-bearing plants, labrador tea 3 inches tall with only one or two blossoms, and equally dwarfed willows. Spaces were filled in with mosses and lichens. Swampy places farther inland had rank grasses and sedges as well as white, tufted cotton grass (*Eriophorum* sp.) and also, of course, sphagnum and other mosses.

Six miles inland, 1,000 feet above sea-level, blueberries, cranberries, and crowberries were in bloom on August 9, white cassiope and labrador tea were gathered as fuel, and a yellow composite (*Arnica alpina*) was gathered in a sheltered valley. Still farther inland two kinds of willows rose as bushes to heights of 2 or 3 feet, and the Arctic birch (*Betula nana*) sprawled on the ground. The low fireweed was in bloom on August 12. Sorrel and cassiope were found up to about 2,000 feet.

On Nachvak bay (latitude 59 degrees) the protected inner valleys included most of the plants mentioned above, but at an advanced stage on August 18. The usual assemblage of maritime plants was seen on the gravel beach edging the fiord, the rank sand-bind grass forming a long band 10 feet wide, almost as if planted. Ordinary kelp and broad-bladed, long-stemmed seaweeds made a brownish-green, or pink, or dark red windrow just below this as the tide receded.

Passing into the valley the drier surfaces were covered with an extraordinary turf looking, at a distance, like grass but composed mainly of two kinds of dwarf willow (Plate V B), blueberry, cranberry, crowberry, lichen, and, most of it, with a little grass. Somewhat higher up, the tall fireweed was coming into bloom and also a pale variety of "painted cup" (*Castillija acuminata*), violets (*Viola adunca*), bluebells (*Campanula rotundifolia*), and beautiful dark pink bunches of Lychnis. Several of the wild fruits were ripe on August 18, including the Arctic bramble. Rarely there were bushes of the musky red currant (*Viscaria alpina*) just ripening. The low species of fireweed was going out of bloom. It may be mentioned that a white variety was rather common near the head of Nachvak bay.

To the lowland plants mentioned should be added a purple gentian and the twin flower (*Linnea*) which were observed at Bear gut south of Nachvak. The lower slopes and drier valleys of northern Labrador are often carpeted with low or trailing berry bushes covered with fruit in the latter part of August and the beginning of September. The bearberry is very common but too insipid to eat. Its leaves take on an intense crimson colour in autumn (the most brilliant colour in Labrador.) Toward the southern part of the region here described the bunchberry (*Cornus canadensis*) may be found in dry places and the bake apple or cloudberry (*Rubus chamaemorus*) in moist ones. The latter is the favourite berry of the fishermen.

In the more fertile and sheltered valleys thousands of acres are covered with these wild fruits, so that in autumn Labrador is a land of plenty for anyone willing to stoop to gather them.

The sheltered valleys are rich with low-growing vegetation, but plant life, except mosses and lichens, rapidly diminishes as one ascends the mountains, though sorrel, the yellow poppy, the moss campion, and the white cassiope continue up to 2,000 or even 2,700 feet. Much of the gentler slopes above the valleys is clothed with the whitish grey reindeer moss (*Cladonia rangiferina*). Still higher there are dull brownish mosses and grey scaly lichens which occur near melting snowbanks up to 4,500 or even 5,000 feet. Much of the surface covered with loose rock fragments, so common at higher levels, seems to be quite devoid of plant life, perhaps because the drainage is too perfect.

The higher plants have, of course, only a very short season for growth, often a month or less between the thawing of the winter's snow and the fresh falls in the late August or early September; and there are seasons when the loftier snows do not melt at all, condemning the mosses beneath them to two years' imprisonment.

The flora, as just described, is an Arctic one in spite of the comparatively southern latitudes of the region. In many respects it resembles the high alpine flora of the Rocky mountains.

FAUNA[1]

A good deal of collecting has been done by missionaries and travellers on the Labrador coast and more or less complete lists of the mammals, birds, insects, and fishes have been published, so that it is unnecessary in a geological report to go into details as to the zoology of the region.[2]

LAND MAMMALS

Of the land mammals the barren ground caribou is of most importance to the Eskimos, who hunt it in the winter, but it is reported to be getting much less numerous than formerly. During the writer's field work caribou were seen in small numbers near Nachvak and Komaktorvik bays, and one was shot near mount Tetragona. Caribou flesh is the best meat to be found in Labrador. Tracks of what seemed to be a small bear were seen, possibly of a black bear (land bear, as it is called in Labrador) though there is some doubt as to whether black bears go beyond the timber-line. The white bear, coming south with the ice, and hence called a "water bear", seems more common. Wolves are reported and red and white foxes are common, black and silver foxes less so. Hares or rabbits are numerous also, but a small lemming, somewhat rat-like but short-tailed, is the commonest land animal, its burrows and nests being seen everywhere in dry, grassy situations.

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[1] Thanks are due to Prof. B. A. Bensley for suggestions and advice in regard to the fauna.

[2] Geol. Surv., Can., vol. VIII, pt. L, pp. 313-333.
"Labrador, the country and people," Grenfell and others.
"The Labrador coast," Packard.

Land birds seem infrequent to a visitor from southern Canada and many of our common species are lacking. Ravens, certain hawks, and, in the southern parts, the robin, are very common. A pair of ravens occupies every valley; and one or more pairs of large hawks may also be seen quartering the ground in search of lemmings or ptarmigan. Rock and willow ptarmigan were seen, as well as sparrow-like birds sparsely scattered in the valleys. Small, red-capped kinglets were observed in the spruce grove at Nain.

Among insects the mosquito and black fly rise in clouds from the vegetation in the valleys when the temperature is high enough. It was found that they ceased work at about 45 degrees and made no trouble below that temperature. Among other insects may be mentioned bumblebees working at the flowers, and a few grasshoppers.

The life of the land is very sparse and but for the croak of ravens and the scream of large hawks is seldom in evidence. Beyond timber-line other land bird notes are not often heard; and a land animal is never seen, except a rare fox or a caribou far off in some valley. It is very different with the water animals which are usually much in evidence.

MARINE MAMMALS

The mammals of the sea are numerous in species and are of the utmost importance to the Eskimos, particularly the seals, on which they largely depend for food, fuel, and clothing. The seals include harps and hoods and the other species found near Newfoundland, and are taken by the Eskimo both when they come down from the north with the Arctic ice and when they return. In early August, 1915, seals rose all about the writer's party in the quiet water of Komaktorvik bay, causing great excitement among the Eskimos, who launched the kayak and in two or three days had killed six. Seal meat is very dark coloured and has a fishy flavour, though the flesh of a young seal has less of the fishy taste than that of an older one.

The walrus, which used to abound as far south as the gulf of St. Lawrence, is now rarely found, though stray specimens come south with the ice and a young female was killed near Rowsell harbour, south of Nachvak, in August, 1916.

Whales of small size were seen in considerable numbers, and bones of large whales are found occasionally at old camp grounds or winter villages of the Eskimos. Only one whaling station now operates in Labrador, that of Hawk bay in the southern part.

"Jumpers," apparently grey porpoises, are shot and harpooned for food and furnish the best meat derived from the sea, having much less of the fishy taste than seal meat. The white whale or porpoise also is harpooned for food. One 18 feet long was hauled ashore at Hebron in September, 1916, and while it was being cut up many of the bystanders helped themselves to strips of the thick gelatinous white skin, which is considered to be a luxury.

SEA BIRDS

Sea birds are innumerable, including gulls and terns of several kinds, guillemots or sea pigeons, and eider and other species of ducks. All of these are used for food, and the eggs are gathered in immense numbers in the nesting season. Guillemot eggs are a standard article of food at the mission stations, and it seems as though the quantities taken by Eskimos and fishermen must seriously reduce the numbers of these birds in the future. The yolk of the "pigeon's" egg is bright red in colour and this hue is imparted to cakes or other food in which these eggs are used.

Rev. Mr. Perrett of Hopedale is an authority on the birds of Labrador and has a splendid collection of eggs.

FISH

On the Labrador coast, as in Newfoundland, only one inhabitant of the sea is "fish," the cod; and the summer visit of Newfoundland and other schooners to this bleak coast is solely to take the cod. On the northern Labrador coast they are caught mainly in trap nets set along shore, either in the bays and fiords and ticklers or on the open sea near some harbour. Practically every sheltered anchorage along the coast of Labrador is occupied by schooners in the latter part of July, the whole of August, and often for a week or two in September. In Nachvak bay there were five craft anchored near its mouth in 1915 and seven in 1916; and there were a number of others in Rowsell harbour and in Ramah harbour a few miles to the south. Komaktorvik bay, however, seems to be avoided, though Ryan bay and Eclipse harbour farther north are occupied. More than 800 Newfoundland schooners frequent the Labrador coast, and as each carries about ten of a crew there are 8,000 or 10,000 Newfoundlanders engaged in the cod fishery on the shore. Of these more than 1,000 occupy harbours from Mugford northwards. A considerable quantity of cod is caught also by the Eskimo and halfbreed settlers along the coast.

The visit of the cod seems to be determined largely by the temperature of the coastal waters; it commences, usually, toward the south and advances northwards with the warmer season. The cod arrived unusually early in 1916, the warmest and earliest season on record among the fishermen, and many schooners were too late for the catch. The unusual mildness in 1916 seems to have been caused by the small amount of ice brought down by the Labrador current. The cause of this diminution in the amount of floe ice and bergs should no doubt be looked for in earlier weather conditions in Davis strait, Greenland, and the Canadian islands in the far north.

Salmon run in most of the rivers entering the southern fiords of Labrador, but so far as could be learned from the fishermen and Eskimos, in the northern rivers they are replaced by splendid sea trout of at least two species. These are caught in large numbers by the Eskimos and salted at the Mission stores to be shipped to Newfoundland or England. In the northern rivers, such as those of Nachvak and Komaktorvik, magnificent trout, of a golden and coppery colour with red and white spots, are frequently seen battling their way upstream among the rocks, toward their spawning grounds. In shoal places they have barely enough water to swim in and may sometimes be caught in the hands or killed with stones. One killed, with stones, in the river flowing into the third cove on the south side of Nachvak measured 2 feet 5 inches in length and more than 2 feet in girth. The flesh is as red and well flavoured as salmon. The larger fish, such as cod and salmon, feed on smaller fish, especially the caplin, which often swarms in millions in the shallow waters of the bays where its spawn is deposited. On the other hand the cod and trout are the prey of sharks, which are occasionally seen, and still oftener of the seals.

CHAPTER III

GENERAL GEOLOGY

Northeastern Labrador, so far as known, includes only Precambrian and Pleistocene formations, the great time interval between these extremes having been passed supposedly under dry-land conditions. Previous writers have recognized under the Precambrian formations Laurentian and Huronian rocks and under the Pleistocene boulder clay and moraines formed in the Glacial period and beach and river deposits of post-Glacial origin. In regard to the Precambrian it seems to the writer that the distance of the region from the type localities in the Great Lakes region is so great that caution should be exercised in extending formation names derived from studies made in Ontario and Quebec to formations that resemble them in Labrador.

If the Laurentian is defined in the usual way, as including the oldest series of granites and granitoid gneisses, it may be admitted that rocks of this character have been extended by Low's work as far as central Labrador; and, therefore, it is probable that they extend through to the Atlantic coast. Whether later granites and gneisses occur, also, there is at present no evidence to show.

Rocks resembling some phases of the Grenville are widespread in Labrador and have the same relations to the rocks mentioned above as the Grenville of Ontario has to the Laurentian. These rocks are here referred to as Grenville, though positive evidence as to their identity in age with the original Grenville is not available.

The rocks called Huronian by some earlier writers, for instance, Robert Bell, are evidently of much later age than the formations thus far referred to, and they resemble part of the rocks of the original Huronian as defined by Logan and Murray; but, as they include no "slate conglomerate"—perhaps the most characteristic rock of the original Huronian—and are separated by more than 1,000 miles from the nearest known outcrop of Huronian, it is safer to use a local name for them, the name chosen by Daly, the Ramah series, being suitable. How the Ramah rocks are related to the somewhat similarly placed Mugford series 60 or 70 miles to the southeast is not certain. The character of the Mugford rocks suggests the Keweenawan, including probably part of the Animikie, rather than the original Huronian. It is advisable to leave these rocks under the name Mugford series, as used by Daly.

Fossiliferous sediments have not been found in the region, so that the Palæozoic, Mesozoic, and Cenozoic ages are not recorded. If marine rocks were ever deposited over the older series referred to above they have since been removed, and it may be that the region has been under dry-land conditions since the end of the Precambrian. The amount of weathering and denudation by stream action during that vast lapse of time must have been great and probably resulted in peneplanation; though the present rolling surface is of the same type as that beneath the Ramah and Mugford beds, suggesting that peneplanation had already progressed far before the later Precambrian deposits were formed.

Since the elevation of northeastern Labrador, an event which, so far as can be discovered, came late in the Cenozoic, weathering must have taken place with extreme slowness (as suggested on an earlier page), because of the cool and somewhat dry climate and the resistant character of the crystalline rocks. There were, however, in all probability, canyons or at least deep valleys excavated by rivers near the edges of the tableland, and during the Glacial period these were greatly widened and perhaps also deepened by the powerful local glaciers which occupied them. The results of their work are to be seen in the rugged and deeply channelled margin of the tableland resulting in the formation of the Torngat mountains.

Classification

Recent..................	River gravels and beach deposits.
Pleistocene...............	Terraces Glacial deposits
	Great unconformity
Precambrian...............	Mugford series. Ramah series. *Great unconformity* Basic dykes probably older than the Ramah series Igneous granites and gneisses in eruptive contact with the Grenville (Laurentian?) Grenville series? Keewatin?

GRANITES AND GNEISSES (LAURENTIAN?)

All the writers who refer to the geology of Labrador speak of the coast as consisting mainly of Laurentian rocks, meaning ancient gneisses, but very little has yet been done to separate the gneisses of igneous origin from other gneisses in which ancient sediments are the chief ingredients. In fact many of the references to the Laurentian of Labrador are founded merely on the appearance of shores and cliffs as seen from a passing vessel.

Much of the southern shore appears to be true igneous gneiss, often with the characteristic pinkish colour, but in the north eruptive gneisses are relatively uncommon, seldom cover a large area, and the pink colour is commonly wanting. Whether pink or grey the true igneous gneisses are essentially foliated granites made up of feldspars, quartz, and mica, the mica being mainly of a dark variety. The feldspars are seen in the few sections studied under the microscope to be chiefly orthoclase or microcline, with a subordinate amount of plagioclase having a small extinction angle. The quartz often shows strain shadows, and in some specimens porphyritic feldspars are tailed out into "augen," showing that the rock has undergone shearing strains.

Along with the typical granitoid gneiss just mentioned there are often well banded varieties, light and dark, the darker bands being more biotitic or hornblendic, and in places an older basic rock has been carried off as angular blocks, then drawn out and rendered schistose, making the darker bands of the gneiss, all phases of the operation being present.

The best example of the structures typical of the Laurentian was observed at Hopedale, where a wave-swept surface exposed at low tide displays folds, crumpling, shearing, faulting, and *lit par lit* injection as well as later dykes of pegmatite or granite.

In general the igneous gneisses of Labrador are so much like the well-known ones of Ontario as to need no detailed description.

Along with the gneisses in most places are to be found the usual irregular dykes of pegmatite, generally consisting of pink feldspars and quartz. One such dyke, however, on Tomchuk island, Saglek bay, is formed of very white feldspar with some quartz and large plates of black mica, making a very striking rock.

