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UPPER CANADIAN (BEEKMANTOWN) DRIFT FOSSILS FROM LABRADOR

BY

SHARAT KUMAR ROY
ASSISTANT CURATOR OF INVERTEBRATE PALEONTOLOGY

RESULTS OF THE
RAWSON-MACMILLAN SUBARCTIC EXPEDITION OF 1927-28

OLIVER CUMMINGS FARRINGTON
CURATOR, DEPARTMENT OF GEOLOGY
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CHICAGO, U. S. A.
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SKETCH MAP OF LABRADOR

The arrow points to the approximate position of Sculpin Island

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PREFACE

The drift fossils described and figured in this paper were collected by the writer at Sculpin Island, northeastern Labrador, during the summer of 1927, while a member of the Rawson–MacMillan Subarctic Expedition for Field Museum.

The material which this paper describes is a small unit of the paleontological material collected by the expedition. It consists of only a few specimens, all of which are small in size and more or less fragmentary. Fortunately, however, they serve the main purpose of the paper, which is to provide paleontologic evidences of the occurrence of Upper Canadian (Fort Cassin Division of the Beekmantown) beds, previously not known in the eastern American Subarctic or in the American Arctic regions.

The writer here wishes to acknowledge his indebtedness to Mr. Frederick H. Rawson, without whose generous contribution the material for this paper could not have been secured; to Mr. Stanley Field, President of Field Museum of Natural History, who contributed to the schooner *Radio* which carried the supplies to Labrador; to Captain Donald B. MacMillan, who commanded the expedition and whose long experience of the Labrador coast made it possible to cover more ground than had been expected; and to Captain John T. Crowell, second in command, for many considerations shown.

The writer also wishes to express his deep appreciation to Dr. Oliver C. Farrington for his constant encouragement; to Mr. Henry W. Nichols for the chemical analysis of the rocks referred to in the text; to Dr. Charles Schuchert for helpful information; and, finally, to Drs. Rudolf Ruedemann, Aug. F. Foerste and Josiah Bridge for constructive criticisms and valuable suggestions in the preparation of the manuscript.

The illustrations are by Mr. Carl F. Gronemann, Staff Artist of Field Museum.

UPPER CANADIAN (BEEKMANTOWN) DRIFT FOSSILS FROM LABRADOR

BY SHARAT KUMAR ROY

GENERAL REMARKS

Sculpin Island or Kanaiotôk Island, as the Eskimos call it, is situated about twenty-one miles northeast of Nain (Plate I), the largest Moravian mission village on the coast of northeastern Labrador.

It may be well to mention here that though there is no accepted line of demarkation between northern and southern Labrador, one may divide the two at Hamilton Inlet. This division, of course, is purely arbitrary. Save for the types of people inhabiting the two parts, and for the fact that the northern coast is more mountainous, rugged and bold, there are no pronounced differences. Roughly, the country north of Hamilton Inlet is the home of the Eskimos and the Naskapi Indians, while the southern part is inhabited by a few scattered families of white settlers, known as "liveyeres" (live here). It is also the summer home of a number of Newfoundland fishermen.

The interiors of both these divisions of Labrador are essentially the same. They present a comparatively level surface broken here and there by low, rounded, roughly parallel ridges of Archean rocks, none of which exceed three hundred feet in altitude. The surface is further modified by low ridges of glacial drift, eskers, kames, and moraines. The valleys between the ridges are occupied by countless lakes of various shapes and sizes, all connected by large or small swiftly running streams. In fact, fully one-fourth of the interior of Labrador is a network of lakes and streams.

It may be emphasized here, especially for those who are not acquainted with conditions in the interior of Labrador, that the chief obstacles to geological field work there are heavy snowfall in the winter and mosquitoes and black flies in the summer. Of the latter pest, much has been written and said, yet what has been written is wholly inadequate and what has been said might shock even the most unrestrained. On the contrary, no obstacle to exploration is so great that it cannot be surmounted by foresight and proper equipment. The long and hazardous journeys of Drs. A. P. Low and

W. D. Strong to the interior without any serious mishap may be cited as an excellent precedent. Those who wish to follow their fruitful traverses will not be disappointed. Labrador, though often spoken of as being a forbidding, uninhabitable country, is rich in its natural history.

The fossils[1] described in this paper were recovered from two pieces of drift dolomite which were found a short distance from tidewater. Both dolomites are identical in their faunal contents and lithological characters and have, doubtless, drifted from the same bed. They are angular in shape, gray and light brown in color, medium grained, compact and very hard. A third piece of magnesian limestone with traces of unrecognizable crinoidal fragments in it was also found within a few feet of the two above mentioned. This third fragment is also angular in shape, dull white with a yellowish cast in color, highly crystalline and only moderately hard. It may have been transported from the same place as the two preceding but evidently came from a different horizon, as may be inferred from the noticeable differences in physical properties and chemical composition (p. 52).

A thorough search of Sculpin Island by the writer as well as of neighboring islands, revealed no Paleozoic sedimentary strata in place. In fact, nowhere along the coast from Battle Harbor to Cape Chidley were any sedimentary strata other than Precambrian, Pleistocene and Recent deposits observed. The fossiliferous Paleozoic erratics found at Sculpin Island were evidently transported there by ice and water from an unknown source.

A total of twenty-two specimens, representing four genera and six species, were recovered from the dolomite fragments. Four of the species are new and one is not determined.

Most of these fossils, as will be seen from their measurements, are exceedingly small. Some are of microscopic size. All belong to known genera and all are closely allied to the known Upper Canadian (Beekmantown) species. It is significant, however, that they were not previously known in eastern American Subarctic or Arctic paleontology and, as such, are of considerable stratigraphic and paleontologic interest. Their probable source is also of no less interest but as to this no positive evidence is as yet at hand.

[1]It may be of interest to note that in association with the fossils described in the present paper, two fragments (F.M.N.H. No. P 23359) of extremely narrow, crinoid-like stems were also observed. The writer, however, is unable to say if they are crinoidal or cystidean. The only other occurrence of crinoidal stems below the Chazy was reported by Holtedahl in the Canadian strata of Bear Island in the Barents Sea (O. Holtedahl, 1918).