BASIC PHASES

Beside the usual granitoid gneisses there are bands and sometimes larger areas of more basic rocks apparently of much the same age and having a similar gneissoid structure. Some of these have the composition of quartz diorite schists composed of plagioclase and hornblende with some quartz; others, paler in colour and collected as average grey gneisses, turn out to be gneissoid norites, consisting of preponderant plagioclase with small amounts of hypersthene and of hornblende, probably secondary. An era of typical norite consisting of nearly equal parts of plagioclase and hypersthene with a considerable amount of magnetite occurs on the south side of Nachvak bay, but it shows no schistose structure and may be a later eruptive.

It is probable that the anorthosite containing the famous labradorite of Paul island and adjacent islands and parts of the mainland is of the same age as the granite gneisses. This rock is usually quite massive and is cut in places by dykes of coarse pegmatite, e.g., at Green cove, Aulatsivik island, suggesting that it belongs to the earlier eruptive rocks.

KEEWATIN ?

Finally the dark bands enclosed in the igneous gneisses, mostly having the composition of diorite schist or of amphibolite, are widely spread and sometimes in masses or bands of considerable size. They have characters like much of the Keewatin of northern Ontario, and as they seem always to be older rocks than the granitoid gneiss, they should, perhaps, be classed with the Keewatin. The fact that banded iron formation of jasper and iron ore occurs as loose blocks near cape Chidley supports the idea that Keewatin occurs in the region, though iron range rocks have not yet been found in situ.

SEDIMENTARY (GRENVILLE?) GNEISSES

A great series of grey or pale pink gneissoid rocks, mostly characterized by the presence of garnets, extends over large parts of the Komaktorvik and Nachvak regions. This may be equivalent to the Grenville series of Ontario, though crystalline limestone, the most typical rock of the original Grenville series, is seldom found, and never in large amounts. In reality the Grenville of Ontario consists only to a subordinate extent of limestones, though these rocks have attracted more attention than the gneisses and quartzites with which they are associated.

The rocks here referred to include a wide range of materials, such as pale or pinkish gneisses, often highly garnetiferous; dark grey gneisses, also garnetiferous and frequently containing pyrite, and weathering very rusty; graphitic gneisses often containing pyrite as well as graphite; and grey limestone thickly sprinkled with small, oval, green spots, which in thin sections prove to consist of pale green augite and scapolite.

Most of the rocks mentioned are quite siliceous and some might be called garnetiferous quartzites. Feldspars are generally recognizable, but not always;

biotite is common; graphite is prevalent near the west end of Nachvak, but has not been seen elsewhere; and augite and hornblende occur in one very garnetiferous specimen from Komaktorvik, which may be in reality a metamorphosed basic eruptive. The garnets seem to be of more than one kind, ranging from pale rosy crystals in the more quartzose rocks to dark brownish-red varieties in the more basic rocks of the series.

Rusty weathering bands of gneiss often lie beside fresh-looking, pale varieties. The whole series appears to be sedimentary, representing sandstones or shales, sometimes perhaps containing organic matter now transformed into graphite. In attitude these rocks are commonly steeply tilted or even vertical. Granitoid gneiss is often interbanded with the sedimentary gneisses and both are penetrated in many places by dykes of pegmatite or granite.

A POSSIBLE TIMISKAMING OR SUDBURY SERIES

There are a few indications that another less ancient series of sediments than the Grenville, but older than the Huronian, exists in Labrador. The schist conglomerate described by Dr. Daly from Pomiadluk point, south of Aillik, with flattened pebbles and boulders up to one or more feet in diameter, steeply tilted, with green schistose matrix suggests the Doré or Timiskaming conglomerate of northern Ontario. As the boulders include granitite and granite porphyry, the conglomerate is presumably later than the gneisses here referred to as Laurentian, and, therefore, later than the sedimentary gneisses which resemble the Grenville series. The variable but steep dip and the probable great thickness of 8,000 feet, ending in " metamorphic sandstone " are reminiscent of the Timiskaming or Sudbury series.[1]

Whether the white, red, and purplish banded quartzites of Aillik bay 15 miles northwest of Pomiadluk point are of the same age is uncertain, but they are cut by granites and pegmatites and must be decidedly ancient.[2]

Blocks of schist conglomerate, arkose, and quartzite, near Schooner cove on Nachvak bay, may be of the same age, but here the rocks have not been found in place. Similar drift blocks of conglomerate occur on Signal hill, Cartwright, in southern Labrador; but here again, the bedrock from which they came has not been observed, though Packard maps that part of the coast as " Domino gneiss," which he describes as an ancient sedimentary rock, largely quartzite.[3]

LATER ERUPTIVES

Every observer of the Labrador coast is struck with the great number of black dykes which cut the gneisses almost everywhere. They are of all dimensions up to 100 yards in width, are commonly about vertical but may strike the cliffs at any angle even to the horizontal, suggesting sills in that case, though they strike across the schistosity and are, therefore, not true sills. These dykes have not been observed to continue up into the Ramah or Mugford series and so are probably the older.

Most of the dark coloured dykes are probably diabase, since the few which have been studied in thin sections have a distinct ophitic structure with laths of

1 Bull. Mus., Comp. Zool., Harvard, vol XXXVIII, Geol. Ser., vol. V, No. 5, pp. 214-15.
2 Ibid, pp. 215-16.
3 " The Labrador coast," pp. 286-8.

plagioclase enclosed in augite, the augite sometimes in porphyritic crystals. The ones examined are badly weathered and more ancient looking than the comparatively fresh diabases of northern Ontario, usually considered to be of Keweenawan age.

Other basic eruptives are not uncommon, such as the large dyke or mass of pyroxenite which occurs northwest of Ramah on the slopes of Cirque mountain. It is pale greenish grey, weathering brown, and in thin sections proves to be quite fresh and consists of augite with a little brown biotite and magnetite.

RAMAH SERIES

Stratified rocks, seen by R. Bell, on the south side of Nachvak bay, were not personally examined by him, but were thought from their appearance to be Huronian, and the slates described by him from Ramah a few miles to the south, were considered to be of the same age. The Ramah rocks were crossed for about 30 miles by Prof. Delabarre[1] and his companions in 1900 and were found to consist mainly of slates "with occasional sandstone and breccia."[2] They were named by Daly the Ramah series.

The series includes probably 4,000 feet of sediments, chiefly slates, quartzites, arkose, and impure dolomite, with a layer of amphibolite. No basal conglomerate was observed, but the sediments lie, usually with rather low dips, upon the truncated edges of the sedimentary and also of the eruptive gneisses, showing that they are of very much later age. The fact that no dykes of granite or pegmatite have been found to penetrate them suggests the same thing. The rocks do not appear to be greatly metamorphosed, though they are locally thrown into rather sharp folds; and they are not unlike the typical Huronian if the thick boulder conglomerates or tillites of the Huronian be omitted. All the rocks of the Ramah series are well stratified, except the 50 feet or so of amphibolite, and in places, crossbedding and ripple-marks are well preserved. In the slates cleavage across the stratification is very perfect, this and the folding of part of the upper beds giving evidence of compression from east to west. The whole series forms a synclinal band 30 miles long and in places 7 miles wide.

MUGFORD SERIES

The Mugford series is 70 or 80 miles southeast of the nearest part of the Ramah series and differs greatly from the rocks just described though its attitude to the older granite gneiss is similar. Basic eruptives in the form of great sills and also of tuffs and agglomerates make a large part of the series as shown in the splendid Mugford cliffs, but beds of dark slate, chert, quartzite, sandstone, and limestone also are reported by Daly, who estimates their thickness in one place at 900 feet.[3] The presence of diabase sills with chert and slate as the commonest sediments reminds one of the Animikie of lake Superior, but the ash rocks and bombs show volcanic activity suggesting the Keweenawan. If these suggestions are accepted the Mugford series is later than the Huronian and, therefore, probably later than the Ramah series, though the evidence is not very conclusive.

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[1] Geol. Surv., Can., 1882-4, pt. D, p. 16.
[2] Bull. Geogr. Soc. Phila, vol. III, No. 4, pp. 100-107.
See also, Daly, Ibid., pp. 225-6.
[3] Ibid., p. 221.

PLEISTOCENE

Pleistocene deposits are not as a rule widespread or thick in Labrador and are not always easy to classify as compared with the Pleistocene of better known regions of North America. Two subdivisions are easily made, viz., Glacial deposits and marine terraces, so that the main classification is as follows:

Pleistocene..	Marine—Raised beaches. Glacial—Boulder clay and moraines.

The evidence of glacial action is absent from a considerable area in northeastern Labrador, since the higher tableland and the tops of the mountains which fringe it on the Atlantic side show no marks of having been overridden by an ice-sheet. The area left unglaciated (Plate VI A) cannot yet be exactly outlined owing to the absence of observations over most of the region; but it is known that along a coastal belt extending from Saglek to Komaktorvik, a distance of 80 miles, there is no appearance of ice action above the valleys. At Nachvak this unglaciated condition is known to reach at least 50 miles inland, giving a "driftless area" of perhaps 3,000 or 4,000 square miles. The tops of the Kiglapait and Kaumajet mountains to the south and of the Four Peaks to the north, as well as many other isolated peaks, probably rose as nunataks above the surrounding ice.

The unglaciated character of the higher levels at Nachvak and northward was noted by Lieber and Bell, who remark upon the jagged character of the mountains as incompatible with the passage over them of an ice-sheet. Daly goes more fully into the question and reaches the conclusion that Nachvak glacial ice did not reach higher than 2,100 feet above sea-level.[1] The idea suggested by these writers that the Labrador ice-sheet made its way through depressions in the tableland, such as Nachvak fiord, and reached the Atlantic is not borne out by the writer's observations.

Though the northeastern peninsula of Labrador was not covered by the great ice-sheet, its depressions were occupied during the ice age by long and large glaciers which scoured out the valleys and in many places left deposits of boulder clay and moraines. This work seems to have been done, in part at least, toward the end of the Glacial period, as shown by the unweathered character of some of the deposits and of the lower glaciated surfaces; whereas old looking, strongly indurated till in other places was probably laid down earlier.

The small existing glaciers may be looked on as remnants of these far greater valley glaciers.

South of the unglaciated area mentioned above there can be no doubt that the continental ice-sheet reached the sea, since even hill tops present *moutonnées* forms and erratic blocks, though striated surfaces are seldom seen except on the lower levels. Distinct moraines and boulder clay are not common, probably because the region was one of erosion rather than deposit, but morainic material and till may have been deposited off what is now the coast on the submerged continental shelf.

What boulder clay occurs, as at Cartwright, is indurated and ancient looking, perhaps of the age of the Kansan or pre-Kansan of the central United States; and this impression of age is strengthened by the large amount of rock disintegration on higher ground. The gneisses are crumbled into debris of all sizes down to coarse, angular grains of feldspar and quartz. The higher *moutonnées* forms seldom show polished or striated surfaces on account of this disintegration.

[1] Ibid., pp. 249-251.

Innumerable small rock basins exist above the valleys, perhaps originally due to differential glacial scour, but partly formed by differential weathering since the ice-sheet departed.

The impression of age in the region is marked as compared with Ontario, and it is probable that the later glaciations from the Labrador centre, especially the Wisconsin, never reached the Atlantic coast.

TERRACE EPOCH

That the sea stood higher than at present after the ice age is shown by marine terraces almost everywhere along the Labrador coast, and has been noted and described by all geologists who have visited the region. Packard[1] and Daly have gone into considerable detail in regard to these terraces, and Daly has added notes as to the height below which loose boulders are not found because of wave action at higher stages of the sea. Combining the two lines of evidence Daly has worked out the upper limit of marine invasion and shows that this follows a curving contour 260 feet high near Hamilton inlet, rising to 390 at Hopedale, and descending again to 250 at Nachvak.[2]

During the two summers' field work reported on here a large number of aneroid readings were made on raised beaches, which were found at almost every harbour or inlet visited. These beaches occur at various heights from a few feet above the present sea-level to 430 feet. Most of the beaches noted are at comparatively low levels and it is probable that the actual highest marine level was observed in only a few cases, the highest measured reaching 430 feet near Green cove on Aulatsivik island, about 15 miles north of Ford harbour. It is a well-formed boulder beach, with two others below it at 368 and 360 feet respectively. The reading does not accord well with Dr. Daly's highest at Ford harbour, which reaches only 290 feet.

The most northerly beaches measured are a few miles west of Komaktorvik fiord where several well-built delta terraces of gravel are found at 140, 203, and 225 feet above the sea. The last level is 25 feet lower than Daly's most northerly determination, 250 feet, at Nachvak, and supports his conclusion that there is a gradual diminution of elevation towards the north.

This lowering of the marine level northward is probably connected with the fact that the Torngat tableland was not ice covered and that the valleys in most cases were filled with ice only to about 2,000 feet. The load was not heavy and the region was relatively little depressed.

In Newfoundland beach deposits occur up to 500 feet or more, which suggests that the ice was thicker over the island than on the mainland.

Marine shells were found at three points only and in deposits much below the highest beaches. One is 2 miles west of the end of Komaktorvik bay, where saxicava occurs 23 feet above tide; another near Nain, where *mya* is found in clay 140 feet above the sea, and the third at Hopedale. The present seashores present few shells and apparently the post-glacial beaches were inhabited by still fewer mollusks.

The raised beaches of the Labrador coast have not been traced from point to point continuously as those of the glacial lakes of southern Canada and the adjacent states have been, so that the upper marine limit can hardly be looked

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1 "The Labrador coast," p. 304, etc.

2 Bull. Mus. Comp. Zool., Harvard, vol. XXXVIII, Geol. Ser., vol. 5, No. 5, p. 259.

upon as fixed for the whole coast. The highest level reported from Labrador, 430 feet, is much lower than the known marine levels of the St. Lawrence valley, which reach 620 feet, or possibly more, near Montreal, and 690 feet at Kingsmere.[1] It is probable that the Labrador ice-sheet where it reached the sea, between Saglek and the straits of Belle Isle, was relatively thin, certainly not more than 2,000 feet thick at Hebron and Mugford, for instance; and hence the land was less depressed by its weight than on the St. Lawrence where it must have been at least 5,000 feet thick to pass over the Adirondacks. The lowering of the beaches northwards, reaching 225 feet at Komaktorvik, would correspond to a still further diminution of load where the tableland was not ice covered and only valley glaciers existed.

RECENT DEPOSITS

The small existing glaciers are transporting a little material (Plate VI B) and slowly depositing moraines, but their meagre dimensions give evidence that their operations are of little importance. On the other hand frost action on the steep and lofty cliffs so common along the fiords and deeper valleys is a very powerful factor in quarrying blocks and piling up a talus at the foot of the cliffs. Rivers also are efficient scouring and transporting agencies wherever the slope of their bed is steep enough, and they are rapidly filling in the heads of bays and of the two arms of Nachvak fiord. In the case of the western arm a side torrent coming in with a steep grade from the south has piled up an immense fan of large blocks taken from an old moraine and has thus cut off the former westward continuation of the fiord, now forming a lake 7½ miles long and about 50 feet above sea-level.

The southern or Tallek arm of Nachvak was once much longer than now, but the river entering it has filled up its end with delta materials for 4 miles. In a general way it may be said that the U-shaped valleys left by the glaciers are rapidly losing the verticality of their walls by frost work and are having their hollow bottoms filled in by the rivers, so that their cross-sections are growing five-sided, with cliffs on top, talus slopes below, and a flat floor of coarse or fine river deposits.