DESCRIPTION OF SPECIES

Phylum MOLLUSCA

Class GASTROPODA

The gastropods (especially the minute Helicotomas) are most abundant in this collection. Unfortunately, however, the state in which they are preserved is far from being satisfactory. The test, with the exception of only one specimen (Plate II, fig. 4) is invariably missing, and hence, surface characters which often furnish excellent data for specific determinations are also wanting. It is needless to remark that identifications of allied species, even of genera of gastropods, from their casts only are often uncertain if not baffling.

Subclass STREPTONEURA Spengel

Order ASPIDOBRANCHIA Schweigger

Suborder RHIPIDOGLOSSA Troschel

Family PLEUROTOMARIIDAE d'Orbigny

Genus HORMOTOMA Salter

Specimens of fragmentary nature of this genus are fairly common in the present collection. An entire specimen, however, is extremely rare. In fact, it has not been possible to recover a single complete one from the matrix, nor was one observed embedded in its entirety. Furthermore, since the specimens are all casts, it has not been possible to compare them satisfactorily with other described species. It is not unlikely that among the specimens examined there are several different species, but most of them seem to intergrade and lack clear-cut characters for specific differences. Two forms, however, have been recognized, which show sufficient variations to warrant their separation.

Hormotoma labradorensis Roy, sp. nov. Plate II, figs. 1, 2.

Description.—Shell small, moderately slender, gently ascending, consisting of seven or more volutions (the figured specimen has three and part of the fourth volutions preserved and another individual, also incomplete, has seven but none well preserved). Volutions almost twice as wide as high, convex and gently rounded between sutures, which are deep and well defined. Surface, other than a rounded band a little below the middle of each volution, apparently smooth. This band in some instances shows signs of division. Aperture not known.

Measurements.—The figured specimen, so far as it is preserved, is 13.5 mm. long. Another smaller specimen with seven volutions is 11 mm. long.

Remarks.—This species, as can be seen from the measurements, is variable in size. In specific characters, chiefly with reference to the shape of the volutions, it appears to be intermediate between *Hormotoma*(?) *cassina* (Whitfield) and *Hormotoma obelisca* (Whitfield), differing from the former in having less and from the latter in having more rounded volutions between the sutures. Otherwise, it is more closely allied to *H.*(?) *cassina* than any other described species of the genus. The Labrador species is also a smaller form. It is certainly much smaller than *H. obelisca,* in which the median bands of the volutions are also wanting.

Both *H.*(?) *cassina* and *H. obelisca* are from the Upper Canadian (Beekmantown) of Fort Cassin, Vermont.

Horizon and locality.—Upper Canadian (Beekmantown). From the drift dolomite at Sculpin Island, Labrador.

Collector.—Sharat K. Roy.

No. P 23353 Field Museum.

Syntypes.

Hormotoma minuta Roy, sp. nov. Plate II, fig. 3.

Description.—Shell very small; the largest one (holotype), which is almost complete, is 6.5 mm. long, rapidly ascending, consisting of (as can be judged from the holotype and paratypes) five or more volutions, which are rounded but slightly angular between the well-defined, deep sutures. Volutions decrease in size rapidly, the last one being almost twice as large as the preceding one, each marked by a faint, rounded band which is placed very low on the whorl. The band on the last volution is almost central. Aperture filled with rock material and its form cannot be determined.

Remarks.—This species bears some resemblance to *Hormotoma gracilens* (Whitfield) but is more closely allied to *Hormotoma confusa* (Whitfield). It, however, can readily be distinguished from the latter in having more rapidly decreasing and more rounded volutions, also in having surface bands. It is also a smaller form.

Both *H. gracilens* and *H. confusa* are of Upper Canadian (Beekmantown) age.

Horizon and locality.—Upper Canadian (Beekmantown). From the drift dolomite at Sculpin Island, Labrador.

Collector.—Sharat K. Roy.

No. P 23354 Field Museum.

Holotype.

Genus TURRITOMA Ulrich

Turritoma cf. **T. ada** (Billings). Plate II, fig. 4.

Cf. *Murchisonia ada* Billings, Pal. Foss., **1**, Geol. Surv. Canada, 1865, p. 346, fig. 333.

A single specimen, of which the lower portion is missing, represents this species. It is also the only gastropod in this collection the test of which is preserved.

Description.—Test small, spirally conical, gently ascending. Only seven volutions preserved, upper and lower ones wanting. The volutions are comparatively small, there being seven in 7.1 mm. They are convex or rounded at the base, becoming concave upwards and each terminating in a narrow, rounded band below the suture. Surface not well known. Faint, thread-like, transverse lines just below the band, also a few indistinct striae curving backwards on the concave portion, have been observed in one of the volutions.

Remarks.—This species closely resembles *Turritoma ada* (Billings). It is, however, a much smaller form with comparatively much smaller volutions. The Labrador species has seven volutions in the same length in which *T. ada* has only five. Otherwise the two species are practically identical.

T. ada is from the Upper Canadian (Beekmantown) of Leeds and Grenville Counties, Canada.

Horizon and locality.—Upper Canadian (Beekmantown). From the drift dolomite at Sculpin Island, Labrador.

Collector.—Sharat K. Roy.

No. P 23355 Field Museum.

Holotype.

Family EUOMPHALIDAE de Koninck

Genus HELICOTOMA Salter

Helicotoma rawsoni Roy, sp. nov. Plate II, figs. 5–7.

There are a number of specimens of this species, all of which are casts and molds.

Description.—Minute in size, the largest one (holotype) 4.2 mm. wide, consisting of four dextral, rapidly expanding coils, the spire of which rises only slightly (1 mm.) above the carina of the body whorl. Upper surface convex, with a faint, narrow band a little below the outside edge of the last whorl. Lower surface also convex, sloping in the umbilicus. Outer surface, especially on the upper half of the body whorl, appearing flattish because of the presence of the adjacent band on the upper surface, but actually moderately and uniformly rounded. Umbilicus very wide, easily two-thirds the entire width of the specimen. Surface smooth. Aperture not clearly observed, probably trapezohedral. Width, 1.5 mm.