SOLIFLUXION

Where coarse and fine materials are mixed on gentle slopes along the valley sides or on flat cols or slightly inclined mountain summits another process is at work, that of solifluxion (Plate VII A) rearranging things in a somewhat mysterious but quite striking way. The surface becomes parcelled out into rude polygons from a few feet up to 20 feet in diameter, the finer stuff in the middle and the coarser on the outside, where angular blocks of 2 or 3 feet in dimensions may be lodged with open spaces between them. The drainage takes place between the loose blocks at the edges of the polygons. At low levels the spaces may be overgrown with plants, forming small garden beds, and sphagnum fills the openings round the edges; where grass grows the rims of the areas may be of turf, and the whole arrangement may be more suggestive of the flow of a plastic substance with lobe after lobe creeping downwards.

At high levels there is little or no vegetation except mosses or lichens, and the smoothly surfaced polygons have a quite artificial look. They occur on such flat

[1] Johnston, W. A., Geol. Surv., Can., Mus. Bull. No. 24, pp. 5, 6.

surfaces so frequently that "fluxion" seems hardly a correct expression and it is difficult to explain the cause of the structure. It seems almost as if the finer materials, sandy or gravelly rather than muddy, ascended and spread out from the centre, crowding the coarser blocks to the edge.

BOULDER PAVEMENTS

Delabarre[1] and Daly[2] have referred to pavement-like arrangements of blocks of stone in the Nachvak region, Delabarre suggesting that ice compressed between steep walls may have done the work, whereas Daly leaves the question as to cause unanswered. These structures are not uncommon in the region, having been seen at two places near Komaktorvik and at several places about Nachvak. They are generally found at narrow points in valleys or passes where there are rock walls not far off on each side. The blocks may be small or large, but all have a flat or rounded upper surface making a pavement easily walked upon. Commonly the paving stones are solidly laid and crowded together so as to be firm under foot, but sometimes they are loose and may move when stepped on. Rather frequently they occupy the floor of a valley and the creek or river makes its way by innumerable channels between the blocks, the pavement providing easy stepping stones to cross a torrent that would be impassable if in a single channel. The river may thus be lost in streamlets for hundreds of yards.

This type of boulder pavement differs from the boulder pavements found in Ontario between two sheets of boulder clay; the surfaces of the blocks are not striated, so far as observed; and the stones are not fixed in boulder clay as a cement, two points which seem to oppose their production by the action of true glacier ice. It is possible that the movement of deep snow under pressure may be the cause of the structure. Great quantities of snow must avalanche down into steep-walled parts of the valleys and the lower parts may be driven downwards by pressure from above.

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[1] Bull. Geogr. Soc. Phila., vol. III, No. 4, p. 99.
[2] Bull. Mus. Comp. Zool., Harvard, vol. XXXVIII, Geol. Ser., vol. V, No. 5, p. 249.

CHAPTER IV

REGIONAL DESCRIPTION

KOMAKTORVIK REGION

Komaktorvik is shown on the Admiralty chart as a bay in latitude 59°25′ running 6 miles inland in a northwesterly direction, and islands are not indicated at its mouth; but this inlet is known to the fishermen as Seven Island bay, showing that their experience does not confirm the indications on the chart. It is, of course, known that the northern part of the chart, though very useful, is a rough sketch of the coast rather than the result of a careful survey.

In 1915 the bay or fiord was coasted on its southern side and the group of mountains to the west and south was explored and sketched. It was found that the bay runs nearly due west and that the northern side near the entrance is formed of a number of islands separated by ticklers. Some of these islands are high, and from a ship at sea, particularly in dull weather, may be mistaken for part of the mainland.

The direction of the bay by compass is about northwest, but the variation is 45 degrees to the west in this latitude; its length is about 8 miles; the south side was roughly mapped, but the north shore was sketched in by eye. The map here given (Map 1700), though roughly made by time allowance and compass triangulation, is believed to give a much more correct idea of the bay than the chart does.

Komaktorvik was formerly used by fishermen as a harbour, but has been abandoned of late years, and in the summer of 1915 only one schooner is known to have entered it, remaining only a few days. An old camp ground at the head of the bay shows that Eskimos sometimes visit Komaktorvik, though none were seen in 1915.

A small river enters the bay about half-way up on the south side draining the glaciers and lakes about mount Tetragona 5 miles inland, and a quite large river enters the head of the bay coming from the southwest and draining a large lake among the mountains to the northwest. The region is comparatively low to the southwest, but rugged and snowy mountains rise to the north, west, and south.

Near the entrance of the bay on the south side there is a well-marked terrace rising 68 feet above the sea, with cliffs and a low mountain of grey garnetiferous gneiss behind it, and the same rocks extend round the promontory, including also some bands of green schist and a few diabase dykes.

Terraces at different levels extend along the shore to the west end of the bay, the lowest about 20 feet above the sea, formed of gravel brought down by the large river that empties here. Great boulders scattered over the terrace must have been rafted by ice floes when the land stood lower, just as a barrier of boulders is now being formed round the shoal water of the present bay. The river is clear and swift, about 100 yards wide, and flows through drift materials from a small lake 1½ miles to the southwest. Shells of *saxicava* were found in the sand near the lake.

Following up the river a mile farther a larger lake is reached lying in a deep valley between mountains and bending off to the southwest. Near its outlet splendid sand and gravel terraces, old delta materials, rise in successive steps to 225 feet above the sea. Up to this point no bedrock is found in the valley, but the mountain slopes and cliffs on each side consist of gneiss of the Grenville type, mostly garnetiferous; though occasionally pink, igneous gneiss is interbanded with it.

To the southward of the smaller lake mentioned above, after a steep, rocky ascent of a few hundred feet, a wide, flat valley extends for some miles with a very striking isolated mountain in the middle, which has been called Tower mountain, from its shape.

A wide valley opens also toward the southeast, floored with swamp and morainic materials, often displaying solifluxion, with outcrops of the usual rusty garnetiferous gneiss. Mount Cornelius, named for the writer's trusty Eskimo companion in 1915, consists of the same rock and rises to 3,140 feet, affording a splendid outlook point for Komaktorvik bay and its surroundings.

Its southwest flank has been carved into a cirque, walled by a semicircle of cliffs, and its highest part overlooks a vertical wall dipping toward the southeast into a valley with lakes and a river draining the glaciers of mount Tetragona. The top of mount Cornelius, after passing two small snowfields, consists of weathered gneiss fragments evidently never disturbed by moving ice.

MOUNT TETRAGONA

About 7 miles southeast of the end of the bay a very striking mountain rises to a height of 4,700 feet, formed of the same Grenville gneiss with strikes varying from north 15 degrees west to north 55 degrees east and a southward dip of from 60 degress to 75 degrees. Its summit is a sharp ridge, running nearly north and south, divided into two nearly equal peaks, and evidently resulting from the action of glaciers eating back from the east and the west. Two small glaciers still occupy cirques on the western side, and a steep slope of ice, perhaps no longer in motion, rests against the eastern wall, remnants of the tools which gave the mountain its rugged cliffs.

The largest glacier has about three-quarters of a mile of snowfield above with the usual bergschrund where it lies against the cliffs, and the ice of its lower end is partly covered with stones fallen from the walls of the cirque. Just beyond the dirty ice of its lower margin is a pond of turquoise blue water 1,445 feet above the sea, and this is followed by a second and then a third pond, each with its moraine barrier, the lowest lakelet being nearly a mile below the glacier and 1,200 feet above sea-level.

The northern glacier, in a separate cirque, is smaller, at a higher level, and also has brilliantly coloured ponds beneath it; and the ice-sheet on the east side of the mountain is followed by a lake which was still frozen on August 10, 1915.

The view from the summit of mount Tetragona shows mountains of an alpine type for many miles to the north, probably including the Four Peaks near Ryan bay reported to be 5,000 or 6,000 feet high, though no four distinct peaks could be singled out of the multitude. To the west the mountains become more rolling with few sharp summits, and to the south the blue depression of Nachvak could be seen 30 miles away, with mountains about it apparently as high as any in sight. It was evident that the Torngats do not include distinct ranges of mountains, such as those of the Rockies, but that the peaks and valleys are without any special trend related to the original rock structures, such as the strike of the gneiss. The relief is nearly independent of the schistose structure and has been determined by ice erosion in the accidental shallow valleys of the old peneplain, now elevated to a tableland.

Small snowfields were visible in almost all directions and a cirque glacier could be seen some miles north of Komaktorvik bay. Above the steep north shore of the bay there were three or four short, hanging valleys, each enclosing a lake and sending down a stream which cascaded some hundreds of feet into the bay. Out at sea a broad belt of floe ice extended as far as could be seen in both directions along the coast.

FROM KOMAKTORVIK TO NACHVAK

The coast to the south of Komaktorvik is rugged and more indented than the chart suggests. Shortly after leaving the south head three promontories are passed, with five small islands, the three outermost being low and hardly more than dry reefs. A landing was made on the fourth promontory a few miles north of the White Handkerchief, where a little bay gives precarious shelter for a skiff in winds from other quarters than southeast. The rocks are grey, quartzose gneiss, and nearby a small valley is floored with boulder clay rising about 15 feet above sea-level. The till is quite characteristic but very hard and stony, so that it was probably formed in one of the early glacial stages. The White Handkerchief, one of the landmarks of the northern coast, is much paler in colour than the brown enclosing rocks, which were too far off to be examined. The most striking promontory along this part of the coast is mount Razorback, a few miles south of the White Handkerchief, rising 3,000 feet or more as a jagged ridge. It has been shaped, like Tetragona, by neighbouring glaciers eating back cirque valleys until only a narrow ridge separates them; and a valley on the north side still retains a small glacier with its snowfield, crevassed tongue of ice, and moraines, one of the few glaciers visible from the sea. It is rather surprising that this glacier has not been mentioned by earlier travellers, but it may have been regarded as merely a snowfield, since many snowfields of various sizes may be seen along the coast.

Beyond Razorback the shore trends south-southwest toward Nachvak fiord, presenting cliffs rising to 2,000 feet, and crested, as seen from beneath, with sharp pinnacles and chimneys due to the unequal resistance of the nearly vertical gneiss. Brooks plunge over the edge to be lost as spray on the way down, and larger creeks flow from the two or three U-shaped valleys which break the wall of cliffs, one of them with a fine fall at the edge of the sea. Reefs off-shore and jagged stacks and sea caves show that wave action is undercutting the gneisses, and eating back the coast, thus keeping the cliffs almost vertical.

NACHVAK REGION

Nachvak is probably the finest fiord on the Atlantic coast of America and is already famous from the accounts of Grenfell, Bell, and Daly. The last named writer visited it with Prof. Delabarre's party on the schooner Brave in 1899 and during a stay of ten days ran a chain of soundings to its western end finding that it has the typical fiord relations with shoal water at the mouth and deeper water inland, the greatest depth, 110 fathoms, being 7 miles from the mouth.[1]

The course of the fiord is as follows: 13 miles west-southwest; 11 miles west; 6 or 7 miles, gently curving from west to southwest, with an upper con-

[1] Bull. Mus. Comp. Zool., Harvard, vol. XXXVIII, Geol. Ser., vol. V, No. 5, 226-234.

tinuation, 12 miles long, occupied in part by a lake, trending southwest. Twenty miles from the mouth the fiord forks, sending off a branch, the Tallek, to the south; other similar trough-like branches go off to the south elsewhere along its course. The main fiord and its branches are bordered by high, steep walls. It is probable that before the filling-in process began at the close of the ice age the whole length of the fiord and valley was occupied by the sea.

As a part of the north shore near the old Hudson's Bay post had been worked over by previous visitors, particularly Daly, most of the writer's work was confined to the south side and to the east and west of the earlier mapping on the north side. For purposes of description the part north of Schooner cove (Skynner's cove on earlier maps) will be taken up first, then successive valleys of the south shore from east to west, ending with the lake and valleys to the west of the fiord

VICINITY OF SCHOONER COVE

The small bay in which the fishing schooners anchor (Plate VII B) is about 4 miles from the entrance, and where a short valley and creek come down to the shore. It affords only moderately good shelter, since heavy seas reach the cove during strong easterly gales, and violent gusts come over the mountains and down the valleys in certain other winds. There were five schooners in the cove in 1915, and seven or eight in 1916, and in both years the results of fishing were good.

The valley is floored with moraine material with two distinct marine terraces at 60 and 90 feet, and the cliffs on either side display steeply tilted igneous gneiss, mostly dark grey but partly red, with some bands of amphibolite. A fairly easy climb of 1,400 feet reaches the limits of apparent glacial action on the eastern side. A couple of miles farther over stony slopes is the summit 2,750 feet, facing the sea with a bold cliff to the east, and with a deep valley to the north, beyond which a higher mountain rises.

Two and a half miles above the mouth of the brook which enters Schooner cove is a chain of three small lakes on a col less than 1,000 feet above the sea, and to the east the stony surface sinks to a barren valley opening seawards. To the northwest, after a short climb up the steep rim of the col, a moderate slope leads to the top of mount Gerfalcon, a dome 4 miles from the fiord, reaching a height of 3,570 feet. This dome is a typical example of the ancient unglaciated tableland of gneiss and is covered with angular blocks of all sizes up to 10 or 12 feet in diameter lying practically in their original position, as is evident from the blocks of diabase still resting on a dyke of that rock. These blocks are superficially weathered to brownish tones but have not been rounded at all. In two places there are snowfields, but there is no evidence that snow accumulated sufficiently to form glaciers even during the ice age. On the east side of the dome, however, a cirque encroaches on its regularity, and undoubtedly a small glacier worked when the snowfall was greater; though there is no appearance of motion in the permanent snow and ice which occupy the bottom of the cirque at present. The top of mount Gerfalcon, named by the writer, from a schooner which frequents the cove, gives a wide and splendid view, including Razorback to the northeast, mount Faunce to the northwest, and the fine cliffs and snowy mountains at the west end of the fiord and to the south of it.

In addition to the grey and pink gneiss and hornblende schist observed near Schooner cove there must somewhere be an area of quartzite and schist conglomerate resembling the Timiskaming series of Ontario, since blocks of these rocks are frequently found on the col to the north and near the cove itself.

FIRST COVE ON THE SOUTH SIDE

Naksaluk

The cliff on the south side at the entrance to the fiord has a stratified look with beds of brown, grey, and reddish colour, some bands being pulled out into lenses, the whole having a dip of about 40 degrees to the west, though the gneiss beneath seems to have a steeper tilt, suggesting an unconformity; but unfortunately landing is scarcely possible at the foot of the cliff and the relations were not examined closely.

A flat valley floored with moraine material and some boulder clay cuts through the mountains for 4 miles southwest of the cove, reaching the end of a long lake from which a brook flows southeast to North harbour, thus isolating the group of mountains forming Gulch cape. Such "through" valleys are common in the region and represent perhaps the work of "through glaciers" in the ice age.

The lower slopes on each side of the valley are of the usual grey and pink granitoid gneiss with green schists occasionally, but the tops of the comparatively low mountains on both sides are of the Ramah series, which dips to the south and reaches the level of the valley about 2 miles from the cove. Slate and quartzite fragments from the cliffs are scattered over the floor of the valley.

The surface of the ancient land beneath the sediments is not often well exposed but it seems to have been shattered and weathered and to have been somewhat hilly before being buried. As the Ramah beds dip from 15 degrees to 25 degrees and have gentle undulations the older gneisses must have undergone some deformation since their deposition. The thickness of the lower members of the series was roughly determined as follows, reading from below upwards:

	Feet
Slate	?
Quartzite	420
Slate	90
Arkose	45
Arkose and quartzite	290
Greenstone	240
Quartzite	200
Total	1.285

Igneous gneiss.