Remarks.—This is the smallest *Helicotoma* known. Its size, which alone distinguishes it from all others known of the genus, is its most noteworthy feature. There are no described species that can be compared with it. *Helicotoma eucharis* Billings, a Chazyan species from Newfoundland, approaches it in size, although the smallest (10.5 mm.) *H. eucharis* is almost three times as large as the largest one of the present species. In specific characters the two species vary too widely for comparison.

The name of this interesting species is given in honor of Mr. Frederick H. Rawson, patron of the Rawson–MacMillan Expedition.

Horizon and locality.—Upper Canadian (Beekmantown). From the drift dolomite at Sculpin Island, Labrador.

Collector.—Sharat K. Roy.

Nos. P 23356 and P 23356a Field Museum.

Holotype and paratypes.

Phylum ARTHROPODA

Subphylum BRANCHIATA

Class CRUSTACEA

Subclass TRILOBITA Walch

Order OPISTHOPARIA Beecher

Family BATHYURIDAE Walcott

Genus BATHYURUS Billings

Bathyurus sculpinensis Roy, sp. nov. Plate II, figs. 8, 9.

This species is represented in the present collection by two incomplete pygidia only, a cast and a mold, apparently belonging to two different individuals.

Description.—Small, semioval, short and wide, convex with wide (3.1 mm.), smooth and flat or nearly flat border. Axis prominent, gently tapering, completely outlined by a moderately deep furrow. Annulations, so far as they can be observed on the cast, three in number; on the mold there is a faint suggestion of a fourth. Pleural lobes subtriangular with four pairs of wide, convex ribs which decrease posteriorly in length but none in width; in fact, the fourth rib is wider than those above. The ribs are all marked by faint lines of depressions above the middle. Neither the ribs nor the axis cross the border. Surface of both cast and mold smooth.

Measurements of the cast.—Length, so far as it is preserved, 9 mm. Width of the left pleural lobe across the anterior rib and including the border, 7.8 mm. Width of the second pleural lobe, 2 mm., of the fourth, 2.2 mm.

Remarks.—This species can be compared with *Bathyurus amplimarginatus* Billings, *Bathyurus glandicephalus* Whitfield and *Bathyurus pogonipensis* Hall and Whitfield, but it differs from all three in one respect or another.

From *B. amplimarginatus* and *B. glandicephalus* it differs in being much smaller in size and in having a comparatively longer axis with fewer annulations. It also has wider and longer pleural ribs and a narrower border.

From *B. pogonipensis* it differs in general outline and in having wider ribs. The Labrador species also has an additional rib and wider border.

One salient character, however, is common to all. All have a wide border which is not crossed by the pleural ribs. This character seems to be limited to the species of Upper Canadian (Beekmantown) age only. Both *B. amplimarginatus* and *B. glandicephalus* are known to occur in the Upper Canadian (Beekmantown). *B. pogonipensis*, from the Pogonip limestone of White Pine District, Nevada, has been referred to the Quebec Group but since no detailed classification of the Pogonip limestone is known, the exact horizon of *B. pogonipensis* is more a matter of inference than one based on an established stratigraphic classification.

All that is definitely known of the Pogonip limestone[1] is that it has been divided into two sections, upper and lower, and that it rests above the Hamburg shale (Middle Cambrian) and below the Eureka Quartzite (Middle Ordovician). This range, from the Middle

[1] Charles Walcott, 1884, p. 284.

Cambrian to the Middle Ordovician probably includes nearly all the horizons known to exist elsewhere in a similar vertical section of an area of unbroken stratigraphical succession.

The vagueness of the stratigraphy of the Pogonip limestone, so far as it can be gathered from works on the subject, seems to have been mostly due to the commingling of species and the unusual vertical range of individual species, rather than to inadequate knowledge of its fossil contents. The following excerpts may serve to explain the difficulty of classifying the Pogonip limestone.

Hague[1] says: "Throughout the entire thickness of the Pogonip beds, organic remains characterise the epoch. At the base there is a decided mingling of species, a number of Potsdam forms extending upward for some distance into the limestone. Passing upward, however, these species gradually diminish and there come in rapidly a numerous fauna representing higher and higher forms, till midway in the beds, nearly all the characteristic Cambrian fauna have passed away and genera equivalent to the Chazy horizon of New York have taken place, and near the top a grouping of fossils comes in strongly indicating the Trenton horizon."

Calling attention to the unusual associations of species, Walcott[2] says: "The presence of the Trenton species *Orthis testudinaria* in the upper portion of the lower half of the Pogonip Group in association with the genera Ptychoparia, Dicellocephalus, and Asaphus is a typical example."

Walcott[3] also says: "The succession in the faunal series from the Olenellus (or Middle Cambrian) fauna, through a large, well-defined fauna of the character of that of the Potsdam Group of New York and the Mississippi Valley, to one that in its assemblage of species combines both Cambrian and Silurian types and passes upward into a fauna comparable to that of the Quebec Group, or the Calciferous and Chazy Groups, is of special interest."

"In the next superior grouping, about midway of the Pogonip Group, all the middle Cambrian genera, with the exception of Orthis and Illaenurus, have disappeared, and higher up the genera Receptaculites, Chaetetes, Pleurotomaria, Maclurea, Cyphaspis, Bathyurus, and Asaphus carry the fauna up to the summit of the formation where the genera Receptaculites, Ptilodictya, Chaetetes, Strophomena, Orthis, Tellinomya, Modiolopsis, Maclurea, Cyrtolites,

[1] Arnold Hague, 1892, pp. 49–50.
[2] Charles Walcott, 1884, p. 1.
[3] *Ibid.*, pp. 2–3.

Orthoceras, Endoceras, Coleoprion, Leperditia, Beyrichia, Amphion, Ceraurus and Asaphus give it a facies approaching that of the Lower Trenton and indicating a horizon that is considered to be in a measure the equivalent of that of the Chazy formation of New York and Canada. The fauna of the lower portion of the Pogonip Group corresponds in the same manner to that of the Calciferous sand-rock of the same region. The large number of individuals of the species of Receptaculites, *R. mammillaris* especially, gives the fauna of the upper beds a character that this horizon has not hitherto had. This, united with several of the Trenton species, viz. *Orthis testudinaria, O. tricenaria, O. perveta, Tellinomya contracta,* two species of Modiolopsis allied to Trenton forms, and *Raphistoma Nasoni,* strongly foreshadows the opening of the Trenton Period."[1]

It is apparent that the Ordovician portion of the Pogonip limestone, as it could be deduced from its stratigraphic position and faunal contents,[2] must contain at least the equivalents of the Canadian, the Chazy and the Trenton or its beginning, although there are no apparent lines of demarkation, lithological or faunal, between these horizons. A confusion of this nature, however, is only to be expected in an area where there have been no marked physical disturbances or where unusual associations of species or a long vertical range of individual species are characteristic features.