MOUNTAIN BETWEEN FIRST AND SECOND COVES

Since the section was incomplete as measured on the west side of the valley running southwest toward the lake, another attempt was made to estimate the thickness of the Ramah beds from a point on the shore between First and Second coves. About midway between them the basement rocks, consisting mainly of vertical green schist and gneiss, are immediately overlain by purplish sandstone or arkose containing angular quartz pebbles. There is no basal conglomerate, the ancient surface is even and somewhat weathered, and the sedimentary rock dips about 10 degrees to the southeast.

In order to measure up the Ramah formation a mountain was climbed farther west near a small waterfall about a mile from Second cove, where the sedimentary rocks sink to sea-level. Above the cliffs near the shore the bedrock is more or less covered with loose blocks so that sharp divisions between the different members of the series were not distinguishable, and allowance had to be made for dips varying between 45 degrees and 20 degrees to the southwest, the average dip being assumed to be 30 degrees. The levels were determined by aneroid, and the results obtained must be considered only approximate; no attempt was made to separate small subdivisions. The results are as follows, the total height of the mountain being 2,600 feet:

	Feet
Slate	44
Grey quartzite	126
White quartzite	406
Slate	306
Carbonate	87
Quartzite	510
Slate	490
Quartzite	324
	2,293

A mile to the southwest, after a depression of 200 or 300 feet, a higher summit rises, probably indicating a greater thickness than the section just given.

Boulders of granite or gneiss were not found above 2,100 feet, which is probably the height reached by the glacier of the Nachvak valley in the ice age.

SECOND COVE

Tinutyarvik

Second cove gives entrance to a wide and flat valley walled on each side by cliffs and extending southeast to a comparatively low pass towards Nullataktok bay. On the east side the Ramah quartzites reach to sea-level and pass beneath it; and on the west the mountain consists of grey gneiss which has not been closely studied. The floor of the valley is formed of the usual morainic material with the terraces of old sea-levels at several points, and 2 miles to the south a narrow trough opens eastward filled by the lake which extends eastward to the valley leading from First cove. Near the lake on the north side, granitoid gneiss, with some rusty bands, rises about 400 feet and is then capped by the Ramah sediments. In the middle of the valley opposite the end of the lake, however, there is a low mound of quartzite; the mountain south of the end of the lake consists for perhaps 1,000 feet up of a dark grey rock taken for diorite in the field, but turning out to be norite. The top of the mountain above this shows the stratification of the Ramah series. The quartzite knoll between the two mountains may have been faulted down to its present position.

From a camp on Second cove in 1915 an expedition was made 6 miles south to the top of the nearest high mountain named mount Cladonia from the reindeer moss growing on its lower flanks. After a rather steep climb out of the valley the customary surface of loose stones formed by weathering and frost action from the gneiss beneath is reached, and following an irregular ridge with two depressions and a final stiff ascent, the summit is attained at 5,100 feet. The top is a ridge with vertical walls toward the valley on the east and a steep descent on the west, and looks down upon a lake on each side, the one to the east frozen on August 17, and upon three glaciers in cirques on the flanks of a higher mountain to the south. This peak projects into the heart of the wildest mountain cluster within reach of Nachvak and exemplifies the dissecting power of valley and cirque glaciers in an admirable way.

In the descent a water course was followed down a series of steps, each occupied by a small lake, until the main stream draining the glaciers was reached. This is cutting a canyon in a hanging valley, and in the last 1,000 feet of descent is bridged with snow.

THIRD COVE

Ivitak

Third cove is barred with ice-borne boulders like the two former ones, and behind the barrier a river is actively filling the shallow water with mud and sand, thus extending the valley floor northwards. The valley has the usual U cross-section with the floor flattened by morainic and river-laid deposits, and areas of great angular blocks lie near the foot of the steeper cliffs. Raised beaches occur to the east and west, the sides of the valley consist of gneiss, and the mountains above are not capped with the Ramah formation. The gneisses observed are mostly of the grey igneous type, though some pink gneiss and also bands of sedimentary garnetiferous gneiss occur.

The valley runs southeasterly with only a gentle rise in the first 5 miles, but a more rapid ascent over great moraines and rocky slopes for the next 4 miles, until at 9½ miles from the cove the divide is reached 2,590 feet above the sea. From the summit of the pass there is a somewhat steep descent to the river valley running towards Nullataktok bay. Moraines and striated and rounded gneiss surfaces occur at about 2,000 feet, the last certain evidence of ice action being at 2,200. It is probable that a névé mass occupied the pass and sent down a glacier in each direction during the ice age. Boulder clay of a normal type is shown in river cuttings about 2 miles from the fiord.

The third valley shows more luxuriant vegetation than the second, which is distinctly in advance of the first, owing to the more sheltered situation of the valleys inland from the icy sea. In the third valley willows and alders grow to be good-sized bushes along the sides, and the floor is well clothed with turf.

Six or seven miles from the cove two large tributaries come in, one from each side, carrying the drainage of hanging valleys containing glaciers and lakes. The stream from the east begins in a deep and wild valley between mountains rising to 5,000 feet or more and is one of the most impressive of the deeply gnawed fastnesses of the ancient glaciers.

North of the boulder barrier of Third cove there is anchorage for schooners and a landing for boats on a strip of beach beneath cliffs of grey gneiss; and on the tableland to the west are four small lakes, the largest about a mile long and 860 feet above the sea. The short grass and reindeer lichen near the lakes make grazing ground for caribou; and farther west a mountain rises to more than 3,000 feet.

A sand terrace 80 feet high, in a well-sheltered little bay to the northwest, is the winter home of the Nachvak Eskimos, who have dug out of the sloping bank eight half-subterranean houses, of which only two are now in use. The houses are entered by a trench, no doubt covered in winter, and each has a sort of dormer window raised above the sods with which the house is built and glazed with seal intestine instead of glass. There are evil smelling caches of seal blubber nearby, bones of whales, walrus, and seals are scattered round, and large soapstone lamps, for burning blubber, lie on the floor inside the houses beside a rusty stove and some pans and kettles, the old and new methods mingling.

The low, rocky promontory on the west of the bay consists mostly of green schist with garnets, suggesting some types of Keewatin, and the sand beach is largely garnet.

SOUTH ARM

Tallek

Beyond the sheltered bay with the Eskimo village, steep cliffs begin to rise toward the west until after 5 miles of coasting the grand entrance to the Tallek is reached, the eastern head rising almost vertically to 3,400 feet and the western one to 3,300, according to the determinations of the Admiralty surveyors many years ago. The South Arm is about a mile wide and 6½ miles long, with an unbroken wall of cliff and mountain on the east side, but with a fairly wide valley south of the first mountain on the west.

A considerable river comes in through numerous interlaced channels at the head of the bay and spreads out over muddy tidal flats. Its valley continues the direction and the mountain walls of the Tallek 4 miles farther before turning off to the southwest. There are no lakes in the valley, showing that the present surface is not that left by the ice but has been filled in with river deposits. The rocks observed along the valley are gneisses of the common Grenville type.

Half-way up the Tallek on the west side a mountain torrent has built a delta of gravel and cobbles, and its gorge rises rapidly between fine mountains on the southwest. The rocks are sedimentary gneisses, often rusty and usually garnetiferous.

A mile to the north a rather low valley strikes across to the other arm of Nachvak isolating the fine peak which forms the western head of the Tallek.

SOUTHWESTERN ARM OF NACHVAK FIORD

Tessyuyak

The promontory where the fiord turns southwest (Plate VIII A) consists partly of gneiss enclosing garnets, sometimes 2 or 3 inches across, and partly of hornblende-hypersthene schist with some quartzose bands. The latter rock seems more resistant than the ordinary gneisses and projects as a heavily glaciated point on each side of the fiord, forming a narrows. A long shoal, bare at low water, stretches northwards half-way across the fiord, here about a mile wide, but Daly's sounding shows 15 fathoms beyond it at this point, so that there is plenty of water for navigation between the shoal and the north shore.

Beyond the frowning cliffs of the promontory, 2,500 or 3,000 feet high in places, the low valley mentioned before crosses to the South Arm, after which cliffs rise to still greater heights as the end of the fiord is reached, finally attaining about 4,000 feet on the north side of mount Silene.

The cliffs are unscalable at the end of the fiord, and mount Silene, so named for the pretty mosslike plant with pink flowers (*Silene acaulis*) which grows on its flanks, was climbed from the valley to the east. The ascent is over steep slopes of loose stones with a few cliffs of gneiss until, at 4,000 feet, a more gently inclined surface is reached, which rises southwestward to 5,000 feet, the last mile being over snow with a slope of 25 degrees or 30 degrees. The summit overlooks deep, glaciated troughs draining northeast into the Tallek and northwest into the river entering the west end of the fiord.

From the summit higher peaks and domes can be seen to the south and west, but probably none rising 1,000 feet higher than mount Silene. From the north side of the rolling mountain top, at 4,250 feet, the fiord can be seen running eastwards to its mouth, and a narrow and deep valley is disclosed continuing the direction of the fiord inland. After a mile of loose stones the valley is completely occupied by a long lake. The rocks observed on mount Silene are sedimentary gneisses, often garnetiferous and sometimes containing graphite.

On the northwest side of the fiord, near its end the cliffs are not as lofty but are still imposing and richly coloured from the weathering of the pyritous gneiss of which they are composed. This part of the region was studied mainly from the first valley on the north side, about 6 miles from the end of the fiord, where a brook enters and gives a chance for climbing. Here graphitic and often pyrite-bearing gneisses make up a large part of the rocks, and a curious crush breccia of small gneiss fragments cemented by a black material like chert is found as loose blocks. In one such band of faulting and crushing small amounts of solid graphite and a good deal of black powdery material were observed.

From the cone of great rock masses brought down by the brook a narrow valley to the west reaches a pass at 1,700 feet leading over to another deep hollow between mountains, occupied by Chasm lake, one of the most impressive and desolate bodies of water in Labrador.

The mountain just southeast of Chasm lake was climbed: it has much the same character as mount Silene, but rises a little higher (5,220 feet) and gives a fine view westwards over mountains growing lower and less alpine towards Ungava bay. The mountain was called Innuit from the name which the Eskimos apply to themselves. No glaciers were seen on either mount Silene or mount Innuit; and it appears that glaciers are confined to cirques within 25 miles of the open sea, probably because there is a greater snowfall near the sea than inland.

NACHVAK OR TESSERSOAK LAKE

Nachvak fiord ends where it does because a mountain torrent coming in from the south has piled a huge fan of loose stones across the valley cutting off its natural continuation and forming Nachvak or Tessersoak lake, 50 feet above the sea and connected with it by a river crowded against the northwest side of the valley. Nachvak lake occupies the whole width of the narrow, steep-walled valley, so that it is impossible to traverse its southeast side and difficult to get along the northwest side, where cones brought in by side streams and talus blocks at the foot of cliffs give a precarious foothold. Packing camp equipment and supplies along this rocky shore, especially when rendered slippery by rain, is a most disagreeable task.

The walls of cliffs are unbroken for the 7½ miles of the lake, and rise on an average 2,000 or 3,000 feet. Small brooks rush down through narrow and steep ravines or pour over the tops of cliffs as white cataracts in view for 1,000 or even 2,000 feet from the opposite side. Five such foamy torrents can be seen at once on the southeast wall of the valley about a third of the way up the lake, which is deep and pure and of a pale turquoise blue colour.

Crystalline limestone occurs for a quarter of a mile along the shore near this view point, but most of the rocks observed are gneiss with graphite, garnets, and pyrite. About 2½ miles from the west end the gneiss strikes north 25 degrees west and has a vertical dip.

The breccia of gneiss fragments cemented by black chert found on the north side of the fiord, as mentioned above, continues along the lake shore for some miles, as shown by numerous talus blocks, and gives evidence of faulting on a considerable scale, but there is nothing to show at what date the faulting and crushing took place.

NACHVAK RIVER

The head of Nachvak lake is much like the head of the fiord except that the river entering it is smaller; and the valley continues for 3 miles farther, growing shallower, however, since the mountains walling it in are lower and less continuous. Then the river forks, the main stream coming from the west for 4½ miles, after which there is a southward bend and the trough ends in a wide, flat depression between low, rounded mountains. Numerous small snowfields are still to be seen, but the alpine character of the mountains is lost and the gentle slopes seem to merge into the usual rolling plain of the Archæan. This broad, upper part of the valley may have been the gathering ground of snow for the great glacier which deepened and widened the trough now occupied by the river, lake, and fiord; and the smoothed surfaces of gneiss near the head of the river indicate ice work at the lower levels, though cliffs rising above it have the customary rugged contours, and the higher mountain slopes are covered with blocks which have apparently never been shifted by ice.

The river is actively cutting down its bed, forming a canyon with two fine waterfalls at its upper end, while lower down, near its bend toward the lake it is excavating a mass of blocky moraine below the cliffs of Citadel mountain, and still nearer the head of the lake it is removing a gravel terrace rising about 200 feet on both sides of the valley, probably a delta which it had built when the land stood lower. With these materials a new delta is being formed in the lake.

On the river flats near the head of Nachvak lake vegetation is often quite luxuriant and includes large bushes of willow and alder and smaller ones of Arctic birch, as well as low berry-bearing plants of various kinds and grasses and sedges; so that it was no surprise to see caribou grazing across the river.

The rocks of the river valley include both sedimentary and igneous gneiss, the latter represented by bands of augen gneiss, some having "eyes" of flesh-coloured feldspar 7 inches long and 4 inches wide. These gneisses are interbedded with darker, more micaceous layers, and represent coarse granites or pegmatites that have undergone shearing strains.

The sedimentary gneisses are of the usual varieties, light and dark, garnetiferous, and sometimes graphitic and rusty. One graphitic band examined near a side cascade proved to be 100 feet wide and had a strike of about north and south with a vertical dip.

The graphitic and pyrite-bearing gneisses, weathering to a rusty surface, are not so widely distributed as the lighter coloured and more garnetiferous varieties, but extend with interruptions from the brook 6 or 7 miles down Nachvak fiord, on the north side, to the outcrops just mentioned, 14 miles inland; and it is probable that they extend still farther westwards, to the mouth of George river 50 miles west on Ungava bay, where Low describes briefly gneisses of a similar type.

NORTH SIDE OF NACHVAK FIORD

The north side of Nachvak fiord between the southwest arm and Schooner cove, had previously been studied by Bell and Daly, and much of it had been mapped by Daly, so that it was not considered necessary to continue the work along that part of the shore.

Opposite the mouth of the southern arm (the Tallek) a comparatively wide and open valley runs northward, and on the eastern side of this low ground the Hudson's Bay Company had a post for a number of years under the charge of

Mr. Ford. This was discontinued eight years ago, and one of the two buildings has fallen, and the other lacks doors and windows. The small Eskimo village across the fiord, mentioned on a former page, was apparently not populous enough to justify a trading post at Nachvak, and the permanent population is now reduced to two or three families who get what supplies they need from the fishing schooners that resort to the bay in summer (Plate VII B).

The gneiss of this part of the north shore as described by Bell and Daly appears to be igneous rather than sedimentary, since no mention is made of the presence of garnets, which are characteristic of the latter. A specimen collected about 3 miles west of Schooner cove is typical grey igneous gneiss consisting of quartz, orthoclase, plagioclase, and biotite. It is coarse-grained and banded with lighter and darker layers. The cliffs of gneiss are often cut in all directions by dykes and sheets of a dark irruptive, probably diabase.