The present writer does not contend that occurrence of *B. pogonipensis* gives positive evidence of the presence of the Canadian (Beekmantown) horizon in the Pogonip limestone, but support of that view is indicated by the following:

(*a*) *B. pogonipensis* is closely allied to *B. amplimarginatus* and *B. glandicephalus,* both of which species occur in the Canadian (Beekmantown).

(*b*) *B. pogonipensis* is also closely related to *B. sculpinensis* Roy which has been found in association with the gastropods described in this paper, which have remarkable resemblances to the known Upper Canadian (Beekmantown) forms.

(*c*) *B. pogonipensis* is more closely related to *B. sculpinensis* (as well as to *B. amplimarginatus* and *B. glandicephalus*) than to any two other species of *Bathyurus.*

(*d*) Individual or allied species of *Bathyurus*[3] have a very limited horizon.

[1] Charles Walcott, 1884, pp. 3–4.

[2] James Hall and R. P. Whitfield, 1877; Charles Walcott, Monog., 1884.

[3] E. Billings, 1859; P. E. Raymond, 1913. Also see R. S. Bassler, 1915, pp. 104–107, for further references.

(*e*) No species of *Bathyurus* whose pygidium possesses a wide border which is not crossed by the pleural ribs is known to occur in any horizon other than the Canadian (Beekmantown).

The above evidences, therefore, not only indicate that *B. pogonipensis* is of Canadian (Beekmantown) age but also readily suggest that all species of *Bathyurus* having pygidia with wide borders which are not crossed by the pleural ribs are of Canadian (Beekmantown) age.

Horizon and locality.—Upper Canadian (Beekmantown). From the drift dolomite at Sculpin Island, Labrador.

Collector.—Sharat K. Roy.

No. P 23357 Field Museum.

Syntypes.

Bathyurus(?) sp. ind. Plate II, fig. 10.

A single broken mold, doubtfully referred to this genus, was found in association with the preceding species, *Bathyurus sculpinensis* Roy. The specimen, however, is deplorably poor and does not allow of any adequate identification or use as a type for specific description. It can, however, be readily seen from its pleural ribs and wide axis that it is not conspecific with *B. sculpinensis*.

Horizon and locality.—Upper Canadian (Beekmantown). From the drift dolomite at Sculpin Island, Labrador.

Collector.—Sharat K. Roy.

No. P 23358 Field Museum.

Holotype.

STRATIGRAPHICAL NOTES

A brief discussion of the stratigraphy of northeastern Labrador is here introduced, as it seems essential in understanding the probable source of the fossils described in this paper.

The stratigraphy of northeastern Labrador, so far as known, consists of Precambrian, Pleistocene and Recent deposits. It is believed that either the Paleozoic, Mesozoic and Cenozoic seas never invaded the country or that their deposits have since been eroded away. Such a conclusion, however, is purely hypothetical and founded on meager data. The interior of Labrador still remains untouched by geologists except at a few areas[1] about two hundred

[1] A. P. Low, 1895.

miles inland, south of 55° N. Lat., along Koksoak and Hamilton Rivers and Lakes Mistassim and Michikaman. There Low found a series of rocks which he reservedly classified as Cambrian. The rocks are both sedimentary and igneous and lie unconformably upon the Archean. The minimum thickness of the sedimentary beds is estimated to be 2,500 feet. Unfortunately, however, no fossils have been found in these supposed Cambrian sedimentaries, and, until such are found, their precise ages can be, at best, a conjecture, based purely on the superposition of the beds and uncertain lithological characters. They may represent certain members of the Huronian, as suggested by Low in a later work.[1]

North of 55°, practically nothing is known of the interior of Labrador by direct observation. Bell,[2] Packard,[3] Daly,[4] and Coleman[5] have made some explorations, all of which, however, are confined to the coast only, around the Nachvak Bay and Cape Mugford region. The sum total of their works may be expressed in the following section.[6]

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

Of the above section, the Mugford and the Ramah series, included in the youngest Precambrian, are probably of greatest interest to paleontologists. The former derives its name from Ramah, an Eskimo village about fifty miles northwest of Hebron in the Torngats (Eskimo for "Evil Spirits"), and the latter from Cape Mugford (Plate I) in the Kaumajets (Eskimo for "Bright Mountains").

[1] A. P. Low, 1906, p. 193.
[2] Robert Bell, 1882–84, pp. DD 11–17.
[3] A. S. Packard, 1891.
[4] R. A. Daly, 1902.
[5] A. P. Coleman, 1921.
[6] *Ibid.*, p. 22.

The Ramah series[1] consists chiefly of slates, quartzites, arkose, and impure dolomite with a layer of amphibolite. The beds are well stratified, except the fifty feet or so of amphibolite, and in places, cross bedding and ripple marks are well preserved. The whole series forms a synclinal band thirty miles long and in places seven miles wide. The rocks are not unlike the typical Huronian if the thick boulder conglomerates or tillites be excluded.

The Mugford series[1] is seventy or eighty miles southeast of the nearest part of the Ramah series. It consists of slates, cherts, quartzites, sandstones and limestones, with basic eruptives in the form of great sills and also of tuffs and agglomerates. The occurrence of diabase sills with chert and slate as the commonest sediments shows parallelism with that of the Aminikie of Lake Superior, but the ash rocks and bombs indicate volcanic activity, suggesting the Keweenawa. If these suggestions are accepted, the Mugford series is later than the Huronian and, therefore, probably later than the Ramah series. The evidence, however, is by no means convincing, nor is it in any way conclusive.