In general the fiord crosses the strike of the gneiss, and its formation seems to have been little influenced by the structure or even the relative hardness of the rocks through which it was carved. There is nothing to show that the narrow, deep trough has been caused by block faulting, as has been suggested for fiords in general, by certain geologists, and it is natural to account for it as a river valley broadened and deepened by glacier action.

SHORE SOUTHEAST OF NACHVAK

Rounding the south head of Nachvak a comparatively straight line of cliffs runs for 11 miles to Gulch cape, broken, however, by three valleys, the first running northwest to the nearest cove of Nachvak, the second crossing a narrow peninsula southwest to North harbour, and the third cutting off the end of the peninsula called Gulch cape. The second and third valleys are low enough to be lost to sight at a distance, leaving the two isolated mountains to stand out like islands, as noted by the fishermen who use them as landmarks. The removal of beach materials from the low marine flats connecting these mountains with the mainland would make them actual islands, and in earlier times, when the sea built the beaches at higher levels than the present, they were undoubtedly surrounded by water.

North harbour is a fiord on a small scale, running 5 miles westward, with its direction continued by a valley partly occupied by a long lake previously mentioned and extending 8 or 9 miles to Second cove of Nachvak. These deep and steeply-walled valleys filled with drift and marine deposits if not under the waters of a lake or fiord are very characteristic of the mountainous shore of northern Labrador.

The rocks seen in the cliffs along shore and rising from the valleys are all igneous gneiss except the tops of the mountains to the south which have the nearly level stratification of the Ramah series.

Passing a sharp cape of granite gneiss Rowsell harbour opens out toward the southwest, the seaward half with shores of gneiss, while the Ramah series caps the highest points and dips 10 degrees or more to the southwest, reaching sea-level 2½ miles from the mouth and forming the shore of the inner harbour. Slate and quartzite make up most of the Ramah series and provide the materials for the beach and also for the boulder clay rising 50 feet not far from the south shore, black and plastic owing to the grinding up of the slate. At the upper end of the harbour on the south side solid beds of iron pyrites form part of the sediments beneath a cherty band and were opened up as a source of sulphur some years ago. They were worked for only a short time.

On the north shore the Ramah rocks lie discordantly on the steeply tilted gneiss, pale quartzite resting upon Precambrian rocks which had been carved to a plain and swept clean before the Ramah sands began to accumulate. Higher up, the quartzites are grey and resemble sandstone in appearance.

NULLATAKTOK OR RAMAH BAY

Five miles of granite-gneiss cliffs (Plate VIII B) separate Rowsell harbour from the next fiord called by the Eskimo Nullataktok, but by the fishermen Ramah bay because of the Moravian mission abandoned eight years ago. The bay is 8 miles long, the outer half running southwest and the inner part west, and a row of small islands rises a short distance from the northwest shore near the entrance, the only islands to be found in the Nachvak region.

The cape on the north side is of greenish gneisses and schists dipping steeply, but the contact with the overlying sediments is hidden by talus from the cliffs above. The Ramah series begins with a bed of very fine-grained silica, sometimes white and sometimes dark grey, suggesting chert or chalcedony, and it breaks with a conchoidal fracture like flint, but in thin sections it proves to be distinctly granular and so must be called quartzite. A sheet of green or brownish basic eruptive 20 or 30 feet thick overlies it, evidently a lava, since amygdaloidal structure can be seen, though its original minerals are so completely changed to carbonates, chlorite, etc., as to make its original composition uncertain. The cliff above shows in upward succession 10 feet of white quartzite, several hundred feet of black slate interbanded with reddish quartzite, another white band, and a great thickness of slate. These rocks dip about 10 degrees southwestward and extend with the same dip more than 3 miles along shore in that direction, where slate and quartzite still rise perhaps 1,000 feet, indicating a total thickness of at least 4,000 feet, if we assume that there has been no pronounced faulting within this distance.

A little beyond the westward bend of the fiord the former mission buildings stand on a low, gravelly point, including a church, a mission house, and a few other buildings. The mission was on a much smaller scale than Hebron and others farther south. The houses are now occupied by some families of Eskimos, well dressed and respectable looking and very much more comfortably housed and equipped than those of Nachvak.

Between the mission and the end of the bay black slate forms low cliffs, with layers of sandstone or quartzite some hundreds of feet up on the mountain side, the series showing quite sharp folds (Plate IX A) and more or less faulting. There must have been compression from northeast to southwest or else a basin-like collapse to cause this folding, which is very much more pronounced than the gentle undulations seen at Nachvak, 18 miles to the north.

The slate along the shore has a very perfect cleavage, with a strike of north 35 degrees west and a dip of 80 degrees to the southwest, at right angles to the direction of pressure which caused the folding of the strata above. The crumbling slate gives rise to a peculiar beach of thin plates crackling under foot, and where the river enters from the west the head of the bay is rapidly silting up with these flakes and is so shoal that even small boats can land only at high tide.

Around the end of the bay the mountains are low, and broad valleys open out in several directions, one rising 700 feet toward the north over a surface of nearly vertical slate, and after 2 miles sinking almost to sea-level before turning east toward Rowsell harbour.

QUARTZITE MOUNTAIN

An excursion was made from the end of the bay to a ridge which it is proposed to call Quartzite mountain, the route following the valley previously mentioned to a spur of the mountain 6 miles northwest. Up to 1,500 feet only black slate was observed, but here blocks of quartzite and gneiss were found, and a climb westwards over loose fragments of quartzite followed by a steep slope of the same rock led to the top at 4,080 feet. The last 2,000 feet were over quartzite in place or over fragments which had not rolled far from their source, and the summit is a narrow ridge of angular blocks evidently lying nearly in their original position. The summit ridge runs for at least 2 miles northwestward with little change of elevation.

From the top there are admirable views of Nullataktok bay and Rowsell harbour to the southeast and east and glimpses of Nachvak fiord 10 miles north; to the west a deep valley with a chain of lakes separates the summit from a much higher mountain showing no stratified rock, so that the Ramah series ends with Quartzite mountain.

The descent was made southwestward over a very steep slope of quartzite blocks, but boulders of garnetiferous gneiss and granite were found at 2,500 feet, though the base of the sediments was not reached until 1,800 feet where gneiss was found in place beneath a band of quartzite interbedded with impure carbonate weathering brown, like basal beds on the south side of Nachvak. The quartzite has a dip of 40 degrees to the east, and from below it can be seen that a thick bed of slate separates the lower quartzite from upper beds forming the crest of the mountain, the whole thickness of strata being not less than 2,200 feet.

The highest lake in the long valley is at 1,650 feet and the lowest at about 1,200, with three or four ponds strung out between, and they have shores of solid gneiss or of blocks rolled from above with moraines damming their outlets in succession. The lowest lake drains south falling hundreds of feet over a fine set of cascades into Nullataktok river.

After leaving the quartzite the only rock observed was gneiss containing garnets, and the width of the Ramah series at this point is estimated at 7½ miles.

CIRQUE MOUNTAIN

To reach Cirque mountain the main valley of Nullataktok river may be followed westwards, keeping above the swampy land with lakelets beside the river so as to have good walking on terraces of boulder clay and sand on the north side. Where the main river turns southwest gneiss begins to crop out and a large creek comes in from the north as waterfalls over cliffs of this rock. Near the foot of the steep slope the creek forks, the western branch leading northwestwards giving the best route to Cirque mountain.

The valley is walled with precipitous cliffs and ascends in great steps, each containing a lake, the largest, at 2,650 feet, being enclosed cirquelike on three sides, though a waterfall comes in from the north draining two ponds which can be seen from the edge of the mountain above. The valley of the largest lake is encumbered with huge fallen blocks, and the best route of ascent turns west from its outlet up a narrow, steep ravine to the lowest dip of the mountain edge, at about 4,000 feet. From this point easy grades over a surface of loose stones or snowfields lead northwest for about 2½ miles to the summit, where the mountain suddenly breaks off in tremendous cliffs above a small glacier in a cirque. Two other cirques with glaciers occur to the northeast and cirques open out on other sides of the mountain, suggesting the name Cirque mountain for this mass of high ground cut into on all sides by glacier-carved valleys. The actual summit, on a small snowfield above the western glacier, is about 5,500 feet above the sea and is the highest point yet reached in Labrador, surpassing by several hundred feet the three loftiest mountains ascended from Nachvak fiord.

Evidences of glacial action in the shape of ice-smoothed surfaces and moraines are found near Cirque lake at 2,650 feet, where the steepest part of the ascent begins, the highest level at which there is positive proof of ice work in Labrador. Much above this point, however, there are snowfields, which remained until August 28, after the warmest summer on record, and are undoubtedly permanent. Part of these fields consists of hard grains of ice half an inch in diameter, like small glacier grains, but no tongue of ice extends below and there is no sign of motion, so that they cannot be called glaciers.

In places on Cirque mountain one finds the polygonal shapes due to solifluxion but generally the rolling surface consists of loose fragments of gneiss which have scarcely moved from their original position. Unfractured rock is found only on steep ascents, especially near waterfalls over the rim of cirques, and is mainly sedimentary gneiss; though a considerable outcrop of pale green pyroxenite occurs at the ascent from the largest lake.

FROM NULLATAKTOK TO BEAR GUT

The south side of Nullataktok bay was not visited owing to the lateness of the season, but the shore and the low mountains to the south evidently consist of Ramah sediments except at the peninsula separating the main bay from Schooner harbour, where the rocks are granite gneiss. Southwest of Schooner harbour, at a few miles distance, the flat stratification of the Ramah beds may be seen again; to the southeast the mass of mount Blow-me-down rises to 3,000 feet, as given on the chart, and what appear to be two small glaciers lie in cirques on its flanks.

Passing mount Blow-me-down, Bear Gut harbour opens between bold peaks, the anchorage being on the north side, sheltered from easterly winds by a low point of garnetiferous gneiss having a strike of north 25 degrees west and vertical dip. It was observed that this gneiss encloses blocks of an earlier gneiss, sometimes sharp-cornered but usually rounded or elongated, indicating shearing motion. These rocks are crossed by dykes of pegmatite and later dykes of black diabase.

Northeast of the harbour a cirque valley is crossed near its lower end by a moraine which holds up a small lake 240 feet above the sea, and lateral moraines lie along the sides of the valley and a marine terrace reaches 184 feet. To the northeast the cirque wall sinks to a col at 1,900 feet, with higher summits reaching 2,300 feet or more on each side, and to the north can be seen the rugged mass of Blow-me-down.

The rocks north of the harbour are mostly grey quartzose gneiss, having a strike of north 15 degrees west and vertical dip, probably igneous, but among the blocks of the moraine there are some of garnetiferous gneiss and also of diorite and diabase. One boulder of quartzite was found, probably coming from the Ramah series, which can be seen on the flat top of a mountain up the fiord; and on the east wall of the cirque is a belt of very basic rock mostly turned to serpentine and talc.

It is stated by Delabarre that the Ramah formation begins 7 miles north of Saglek bay,[1] which would extend the series of sediments to a point 2 or 3 miles south of the inner end of Bear Gut fiord.

The writer's work has shown that the Ramah series reaches the south shore of Nachvak fiord, so that the whole length of the formation is 34 or 35 miles, 4 or 5 miles more than the estimate of Delabarre. As the width averages 6 or 7 miles where the formation has been crossed, the area covered by these rocks is probably 200 square miles. The general arrangement is that of a long synclinal trough with edges dipping from 15 degrees to 40 degrees inwards, and with the central part slightly compressed and folded.

SAGLEK BAY

From Bear gut there are 10 miles of stormy coast with a series of fine peaks and cliffs before the shelter of Tomchuk tickler is reached, between a long island of the same name and the highland to the north of Saglek bay. The chart indicates only a small island in this position; but the island called Tomchuk by the fishermen runs for 2 or 3 miles parallel to the north coast of the bay and allows a passage into it by a narrow channel with numerous shoals at its southwest end.

Saglek is not a typical fiord, being six or seven times as wide as most of them and containing numerous large and small islands, unlike Nachvak fiord which is without an island. The chart represents Saglek bay as ending westwards in three narrow bays or fiords and as having a total length of 40 miles, which would make it the longest as well as the widest inlet in northern Labrador; but these measurements should be accepted with caution, since Nachvak also is shown as 40 miles long, 10 miles more than its real length.

The north shore of Saglek is mountainous, a continuation of the Torngats, though less rugged than the surroundings of Bear gut and Nachvak, and quite high mountains rise westwards; the south side has lower and less striking forms including "the domes," which are 2,000 feet high according to the chart.

On the north shore the rocks observed are granite gneiss cut by pegmatite, and Tomchuk island has the same rocks with some broad dykes of diabase. The more rapid weathering of one such dyke near sea-level gives an insecure boat harbours, the largest island, at the east of the group, presents three high hills pavement in places. Six or 7 miles south of the southwestern end of Tomchuk island there is an important group of islands, two large and several smaller ones, enclosing ticklers used as schooner anchorages. Some of these channels are too shoal even for small boats at low water, but schooners are sheltered between a small island and the two larger ones, one tickler being to the south and the other to the northeast.

Passing out of Saglek bay on the south side, 4 or 5 miles from the schooner harbours, the largest island, at the east of the group, presents three high hills sharply cut off on the seaward side, apparently by wave work. Just before turning the cape Blue Bell island rises 200 or 300 feet, with steep slopes on all sides, and cape Uivuk itself stands up almost shear as a cliff of 1,000 feet.

The rocks seen at Saglek are all granite gneisses cut by numerous dykes.

[1] Bull. Geog. Soc. Phila., vol. III, No. 4, p. 107.

HEBRON

For 80 miles south of Komaktorvik bay, to a point half-way between Saglek and Hebron (Plate IX B), the coast is devoid of islands and is exposed to all the easterly storms; whereas the rest of the Labrador coast, except the most prominent capes, is well sprinkled with islets and islands, and along much of it there are sheltered channels, the "runs" or "tracks" much used by schooners in their migrations north and south (Plate X). Many of the islands provide serviceable harbours, such as Kikkertaksoak, or Maidment island 10 miles offshore on the way to Hebron. This small island of grey gneiss with the usual strike of north 25 degrees west and the usual dykes of pegmatite and diabase shows no distinct signs of glaciation but has well-formed terraces up to 200 feet. Above this there are loose blocks of the underlying rock, which is greatly weathered and falling into slabs and angular pieces, ultimately crumbling into fragments of quartz and feldspar.

If ever covered by ice it must have been early in the Pleistocene. Below the highest beach there is a large boulder of reddish gneiss, which may have been ice-rafted when the sea stood higher.

Near the mouth of Iterungnek bay a group of islands close to shore has been glaciated, since the largest one, rising 440 feet, has moutonnées forms to the top with many glacially transported boulders. The latest ice-sheet seems to have reached these islands, but failed to reach Maidment island a few miles farther out.

Past three stormy capes in close succession, and in the shelter of a long, low island is the harbour of Hebron (Plate IX B), the most northerly Moravian mission on the Atlantic coast since the abandonment of Ramah. The village is built mainly on bare gneiss, though boulder clay and a low terrace of sandy soil give an opportunity for a little gardening and a graveyard. The spot was a favourite one with the Eskimos before the mission was founded in 1829, as shown by numerous heathen graves close by, oblong structures of gneiss blocks through whose interstices whitened bones can be seen.

The rocks at the village are grey igneous gneiss streaked with green schist, with the customary strike of north 25 degrees west, but a wide belt of rusty weathering rock on the hill rising 500 feet in the rear of the mission may be sedimentary, and the finding of a block of crystalline limestone suggests that rocks of the Grenville type may occur inland toward the west.

On the shore of the harbour, horizontal partings in the gneiss at intervals of 2 or 3 feet, give a striking banded appearance to the rock and facilitate the attacks of waves. These partings have nothing to do with the original rock structures, but cut sharply across the schistosity.

On the low ground near the mission the rock is well smoothed and striated, but all the projecting higher ridges and hills are much decayed, the surfaces crumbling into coarse sand or gravel consisting of fragments of quartz and feldspar. Probably the lower surfaces have been protected by boulder clay until recently, thus preserving their fresh appearance. The top of Johannesberg a mile or two north, which reaches 2,200 feet, seems never to have been glaciated and must have risen as a low nunatak above the ice-sheet.

The hills around Hebron, reaching lower levels than Johannesberg, have rounded surfaces and many small rock basins such as would be carved by an ice-sheet, but its thickness could not have been more than 2,000 feet at this point and the ice invasion must have been one of the more ancient advances from the Labrador centre. A characteristic cirque basin occupied by a lake a little above sea-level may be seen just south of Johannesberg, formed apparently by a local glacier after the continental ice-sheet had disappeared.

Two miles northeast of Hebron a boulder terrace 80 feet above the sea connects what was once a hilly island with the mainland, and beyond this a narrow bay opening northwards, called Jerusalem, is used as a harbour by fishing schooners. Several less conspicuous terraces rise to elevations up to 260 feet as mentioned by Daly.

MUGFORD REGION

Beyond the island which protects the harbour of Hebron, can be seen 17 miles to the east, the small dome of Watchman island, the most exposed along the coast, and to the southeast at a somewhat greater distance the imposing forms of the Kaumajet mountains at cape Mugford, where the Mugford sediments and volcanics rise as great cliffs above their base of granitoid gneiss. The most northern exposure is on Finger island, so called from the slender pinnacles of eruptive rock beside the cliffs on the south side. The beds reach 2,500 feet, rising from a basis of granite gneiss several hundred feet high to the east, and dip at an angle of 10 degrees or 12 degrees westward. A narrow tickler separates Finger island from a peninsula projecting northeast from the mainland and rising to 3,000 feet in the Bishops Mitre and perhaps to 4,000 feet on Brave mountain a few miles west. Southeast of the peninsula and beyond Mugford tickler the series forms Ogualik island 10 or 12 miles long.

This strip of sedimentary and volcanic rocks, with a length of about 25 miles and a breadth of about 6, is limited on all sides by cliffs, sometimes of more than 2,000 feet, and Mugford tickler is one of the grandest bits of coast scenery in the world.

Stormy weather prevented an intended study of the Mugford series in 1916 and the writer's only chance of landing there was during two days of detention by ice in July, 1915. Southeast of Mugford tickler at the mission sealing-house boulders of tuff and of coarse agglomerate, consisting of bombs sometimes 2 feet in diameter, roll down from the cliffs into a ravine, covering the sedimentary rocks; but an ascent of Mugford cape across the tickler disclosed thick beds of chert and slate, the latter rock forming the top of the cliff 2,300 feet above the sea. It is there weathering in place and gives no evidence of having been overridden by ice, though a few granite and gneiss boulders not far below show that the glacier which once occupied the hollow of the tickler must have reached 2,000 feet.

Daly's visit to Mugford in 1899 gave an opportunity for more complete study of the series with results of much interest, and the following description is taken from his report: " Next above the light coloured zone of the (Laurentian) schists comes a series of black slates 50 to 100 feet thick, indurated at the contact by a conformable 300-foot sheet of apparently intrusive diabase. The edge of this sheet forms one of the lowest strong cliffs above the basement. The diabase in its turn is overlain by a great thickness of slates, quartzites, sandstones, quartz breccias, volcanic agglomerates, and trap layers...............These sediments and intercalated traps everywhere have low dips (forming a flat syncline).[1]

The mainland southwest of the Mugford formation is much lower than the mountain group just described, and the rocks at the Moravian mission of Okak, 15 miles in that direction, and of the hill rising 950 feet behind it are of the usual granitoid gneiss.

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[1] Bull. Mus. Comp. Zool., Harvard, vol. XXXVIII, Geol. Ser., vol. V, No. 5, pp. 219-223.

PAUL ISLAND ANORTHOSITE AREA

Southeast of Okak numerous channels and harbours in the Cutthroat region are greatly frequented by schooners in the fishing season. All the islands consist of granite gneiss so far as observed. Beyond the Cutthroat archipelago is the bold headland of the Kiglapait mountains, reaching heights of more than 2,000 feet, after which another maze of islands and ticklers begins at Port Manvers and continues to Ford harbour on Paul island. Most of the islands belonging to the latter group and parts of the mainland consist of bluish-grey anorthosite and have a quite different appearance from the Laurentian landscapes previously seen, since schistose structures and pale colours ranging into flesh red are no longer found.

South of Port Manvers anorthosite forms sombre hills rising to 2,733 feet at mount Thoresby on Aulatsivik island. Near Green cove on this island coarse-grained and finer-grained phases of the rock sometimes show gleams of the precious labradorite, but are more often dull, consisting mainly of plagioclase feldspar with a darker mineral between the crystals, one of the rhombic pyroxenes. The anorthosite shows the same tendency to horizontal banking as is found at various places in the gneisses, proving that some general cause, perhaps connected with climate, gives rise to this structure. Dykes of coarse granite or pegmatite cut the rock at various places, suggesting that the anorthosite may be as old as the granite gneisses, corresponding in age with the anorthosites associated with gneisses in Ontario and Quebec.

Several well-formed boulder terraces are displayed at Green cove, the highest reaching 430 feet above sea-level, the greatest elevation at which marine beaches have been observed on the Atlantic side of Labrador. Hills rising to 1,300 feet have well-rounded forms and are strewn with erratics, mostly of gneiss, either igneous or the garnetiferous sedimentaries, some reaching 10 feet in diameter. These must have been brought by an ice-sheet from the west, proving that Grenville-like rocks exist on this part of the mainland.

Anorthosite is the country rock also at Nain, the headquarters of the Moravian missions in Labrador, and is found on the hills, though the lower ground near the mission is mostly covered with sandy till and marine deposits, the latter in one place charged with shells of *Mya truncata*.

Paul island, just east of Nain, rises as dark cliffs of anorthosite on the way to Ford harbour, but its eastern end is granite gneiss of the usual type. Old beaches are well marked up to 243 feet and the little settlement is on such a deposit connecting what was once a separate island with rocky hills to the west. The best gem labradorite is stated by Daly to come from a quarry on Napoktulagatsuk island between Paul island and the main land, and the anorthosite there is cut by dykes of aplite and pegmatite.[1]

HOPEDALE

From Ford harbour southeast to Hopedale the coast is fringed with capes and islands of all sizes with narrow bays and ticklers, the general effect being like that of the Thousand islands in the St. Lawrence, and the rocks observed are granite gneisses. At Hopedale, the seat of a Moravian mission, all the structural features of the gneiss may be studied, including granitoid gneiss enclosing bands of green schist, sheared and folded and faulted, and cut by dykes of pegmatite and later eruptives.

[1] Ibid., p. 217.

Hills of rounded forms rise behind the mission to the north and west, but they are comparatively low and no mountains are in sight. The hill slopes are strikingly terraced, the gneiss rising in horizontal steps from 2 to 6 or 8 feet high with flat surfaces a few feet wide. One valley running up from the shore of the harbour suggests an amphitheatre with twenty or more of these benches, each with its vertical face of rock and flat top more or less covered with a cushion of moss and low berry-bearing plants.

The hills have in general *moutonnées* forms and show striæ coming from the southwest; but, as in other parts of Labrador, their slopes and surfaces are more crumbled into loose fragments and sharp-angled bits of quartz and feldspar than in Ontario, suggesting an older glaciation than the Wisconsin, and boulder clay is much smaller in amount.

The number of small rock basins on and among the hills is striking and the view from Signal hill, 300 feet high, or a hill to the northwest reaching 560 feet, discloses a great number of pools and small lakes as well as innumerable islands and rocks in the sea to the north and south.

The mission is on a low terrace partly of sand and partly swampy, and its slope facing the sea provided a favourable soil in earlier days, for the Eskimos to excavate their winter houses, the ruins of which lie between the mission flower-garden and the shore. These sands contain numerous marine shells, as noted by Packard.[1]

SEDIMENTARY ROCKS ON THE SOUTHERN LABRADOR COAST

Southeast of Hopedale the writer had few opportunities to land, but, so far as could be seen, most of the rocks are granite gneiss. Two localities referred to by Daly and another mentioned by Lieber and Packard are of special interest, however, as suggesting important sedimentary formations later than the Grenville-like garnetiferous gneisses, and an outline of their descriptions will be given.

In Aillik bay Daly found a narrow belt of variegated and banded quartzite "with white, red, and purplish layers often exhibiting the crossbedding of a typical sandstone." From the description these rocks are not unlike some of the quartzites of the Ramah formation, but the thickness found was only 100 feet, and the beds are cut by granite and trap dykes, which suggests that they may be older than the Ramah rocks.

Fifteen miles southeast of Aillik, at Pomiadluk point, he found a much thicker set of sediments consisting of metamorphic conglomerate passing toward the east into metamorphic sandstone, the matrix of both varieties being intense green owing to the presence of epidote. The pebbles and boulders, up to one or more feet in diameter, include "granitite, quartzite, vein quartz, granite porphyry, and metamorphic sandstone," and they are often considerably flattened. The schistose structure strikes north 15 degrees west, and the dip is variable but steep and generally to the westward. The thickness is estimated at 8,000 feet.

This description gives the impression of a much older formation than the Ramah series or the Huronian, and suggests the Doré conglomerate of lake Superior or some parts of the Timiskaming series; particularly when it is added that the sediments are cut by dykes of pegmatite, granite, diorite, and diabase.[2]

Near the mouth of Hamilton inlet, both to the north and the south, Packard maps "Domino gneiss," following the name given by Lieber in 1860[3], which he

[1] "The Labrador coast," p. 206.
[2] Bull. Mus., Comp. Zool., Harvard, Geol. Ser., vol. V, No. 5, pp. 214-15.
[3] U.S. Coast Survey, 1860, pp. 402-3.

describes as light-coloured, slightly schistose, with a base of "white, granular vitreous quartz with speckles of black hornblende, with a few particles of lilac-coloured mica. There are also minute rude crystals of yellow garnet or cinnamon stone." The rock weathers easily and forms a low, flat plain, very different from the granite gneiss of the Labrador coast. Later he refers to the gneiss as quartzite.[1]

This rock is shown on a rough map as extending for 125 miles or more along the coast; and the geological map of Canada published by the Survey in 1913, colours at Keweenawan or Animikie a band in the same position except that the part north of Hamilton inlet is left as Laurentian. The same colour (A_4) is used on the Survey map for the Ramah and Mugford series and is evidently intended to cover all the post-Laurentian sediments of the region.

The writer's acquaintance with the so-called Domino gneiss was confined to Pack harbour, just south of the entrance to Hamilton inlet, where pale grey gneiss with some garnets and a very stratified look was observed and collected on the north side of the tickler, and coarse diabase rises on the south side. Thin sections show the gneiss to be very quartzose with probably a little orthoclase and certainly some plagioclase, as well as specks of brown biotite and brownish-red garnets. It is almost certainly a highly metamorphosed sandstone, but is entirely different from the Ramah and Mugford rocks and also from the Animikie or Keweenawan of lake Superior, since its materials have been completely recrystallized giving a well-defined schistose structure. The writer referred to it as Grenville, it has all the macroscopic and microscopic chartcters of certain undoubted Grenville sediments of other regions; so that it should be put with the garnetiferous gneisses of the Nachvak and Komaktorvik regions of northeastern Labrador.

1 "The Labrador coast," pp. 286-290.

CHAPTER V

ECONOMIC GEOLOGY

Before the arrival of the whites Labrador was in the stone age, and the Eskimos made use of three important mineral products for various purposes, cherty quartzite, like that of Ramah, for arrowheads and scrapers, soapstone for lamps and pots, and pyrite for producing fire. The arrow or spear heads are crudely made as compared with some of the Indian or European flint or chert weapons. The lamps, shallow and half-moon shaped, served for burning blubber or train oil, moss or other porous material being used as a wick; and they are still employed more or less by the Eskimos of the north where wood is not available. One purchased by the writer is 18 inches long and 9¾ inches broad with a depth of 2 inches. The raw material is found at several places among basic eruptives in the granite gneisses, e.g., on Nachvak fiord and near Hebron, but no longer has much importance. With the introduction of matches by the missions and the fishermen the use of pyrite has disappeared. The supply is large in various parts of the garnetiferous gneiss series, especially on Rowsell harbour.

LABRADORITE

The first mineral to attract the attention of the white man in any special way was the plagioclase feldspar which received the name labradorite from the region itself. It is said by Dana to have been obtained first on Paul island about 1770 by a Moravian missionary named Wolfe, and its beautiful play of colour has rendered it an attractive semi-precious stone ever since. Labradorite is the essential mineral of the anorthosite which covers many square miles in the Paul Island-Nain region referred to above, but in many places it has little or none of the schillerization or chatoyancy which makes it valuable. The usual display is of a brilliant blue colour, visible only from certain angles, but much more intense than the shimmer of certain albites (moonstones) which are also favourite half gems. In a few places the stone shows a variety of brilliant colours, including green, yellow, orange, and red, and at the proper angle has a gorgeous effect.

The size of the crystals of labradorite varies greatly and in the coarser-grained masses suggesting pegmatite they may be several inches or a foot or more on cleavage surfaces. In interstices there may be portions of a dark brown rhombic pyroxene with two very perfect cleavages, determined by J. E. Thompson of the Mineralogical Department of the University of Toronto as bronzite.

The gem variety of labradorite was first obtained from Paul island, but according to Daly the best specimens have come from a quarry opened by R. G. Taber on Napotulagatsuk island between Paul island and the mainland. Apparently the quarry was not a commercial success,[1] though this beautiful stone has been widely sold to museums, and fine specimens several inches square may still be obtained from dealers in minerals. If got out unfractured on a large scale, so as to be sawn into slabs, schillerized labradorite should make one of the most beautiful decorative stones imaginable.

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[1] Bull. Mus. Comp. Zool., Harvard, vol. XXXVIII, Geol. Ser., vol. V, No. 5, pp. 216-17.

METALLIC MINERALS

Little prospecting has been done in Labrador and its mineral resources are practically unknown, but a few ores of metals have been reported, such as copper ore (chalcopyrite), specimens of which were brought to Bell from near Hamilton inlet.[1] The mineral is stated to occur near Makovik also, and Daly mentions a test pit sunk for either copper or gold at Mugford, though he apparently did not see any ore himself.[2] The basic eruptive sheets and volcanics of the Mugford series are sufficiently like the Keweenawan of lake Superior to suggest the presence of copper.

According to the Newfoundland and Labrador Pilot, "it is said that iron ore occurs largely in mount Thoresby, as well as the adjacent land."[3] As mount Thoresby is in the anorthosite area it is quite probable that these basic rocks may have segregations of titaniferous magnetite like those associated with the same rock in Quebec. Thus far, however, the Quebec ores have not been smelted except experimentally because of the difficulty of fluxing off the titanium.