Both the Ramah and Mugford series, however, rest unconformably on the older granite gneiss and each have a minimum thickness of about three thousand feet or more. The average thickness of the Ramah series is believed to be somewhat greater than that of the Mugford series.

Commenting on the age of the Mugford series, Daly[2] states: "No organic fossils have been found in any part of the series of the beds. Geologists cannot say, therefore, just what is the age of these rocks, relatively to the other formations of the world. It is only known that here, as in similar rock-groups, in western and southwestern Labrador, the stratified beds are extremely old in a geological sense, dating in all probability from a time near the beginning of the so-called Paleozoic Period."

The present writer on his way to and from Baffin Land saw both the Ramah and Mugford series, and made cursory examinations of the latter, but under less favorable circumstances than those who worked before him there. He, therefore, cannot make any positive statement as to the age of these beds, nor can he improve upon the previously published stratigraphical classification of northeastern Labrador. He, however, had no reason to suspect that the beds under discussion were of any other age than Precambrian and does

[1] Summarized from A. P. Coleman, 1921, p. 25.

[2] W. T. Grenfell, and others, 1909, Chap. IV, pp. 102–110.

not think so now. They seem to have all the earmarks of the Precambrian. Their lithological characters, nature of metamorphism, lack of fossil contents, and their relations to the basal formation and to the later eruptives, all strongly remind one of the metamorphosed or partly metamorphosed Precambrian sedimentaries of other regions elsewhere. In fact, while the writer was working on the Avalonian series,[1] in the peninsula of Avalon, southeastern Newfoundland, he was constantly reminded of the possibilities of its being contemporaneous with the Ramah and Mugford series, although the nature of the sediments and conditions of deposition of these widely distributed beds might not have been quite similar, nor might they have been subjected to similar tectonic conditions.

Furthermore, those who have worked with Arctic fossils or have done field work in the Arctic Paleozoic, especially in the Ordovician and younger horizons, must have been greatly impressed by the similarity of the lithological characteristics of the beds of the same ages, even of widely separated areas. This is, doubtless, due to the deposition of sediments under uniform or nearly uniform conditions. Foerste, who has long been interested in the Arctic stratigraphy and who has had opportunities to examine a number of fossils from different horizons of widely distributed localities, corroborates this view of the present writer. He writes (letter to Sharat K. Roy, Nov. 8, 1931): "In my previous experience with Arctic fossils I have found that the lithological characteristics often are indicative of their horizons. . . . Of course, identifications by means of lithological characteristics are only wild guesses, but when they confirm the study of the fossils themselves they increase confidence in the determination of the latter, and when they contradict the latter they cause a more intensive study of the same." Certainly the structural and petrographic characters of the beds of the Ramah and Mugford series are very unlike those observed by the writer at Silliman's Fossil Mount, at Frobisher Bay, Baffin Land, also very unlike those observed by others on Akpatok[2] Island in Ungava Bay, on the

[1] The Avalonian series consists of slates, sandstone, sandstone conglomerates, etc. The term was provisionally suggested by C. D. Walcott for this series, it being difficult to correlate it with any of the well-defined continental series. Heretofore, it had been classed partly with both Huronian and Cambrian, into which it seems to merge at the base and at top. There is no perceptible want of conformity in either case. The series is characterized by two obscure fossils, *Arenicolites spiralis* and *Aspidella terranovica* Billings. The latter species occurs below the primordial rocks in Sweden. In many respects the Avalonian series resembles the Auriferous series of Nova Scotia (see legend of the Geological Map of Newfoundland, 1925, also Rep. Geol. Surv. Newfoundland, 1881, p. 28).

[2] R. Bell, 1897, p. 82A.

islands[1] in Hudson Bay, southwestern (Foxe Land)[2] and western Baffin Land,[3] eastern Melville Peninsula,[4] Boothia Felix and King William Land,[5] North Somerset Island,[6] Cornwallis and North Devon Islands,[6] Ellesmereland[7] and other areas[8] in the American Arctic Archipelago. The Paleozoic sedimentary beds, especially the Ordovician and higher horizons of the Arctic region, are all well stratified and do not show any signs of having been subjected to metamorphic processes.

As regards the occurrence of fossils in the Ramah and Mugford series, all evidences so far known are negative. The present writer has not seen any. MacMillan in his twenty years of exploration of the Labrador coast has not found one. Daly[9] mentions that two members of the "Brave" Expedition, Adams and Delabarre, walked over the Torngats from Hebron to Nachvak Bay, a distance of nearly one hundred miles, without finding a fossil, though they were constantly on the lookout for fossils. Other evidences, probably less convincing from the standpoint of scientific accuracy, nevertheless in some measure confirming the view that the Ramah and Mugford series are barren of fossils, are the testimonies of residents of northeastern Labrador. Drs. W. W. Perret and Paul Hetasch, of the Moravian Mission, both of whom are reputable naturalists, have lived in the neighboring regions for nearly three decades without ever seeing a fossil. Testimony of the Eskimos, unreliable as they are thought to be, also cannot be neglected. The Eskimos are born curio hunters. They take great pride in collecting unique objects and many of them have an amazing power of interpreting natural phenomena. An incident that probably will impress any geologist may be cited here as an example. The writer, while within the sight of Silliman's Fossil Mount, Frobisher Bay, Baffin Land, came across an old Eskimo, and being curious to learn if he knew of the existence of fossils in the Mount, carved a *Maclurites* on the ground. The old man without any hesitation pointed his finger towards the Mount and later told the interpreter of the expedition that there

[1] A. P. Low, 1906, pp. 118–120, 210–211.
[2] L. M. Gould, Aug. F. Foerste, and R. C. Hussey, 1928, p. 20.
[3] R. Bell, 1898, p. 17M.
[4] P. Freuchen, and T. Mathiassen, 1925, p. 552.
[5] O. Holtedahl, 1912.
[6] A. P. Low, 1906, pp. 124, 212, 128–129, 214.
[7] O. Holtedahl, 1913, pp. 7–9.
[8] A. P. Low, 1906, pp. 118–130, 200–221.
[9] R. A. Daly, 1902, pp. 226–227.

were a great many sea shells in that hill and the hill must have been once under the sea—a statement which even trained geologists of the civilized world less than a century ago were doubting. In Labrador, a great many homes of the Eskimos were visited by the writer without his ever having seen a fossil other than recent shells in the family collections of curios.