Much the commonest metallic mineral in Labrador is pyrite, which is found disseminated in ancient schists and gneisses, especially of the Grenville type, and occurs as a considerable bed near the base of the Ramah series at Rowsell harbour. It is stated by Capt. Alex. Spraklin, who took up the claims, that solid pyrite is found under a bed of quartzite not far above sea-level, sometimes to the thickness of 7 feet, and that the deposit runs 1½ miles. It was opened up and worked for a time by the Dominion Iron and Steel Company in 1906, but no work has been done upon it since that time.

The ore specimens given the writer are of massive, compact marcasite which weathers rather rapidly to a whitish sulphate of iron.

Along with the pyrite, pyrrhotite occurs also, but in other places pyrrhotite associated with schists instead of basic eruptives has been found to contain very little nickel, so that this is probably of no essential value. No chalcopyrite has been found with this pyrrhotite.

Red and yellow ochre occur on Hebron bay, according to Joe Lane of that place, who has used the red ochre, boiled with seal oil, as a paint for his roof. The colour is good and the paint thus prepared appears to stand the weather satisfactorily.

NON-METALLIC MINERALS

Among non-metallic minerals graphite is mentioned by Daly as occurring abundantly in gneiss and schist at the west end of Nachvak and he states "that a rounded piece of pure graphite measuring 4 by 5 inches has been found at the foot of the talus near the great alluvial fan."[4] The writer's work has shown that graphitic gneiss or schist is widely distributed in that region and for 14 or 15 miles to the west. Most of it is in the form of disseminated scales, but pieces of amorphous-looking graphite were found in a zone of crushing near a creek coming in on the north side of the fiord 6 miles east of the end where Daly reports the mineral. Whether graphitic rock of a workable kind occurs has not been determined.

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[1] Geol. Surv., Can., 1882-4, pp. 12-13 DD.
[2] Bull. Mus. Comp. Zool., Harvard, vol. XXXVIII, Geol. Ser., vol. V., No. 5, p. 221.
[3] Newfoundland and Labrador Pilot, 1907, p. 741.
[4] Ibid., p. 234.

The only other non-metallic minerals of an economic kind observed are soapstone, found in a number of places in masses large enough for Eskimo lamps; and mica crystals of some size in pegmatite veins. It is doubtful if either mineral could be worked profitably.

No reference has been made to building stones, though good materials are widely found, since the remoteness of the region from large cities robs them of value.

GENERAL CONCLUSIONS

From the foregoing brief account of the known economic minerals of Labrador it will be inferred that no deposits of great value have yet been found; but, on the other hand, very little search has been made for them and the slight attempts at prospecting have been made only at or near the coast and usually by inexperienced persons.

The interior has not been touched by geologists or prospectors except at a few points along a band indicated on the latest geological map as "Keweenawan, Animikie, etc.," where Low has proved that iron ores exist.[1] The band runs parallel to the coast, as mapped, but is more than 200 miles inland; and north of latitude 55 degrees nothing is known by direct observation of the intervening country. It has been shown in earlier parts of this report that large areas of the Grenville-like rocks extend inland at Komaktorvik and Nachvak bays; that green schists like those of the Keewatin occur, and that probably Keewatin "iron formation" exists somewhere inland; that rocks resembling the Sudbury or Timiskaming series, the Huronian, and the Animikie and Keweenawan cover large areas; and that in many places basic and acid eruptives cut the older formations as dykes or form sheets among the sediments of the later Precambrian series. So far as can be seen the conditions are similar to those which have caused the economic deposits of the Grenville, Timiskaming, Huronian, Animikie, and Keweenawan series of Ontario and Quebec; deposits which have made Ontario one of the great mining regions of the world.

It is evident that the almost unknown interior of Labrador includes not alone barren granite gneisses, as commonly supposed, but probably also equal areas of other Precambrian rocks of much greater economic promise. It is a region that deserves closer study than it has yet received, and its very bareness and lack of vegetation facilitate such an examination as compared with regions largely hidden under drift or covered with forest.

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[1] Geol. Surv., Can., vol. VIII, pt. L, pp. 268-273.

APPENDIX I

PLANTS COLLECTED BY PROFESSOR A. P. COLEMAN ON HIS LABRADOR TRIP DURING THE SUMMER OF 1915, AND [1]IDENTIFIED BY R. B. THOMSON AND NORMA FORD

The Vienna Congress rules have been followed but where a variation from the code of nomenclature recommended by the American Commission of 1907 occurs, the synonyms authorized by the latter have been added.

The species listed which are of general alpine, arctic, and sub-arctic distribution are indicated by the abbreviation "arct.", those reported by Tyrrell from the Barren Lands in 1885 and 1893 by "bar.", and those common to regions farther south by "com." When the species is of littoral distribution only, and not found in the interior, the abbreviation "litt." has been used.

The collection of plants has been presented to the University of Toronto, and is now in the herbarium of the Botany Department.

Family and name	Locality and date	Distribution
OPHIOGLOSSACEAE		
1. *Botrychium Lunaria* (L.) Sw.	Hopedale, Sept.	com.
Moonwort or Moon-fern.		arct.
OPHIOGLOSSACEAE		
2. *Cystopteris fragilis* (L.) Bernh.	Hebron, July 23.	com.
Filix fragilis (L.) Underw.	Nachvak, Aug. 16.	bar.
Brittle Fern.		arct.
3. *Woodsia ilvensis* (L.) R. Br.	Nachvak, Aug. 21.	com.
Rusty Woodsia.		bar.
		arct.
EQUISETACEAE		
4. *Equisetum arvense* L.	Komaktorvik, Aug. 8.	com.
Field Horsetail.		arct.
GRAMINEAE		
5. *Elymus arenarius* L.	Hebron, July 23.	com.
Sandbind Grass.		arct.
6. *Poa alpina* L.	Komaktorvik, Aug. 8.	com.
Alpine Spear-grass.		arct.
7. *Poa cenisia* All.	Hebron, July 23.	arct.
Arctic Spear-grass.		
8. *Hierochloe alpina* (Sw.) R. and S.	Komaktorvik, Aug. 8.	bar.
Savastana alpina (Sw.) Scribn.	Hebron, July 23.	arct.
Alpine Holy Grass.		
CYPERACEAE		
9. *Eriophorum angustifolium* Roth.	Hebron, July 23.	com.
Tall Cotton-grass.		bar.
		arct.
10. *Carex rigida* Good.	Hebron, July 23.	arct.
Approaching var. *Bigelovii* (Torr.) Tuckerm.		
11. *Scirpus caespitosus* L.	Hebron, July 23.	com.
Tufted Club Rush, or Deer Grass.		bar.
		arct.
JUNCACEAE		
12. *Luzula hyperborea* R. Br.	Komaktorvik, Aug. 8.	arct.
Juncoides hyperboreum (R. Br.) Shel.		
Northern Wood Rush.		

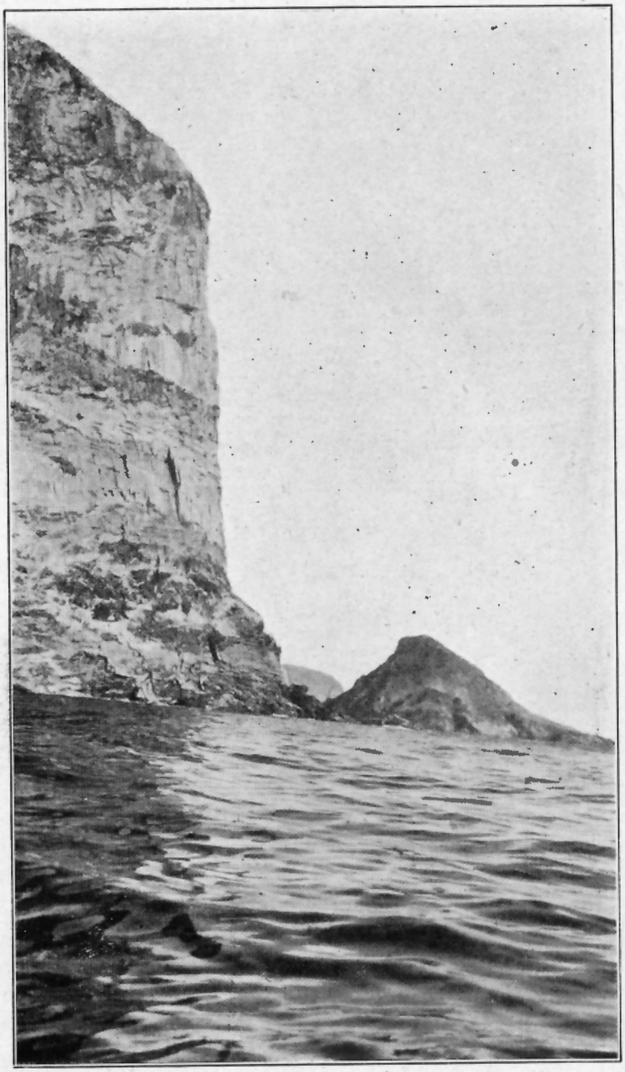
[1] We are indebted to Dr. M. O. Malte, Dominion Agrostologist, for his services in connexion with the identification of grasses and sedges Nos. 6, 7, and 10, also for confirmation of our identification in several other cases.

Family and name	Locality and date	Distribution
SALICACEAE		
13. *Salix reticulata* L.	Komaktorvik, Aug. 8	bar.
Net-veined Willow.		arct.
14. *Salix herbacea* L.	Nachvak, Aug. 19	bar.
Dwarf Willow.		arct.
15. *Salix Uva-ursi* Pursh	Komaktorvik, Aug. 8	arct.
Bearberry Willow.		
16. *Salix Waghornei* Rydberg (?)	Nachvak, Aug. 19	bar.
Waghorne's Willow.	Hebron, July 23.	
POLYGONACEAE		
17. *Polygonum viviparum* L.	Hebron, July 23	bar.
Bistorta vivipara (L.) S. F. Gray		arct.
Alpine Bistort, Serpent Grass.		
18. *Koenigia islandica* L.	Hebron, July 23	arct.
Macounastrum islandicum (L.) Small.		
19. *Oxyria digyna* (L.) Hill	Hebron, July 23	bar.
Mountain Sorrel.	Komaktorvik, Aug. 8	arct.
CAROPHYLLACEAE		
20. *Cerastium alpinum* L.	Komaktorvik, Aug. 8	bar.
Alpine Chickweed.		arct.
21. *Cerastium arvense* L. (?)	Hebron, July 23	com.
Field Chickweed.		arct.
22. *Arenaria peploides* L.	Komaktorvik, Aug. 8	bar.
Honkenya peploides (L.) Ehrh.		arct.
Sea-beach Sandwort.		litt.
23. *Silene acaulis* L.	Hebron, July 23	bar.
Moss Campion.		arct.
24. *Lychnis alpina* L.	Komaktorvik, Aug. 8	arct.
Viscaria alpina (L.) G. Don.	Hebron, July 23.	
Red Alpine Campion.		
24A. A double form of Red Alpine Campion.	Nachvak, Aug. 19.	
RANUNCULACEAE		
25. *Ranunculus pygmaeus* Wahl	Hebron, July 23	arct.
Pigmy Buttercup.		
PAPAVERACEAE		
26. *Papaver radicatum* Rottb	Hebron, July 23	bar.
Papaver nudicaule L.		arct.
Arctic or Iceland Poppy.		
CRUCIFERAE		
27. *Arabis alpina* L.	Hebron, July 23 and Aug. 29	arct.
Alpine Rock-cress.		
28. *Cochlearia officinalis* L.	Hebron, July 23	bar.
Scurvey-grass or Spoonwort.	Komaktorvik, Aug. 8	arct.
		litt.
CRASSULACEAE		
29. *Sedum roseum* (L.) Scop.	Hebron, July 23	com.
Rhodiola rosea L.		arct.
Roseroot or Rosewort.		
SAXIFRAGACEAE		
30. *Saxifraga rivularis* L.	Hebron, July 23	arct.
Alpine Brook Saxifrage.		
ROSACEAE		
31. *Dryas integrifolia* Vahl	Hebron, July 23	bar.
Entire-leaved Mountain Avens.		arct.
32. *Potentilla maculata* Pourret	Komaktorvik, Aug. 8	arct.
Northern Cinquefoil.		
33. *Rubus arcticus* L.	Hebron, July 23	bar.
Arctic Bramble.		arct.
34. *Rubus Chamaemorus* L.	Hebron, July 23	bar.
Cloudberry, Baked-apple Berry.		arct.

Family and name	Locality and date	Distribution
LEGUMINOSAE		
35. *Astragalus alpinus* L.	Nachvak, Aug. 15	bar.
Alpine Milk Vetch.	Hebron, July 23	arct.
36. *Oxytropis campestris* (L.) DC.	Komaktorvik, Aug. 8	bar.
Yellow or Field Oxytrope.	Hebron, July 23	arct.
VIOLACEAE		
37. *Viola labradorica* Schrank	Hebron, July 23	arct.
Alpine Violet.		
ONAGRACEAE		
38. *Epilobium angustifolium* L.	Hebron, Aug. 29	com.
Chamaenerion angustifolium (L.) Scop.		bar.
Great or Spiked Willow-herb, or Fireweed.		arct.
39. *Epilobium latifolium* L.	Nachvak, Aug. 15	com.
Chamaenerion latifolium (L.) Sweet.	Hebron, July 23	bar.
Broad-leaved Willow-herb	Komaktorvik, Aug. 8	arct.
40. *Epilobium anagallidifolium* Lam.	Camp 3, Aug. 12	arct.
Pimpernel Willow-herb.		
ERICACEAE		
41. *Pyrola rotundifolia* L.	Camp 3, Aug. 10-12	bar.
var. *grandiflora* (Rad.) DC.		arct.
Pyrola grandiflora Radius.		
42. *Pyrola* (Two interesting variations of species)	Nachvak, Aug. 15.	
43. *Pyrola* (Two interesting variations of species)	Hebron, July 23.	
44. *Cassiope tetragona* (L.) D. Don.	Hebron, July 23	bar.
Four-angled Cassiope.		arct.
45. *Ledum palustre* L.	Hebron, July 23	bar.
Ledum decumbens (Ait.) Lodd.		arct.
Narrow-leaved Labrador Tea.		
46. *Phyllodoce coerulea* (L.) Babingt.	Camp 3, Aug. 12	bar.
Mountain Heath.		arct.
47. *Rhododendron lapponicum* (L.) Wahl.	Hebron, July 23	bar.
Lapland Rose Bay or Laurel.		arct.
48. *Rhododendron canadense* (L.) BSP.	Hebron, July 23	com.
Rhodora canadensis L.		
Rhodora or Lamb-kill.		
49. *Vaccinium Vitis-Idaea* L.	Hebron, July 23	arct.
Vitis-Idaea Vitis-Idaea (L.) Britton.	Komaktorvik, Aug. 8.	
Mountain Cranberry.		
50. *Vaccinium uliginosum* L.	Camp 3, Aug. 10-12	bar.
Great or Bog Bilberry.		arct.
PLUMBAGINACEAE		
51. *Statice Armeria* L.	Hebron, July 23	bar.
Thrift or Sea Pink	Komaktorvik, Aug. 8	arct.
		litt.
BORAGINACEAE		
52. *Mertensia maritima* (L.) S. F. Gray.	Komaktorvik, Aug. 8	arct.
Pneumaria maritima (L.) Hill.		litt.
Sea Lungwort, Oyster Plant.		
SCROPHULARIACEAE		
53. *Bartsia alpina* L.	Hebron, July 23	bar.
Alpine Bartsia.		arct.
54. *Castilleja acuminata* (Pursh) Spreng.	Nachvak, Aug. 21	com.
Lance-leaved Painted-cup.		bar.
		arct.
55. *Euphrasia arctica* Lange	Nachvak, Aug. 15	com.
Glandular Eyebright.		arct.
56. *Pedicularis euphrasioides* Steph.	Hebron, July 23	bar.
Eyebright Pedicularis.	Komaktorvik, Aug. 8	arct.