It may be argued that metamorphic processes have destroyed the fossils of the Ramah and Mugford series, but the fact that there are a great many beds, especially in the Ramah series, that have not undergone apparent alteration, is strong evidence against such a view. All evidences, therefore, suggest that the Ramah and Mugford series, as classified by Coleman, are of Precambrian age. They may correspond with the supposed Huronian metamorphics of southern Baffin Land.

THE SOURCE OF THE FOSSILS

Previous to 1904 no fossils had been found in northeastern Labrador. In that year Dr. A. P. Low made an interesting small collection of drift fossils[1] at Cape Chidley, the most northeasterly point of Labrador. Dr. Low thought that they were transported there by the ice from Akpatok Island, which is about one hundred and thirty miles west of Cape Chidley. Schuchert,[2] however, was not certain that this island was the source, since he found, among the Cape Chidley fossils, some Helderbergian (Coeymans) species, which are unknown in Akpatok Island. He was, therefore, inclined to think that "they may be rather from the north and from not far away, on Baffin Land."

It is, however, difficult, especially because of the presence of Devonian species, to draw any inference as to whether Baffin Land was a more probable source of these fossils than Akpatok Island. At present no Devonian is known in either of the areas. The nearest Devonian horizons exposed are at Beechey Island,[3] Lancaster Sound, and in areas around Goose Fiord,[4] southeastern Ellesmere Land and adjacent regions, all of which are well over thirteen hundred miles from Cape Chidley. The question of the source of Cape Chidley fossils, therefore, will necessarily remain unanswered until more is known of the faunas of both Akpatok Island and Baffin Land.

[1] A. P. Low, 1906, pp. 322–336.

[2] Charles Schuchert, 1914, pp. 468–469.

[3] A. P. Low, 1906, pp. 50–51, 329–330; C. Schuchert, 1914, pp. 474–475.

[4] O. Holtedahl, 1917, pp. 10–13.

In the opinion of the writer, however, Akpatok is a more likely source than Baffin Land, (1) because Akpatok is nearer, (2) because the direction of ice movement out of Hudson Strait from Akpatok is towards Cape Chidley, and (3) because no Richmond fossils which are common in southern Baffin Land were observed in the Cape Chidley collection.

As to the source of the fossils of the present paper, still less is known or can be ascertained. The known Paleozoic exposures nearest to Sculpin Island are at Akpatok Island and southeastern and southwestern Baffin Land. Mansfield, Coats and Southampton Islands in Hudson Bay may also be referred to as possible sources, but none of these areas has yet yielded any Canadian (Beekmantown) species. A single specimen found among the drift fossils of Cape Chidley, and identified by Ami as *Eurystomites undatus*[1] Emmons, now synonymous with *Plectoceras*(?) *undatum* (Conrad) might deserve mention here. Schuchert, referring to the Cape Chidley fossils and especially to this particular species writes (letter to Sharat K. Roy, Nov. 5, 1931), ". . . also a large coiled cephalopod that then was called *Eurystomites* or *Tarphyceras*, and which I thought of at the time as of Beekmantown age." In his paper, "Notes on Arctic Paleozoic Fossils,"[2] however, he determines this species as "*Eurystomites*, n. sp." with the following notes: "Ami labelled this *E. undatus* Emmons, to which group of *Eurystomites* it undoubtedly belongs. It attains, however, a larger growth, has a very wide dorsum and a shallow hyponomic sinus. It is a fine specimen with a diameter of 6.5 inches." He concludes with the following remarks: "These cephalopods,[2] as they all appear to occur together, indicate the lower part of the Black River formation as developed at Watertown, New York." This is doubtless the most likely horizon. Foerste, who has also seen these fossils, is also practically of the same opinion. He writes (letter to Sharat K. Roy, Nov. 11, 1931): "All of the fossils which I have studied so far from northern Labrador came from the Cape Burwell area and were either of Black River or Utica age."

A similar occurrence of an indeterminable species of *Eurystomites* from the west coast of King William Land in association with a number of Black River with a suggestion of Trenton species—*Receptaculites oweni* Hall, *Actinoceras beloitense* (Whitfield), *Actinoceras* cf. *A. tenuifilum* (Hall), *Gonioceras occidentale* Hall, etc.—has been

[1] A. P. Low, 1906, p. 336.

[2] C. Schuchert, 1914, p. 468.

mentioned by Holtedahl.[1] Commenting on this rather seemingly unusual occurrence of a form generally assigned to a lower horizon, Holtedahl states, "This form does not offer any closer stratigraphical hold, as the genus *Eurystomites* occurs in several divisions of Ordovician, especially in the lower divisions from Beekmantownian to Black River." Foerste,[2] who has studied this particular specimen, believes it to be a *Plectoceras* related to such Black River forms as *Plectoceras undatum* (Conrad) and *Plectoceras halli* (Foord). Its occurrence, therefore, is in keeping with the other species with which it was found associated and may not be considered as an example of confusion of fossils from different horizons. It, furthermore, confirms the view that the *Eurystomites* of Cape Chidley is also a Black River *Plectoceras* and that Ami was probably correct in referring it to *P. undatum* (Conrad) of the Black River.

As regards Mansfield, Coats and Southampton Islands, or other neighboring islands known to have Paleozoic sedimentaries, no species of the Canadian (Beekmantown) has yet been found in them. The same is true of Baffin Land. The present writer has collected extensively from Silliman's Fossil Mount, Frobisher Bay, Baffin Land, but so far has found no indication of the occurrence of any horizon lower than Black River. Moreover, in lithological characters the fossiliferous rocks of Baffin Land (Frobisher Bay region) and those collected at Sculpin Island, are quite dissimilar. These differences in physical properties and chemical composition are shown in the table on page 52.

It is apparent, therefore, that none of the areas nearest to Sculpin Island that are known to have fossiliferous Paleozoic deposits offer any possibilities of being the source of Sculpin Island fossils. There are, however, other areas much farther north, containing early Paleozoic sedimentaries, which may be mentioned here.

At Cape Camperdown, at the southeastern corner of Bache Peninsula, Ellesmere Land, Schei has collected a few fragmentary specimens of trilobites from a yellowish-gray limestone overlying the Precambrian. Holtedahl,[3] who has studied these specimens, has referred them to the genus *Ptychoparia* and believed the horizon in which they were found to be Middle or Upper Cambrian.

At Cape Victoria Head, at the northeast corner of Bache Peninsula, Schei also discovered two zones.[4] The lower one is a bed of

[1] O. Holtedahl, 1912, p. 7.
[2] Aug. F. Foerste, 1921, pp. 247–248.
[3] O. Holtedahl, 1913, pp. 5–7.
[4] *Ibid.*, pp. 7–8.

COMPARISON OF PHYSICAL CHARACTERS AND CHEMICAL COMPOSITION OF LIMESTONES FROM SCULPIN ISLAND AND SILLIMAN'S FOSSIL MOUNT

Nature of Specimen and Locality	Physical Properties			Chemical Composition[1]			Remark
	Color	Texture	Hardness	Sand and Clay	$CaCO_3$	M_gCO_3	
Dolomite from Sculpin Island, containing fossils described in this paper	Gray and light brown	Medium grained	Compact and very hard	12.60	49.97	37.51	
Magnesian limestone from Sculpin Island, containing crinoidal fragments only	Dull white with a yellowish cast	Highly crystalline	Moderately hard	0.07	84.24	13.60	
Limestone[2] from Silliman's Fossil Mount, Frobisher Bay, Baffin Land	Buff	Very fine grained	Hard. Somewhat resembles lithographic limestone but is coarser and not as homogeneous	2.38	96.30	Trace	Soluble silica, iron, alumina and other impurities not determined
Limestone[2] from Silliman's Fossil Mount, Frobisher Bay, Baffin Land	Light bluish-gray	Shaly	Moderately soft	15.35	80.99	Trace	
Limestone[2] from Silliman's Fossil Mount, Frobisher Bay, Baffin Land	Bluish-gray, filled with dark-colored organic matter and often with minute pyrite crystals	Crystalline	Very hard	10.23	88.27	Trace	

[1] Analyses made by H. W. Nichols.

[2] In most instances the lithological characters of the limestone beds at Silliman's Fossil Mount intergrade with one another. These three, however, show sufficient variations to be readily separated.

about three hundred and fifty feet of grayish-white limestone, containing fragments of *Orthoceras*,[1] some badly preserved bryozoans, and a few indeterminable species of *Ptychoparia*, *Illaenurus* and *Lichas*. The upper one is a bed of about one hundred feet of close grained, brown limestone containing cf. *Hormotoma gracilis* (Hall), cf. *Fusispora compacta* Hall and Whitfield, *Maclurites* sp., and a few fragments resembling *Bathyuriscus* or *Ptychoparia*. The stratigraphic evidence of these fossils is believed by Holtedahl[2] to be "the Cambro-Ordovician boundary in the highest Cambrian or basal Ordovician—the Ozarkian of Ulrich."

Foerste, however, is inclined to regard the lower zone as Ozarkian or possibly as both Ozarkian and Canadian, and the upper one as Canadian[3] or even post-Canadian. The suggestion of the post-Canadian was probably prompted by the fact that a single Chazyan fossil, *Maclurites magnus* Leseur, had been reported from Victoria Head by Etheridge.[4] According to Troedsson, however, this needs to be corroborated, as no other Chazyan fossil has been found in this part of the Arctic region by later expeditions.

A little northwest of Victoria Head, near Princess Marie Bay, at Summit, Cape d'Urville, the Peary Expedition of 1898 found a piece of drift limestone containing what Whitfield[5] believed to bear "indications of fossil plants, and what may have been a *Helicotoma* or *Ophileta*, and reminds one of similar appearing things from the Calciferous formation of Lake Champlain."

Although Whitfield's identification and reference to the horizon are necessarily vague, the finding of a form resembling a *Helicotoma* of the Calciferous (Beekmantown) age is of interest and deserves mention here. Positive faunistic evidence of the Canadian, however, is still wanting. From the material actually at hand now, there is more reason for believing that only Cambrian and Ozarkian are present in the section at Victoria Head, Bache Peninsula, than for assuming that Canadian also is present there. The writer, however, strongly suspects that Canadian does occur there, and as a part of the known Canadian beds[6] of the southern coast of Washington Land,

[1] From these fragments, Foerste has described two species, *Clarkoceras holtedahli* Foerste and *Ellesmeroceras scheii* Foerste, both of which were believed to be of Canadian age (Aug. F. Foerste, 1921, pp. 249–250) but are now definitely known to belong to the Upper Ozarkian (*idem*, 1928, p. 5).

[2] O. Holtedahl, 1917, p. 6.

[3] Modified to Upper Ozarkian. See footnote 1 of this page.

[4] R. Etheridge, 1878, p. 605.

[5] R. P. Whitfield, 1900, p. 19.

[6] G. T. Troedsson, 1926, p. 12; C. Poulsen, 1927, pp. 292–310.

northeastern Greenland, across Kane Basin. Any lack of evidence that there might be now is likely to disappear when more complete material can be secured.

Bache Peninsula, however, is more than fifteen hundred miles from Sculpin Island and, even if the occurrence of the Canadian there be taken for granted, it is hardly possible to consider it as a source of the fossils described in the present paper. Rocks are, doubtless, known to have drifted longer distances than this but in this case the angularity of Sculpin Island dolomites must be considered a fatal objection to such long transportation, unless they have been carried between ice without undergoing any abrasion or were broken on the way by some unknown agents, thus losing all characteristic features of drift-worn materials.