Family and name	Locality and date	Distribution
SCROPHULARIACEAE—*Con.*		
57. *Pedicularis lapponica* L.	Hebron, July 23.	bar.
Lapland Pedicularis.		arct.
58. *Veronica alpina* L.	Hebron, July 23.	arct.
var. *unalaschcensis* C. and S.	Komaktorvik, Aug. 8.	
Veronica Wormskioldii R. and S.		
Alpine or Wormskiold's Speedwell.		
LENTIBULARIACEAE		
59. *Pinguicula vulgaris* L.	Hebron, July 23.	
Butterwort.		
CAMPANULACEAE		
60. *Campanula rotundifolia* L.	Hebron, July 23.	com.
Harebell. Blue Bells of Scotland.	Komaktorvik, Aug. 8.	arct.
	Nachvak, Aug. 15.	
COMPOSITAE		
61. *Taraxacum officinale* Weber.	Komaktorvik, Aug. 8.	com.
Leontodon Taraxacum L.		bar.
Dandelion. Blowball.		
62. *Achillea borealis* Bongard.	Hebron, Aug. 29.	arct.
Northern Yarrow.		
63. *Antennaria alpina* (L.) Gaertn.	Hebron, July 23.	arct.
Alpine Everlasting.		
64. *Arnica alpina* (L.) Ohn. and Laden.	Hebron, July 23.	bar.
Mountain Tobacco.	Camp 3, Aug. 10-12.	arct.
	Nachvak, Aug. 15.	
65. *Artemisia borealis* Pall.	Komaktorvik, Aug. 8.	bar.
Northern Wormwood.		arct.
66. *Erigeron uniflorus* L.	Camp 3, Aug. 10-12.	bar.
Arctic Erigeron.		arct.
67. *Solidago macrophylla* Pursh.	Hebron, Aug. 29.	com.
Large-leaved Golden-rod.		
68. *Solidago multiradiata* Ait.	Nachvak, Aug. 15.	arct.
Northern Golden-rod.	Hebron, Aug. 29.	

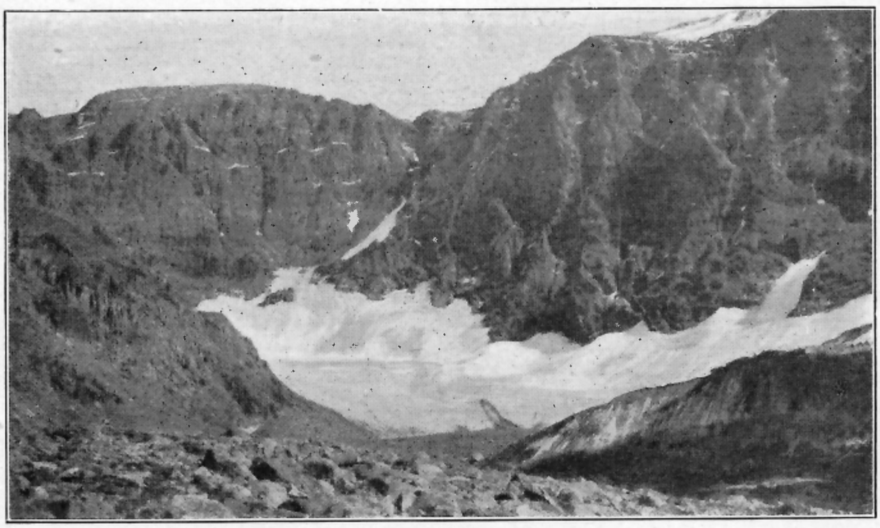
PLATE II.



Cliff south of mouth of Saglek, 1,000 feet in height. (Page 7.)

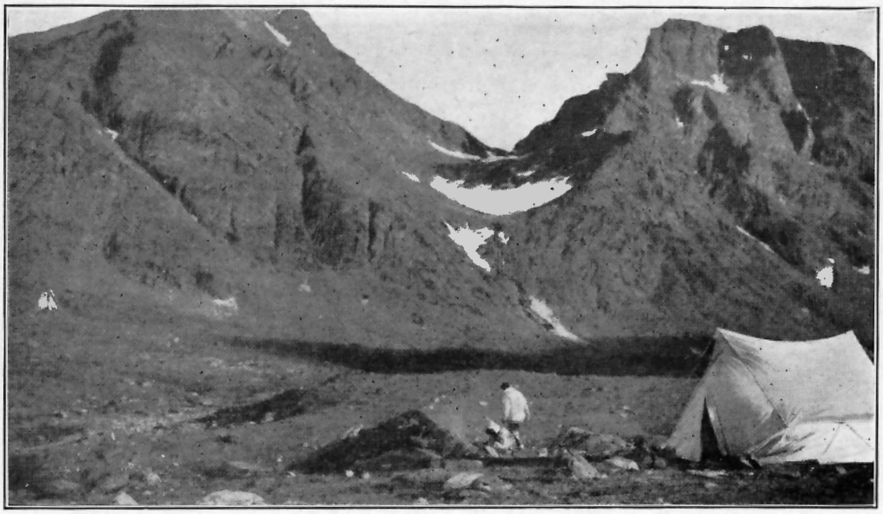
PLATE III.

A. Hanging valley, south of Indian cove, Nachvak. (Page 7.)

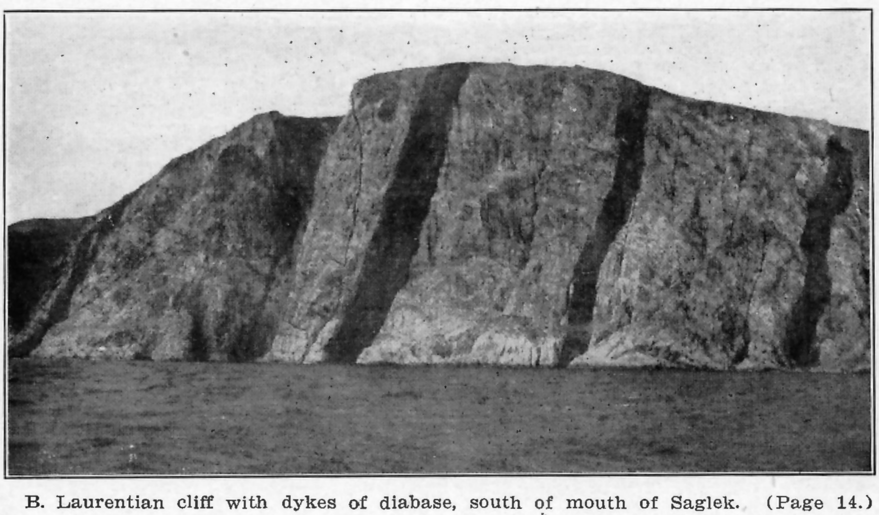


B. Glacier, mount Tetragona. (Page 7.)

PLATE IV.



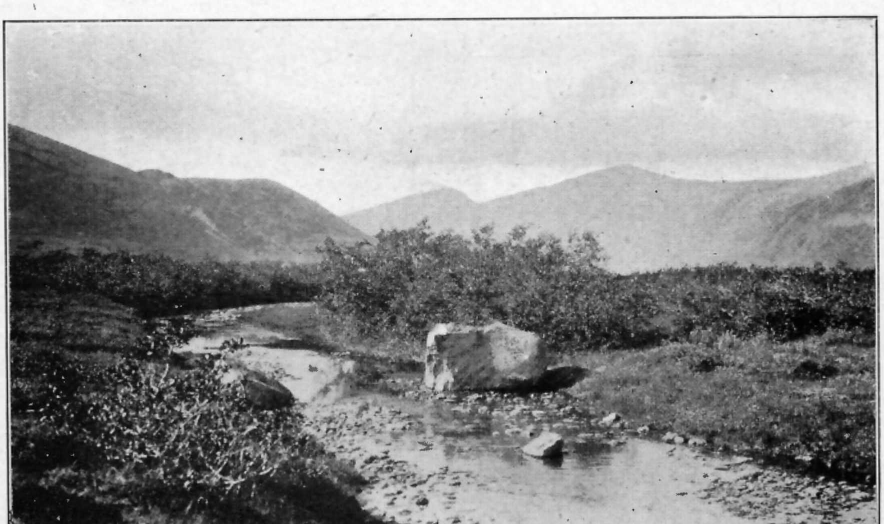
A. Hanging valley (cirque) near mount Tetragona. (Page 7.)



B. Laurentian cliff with dykes of diabase, south of mouth of Saglek. (Page 14.)

PLATE V.

A. Park at Nain—spruces. (Page 16.)



B. Willows, 7 feet high, third valley, south of Nachvak. (Page 17.)

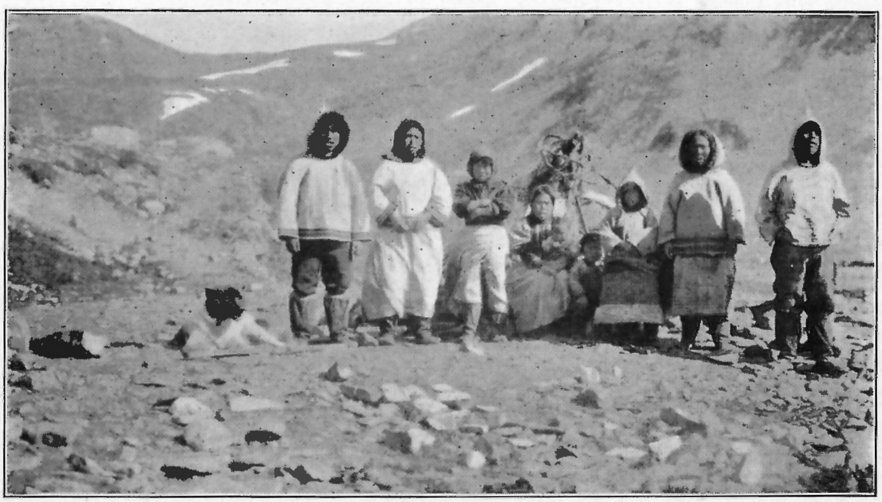
PLATE VI.

A. Surface of tableland, not glaciated, mount Innuit. (Page 26.)

B. Delta materials, near South Arm of Nachvak. (Page 28.)

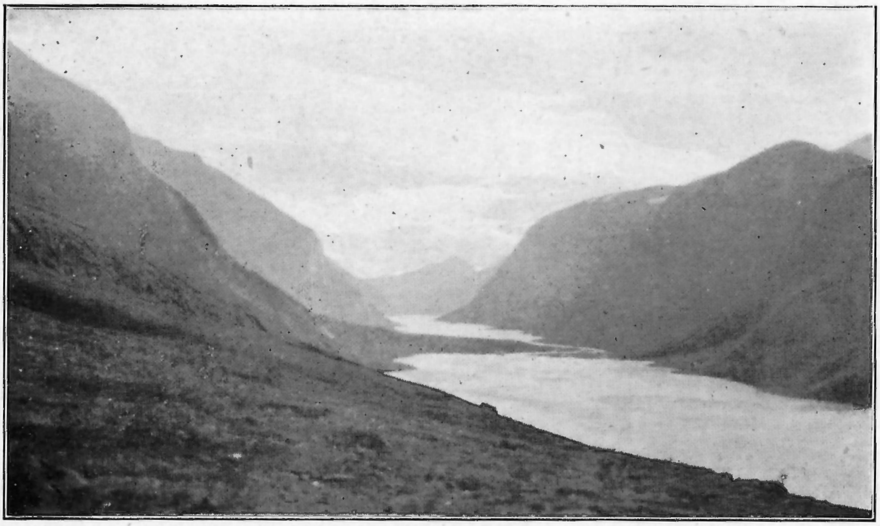
PLATE VII.

A. Solifluxion, north of Schooner cove, Nachvak. (Page 28.)



B. Eskimos, Schooner cove, Nachvak. (Page 33.)

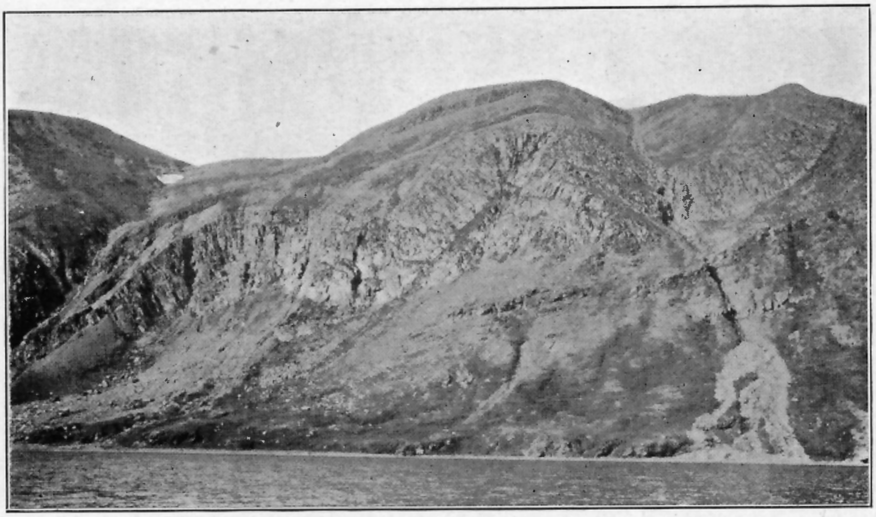
PLATE VIII.



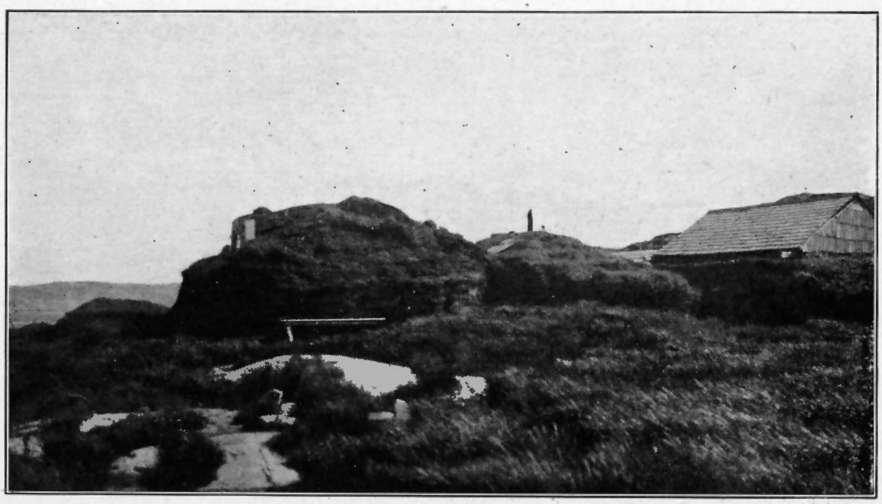
A. Southwest end of Nachvak fiord and lake. (Page 37.)

B. Ramah beds on Laurentian, Rowsell harbour. (Page 41.)

PLATE IX.



A. Ramah beds, folded, near Ramah. (Page 41.)



B. Eskimo houses, sod-covered, Hebron. (Page 45.)

PLATE X.

Hebron bay, filled with floe ice, July, 1915. (Page 45.)

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