The last probable source of the Sculpin Island fossils which may be mentioned is Labrador itself, yet it is difficult even to suggest a locality there from which they might have been transported. In the Stratigraphical Notes of this paper it has been pointed out that all the known sedimentaries both of the coast and of the interior of Labrador are totally barren of fossils. So little, however, is known of the geology of Labrador that it would be premature to arrive at any conclusion at the present time regarding the occurrence of fossils there. The vast unexplored areas of the interior of Labrador offer a field for much future investigation. A study of the expansion of the Arctic Ordovician seas and their encroachments at the very door of Labrador, as indicated by the deposits left at Akpatok and other neighboring areas, at once discredits or notably weakens any suggestion that Labrador was dry land during Ordovician time. Doubtless, many of the deposits have been eroded away by the glaciers, yet, when the interior of Labrador is properly explored, some remnants of erosion may still be found as outliers or basin deposits such as have been observed elsewhere in the Arctic regions. The angularity of the erratics found at Sculpin Island strongly suggests that they have not drifted from a very distant place and that their source was, in all probability, some deposits not yet discovered in Labrador. The general direction of the glacial striae of the northeastern coast of Labrador is, as far as known, east and northeast. This indicates that the Sculpin Island erratics might have been transported from localities west or southwest of the coast; in other words, from some deposits in the interior of Labrador. The glacial history of Labrador, however, is only imperfectly known and any statement now made as to the possible origin of the erratics must, of necessity, be a tentative one.

CONCLUSIONS

While drift fossils coming from a region of which the geology is well known are of little or no interest stratigraphically, paleontologically they are often of interest, since not a few new species of biologic importance have been discovered in drift material. The fossils described in this paper, though of drift origin, must be considered significant both from the paleontologic and stratigraphic point of view. They are, with the exception of one, all new species. Moreover, they very clearly compose a typical Upper Canadian fauna of the American Atlantic phase hitherto not found in the American Arctic or eastern Subarctic regions. Furthermore, if the present writer's suggestion of the source proves to be correct, they indicate a much wider distribution of the northern Canadian faunas than heretofore believed.

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EXPLANATION OF PLATES

I. Sketch Map of Labrador Showing the Approximate Position of Sculpin Island, Northeastern Labrador.

II. Upper Canadian (Beekmantown) Drift Fossils from Sculpin Island, Northeastern Labrador.

Hormotoma labradorensis Roy, sp. nov., page 37

Fig. 1. An incomplete specimen (cast). No. P 23353 Field Museum.

Fig. 2. Longitudinal section of a different individual. No. P 23353 Field Museum.

Hormotoma minuta Roy, sp. nov., page 38

Fig. 3. A nearly complete specimen (cast). No. P 23354 Field Museum.

Turritoma cf. *T. ada* (Billings), page 39

Fig. 4. An incomplete specimen with test preserved. No. P 23355 Field Museum.

Helicotoma rawsoni Roy, sp. nov., page 39

Fig. 5. Upper surface. No. P 23356 Field Museum.

Fig. 6. Outer surface. No. P 23356 Field Museum.

Fig. 7. Calcareous filling through the umbilicus showing the height of the spire and nature of coiling. No. P 23356a Field Museum.

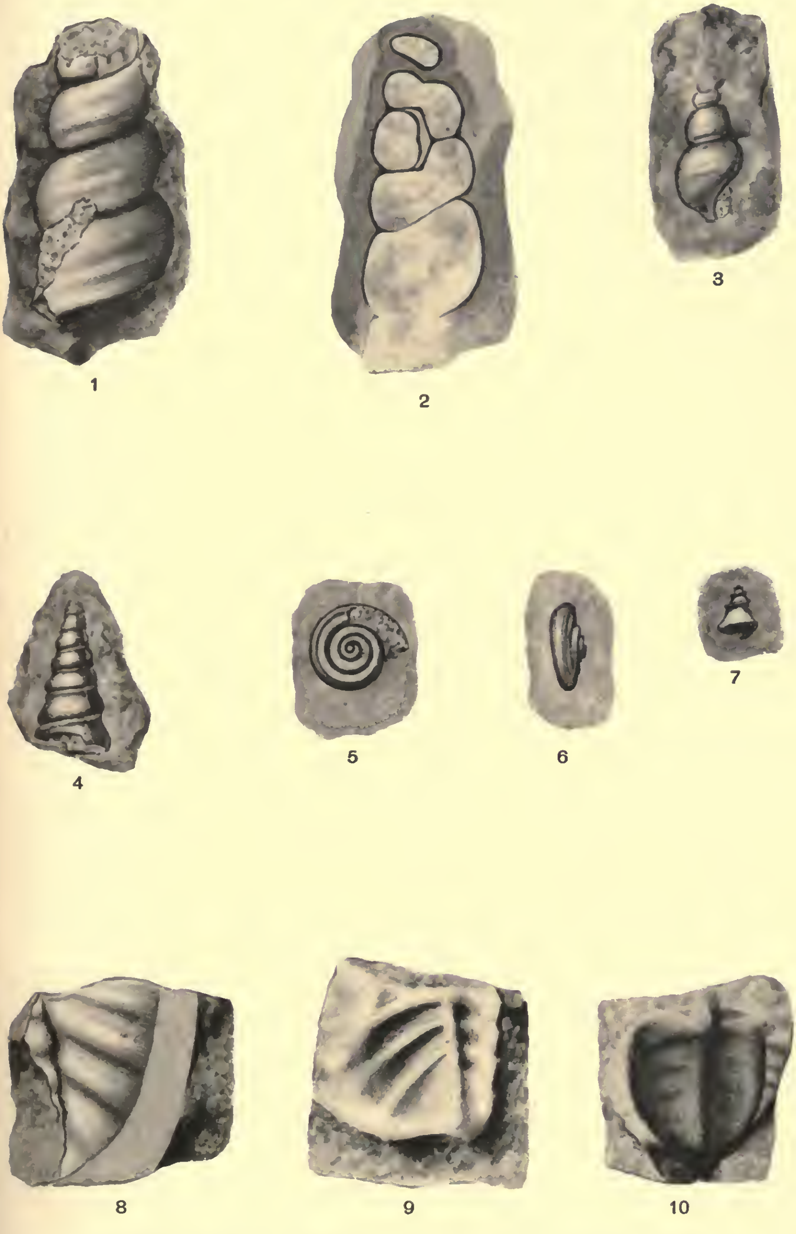
Bathyurus sculpinensis Roy, sp. nov., page 40

Fig. 8. An incomplete pygidium (cast). No. P 23357 Field Museum.

Fig. 9. An incomplete pygidium (mold) of a different individual. No. P 23357 Field Museum.

Bathyurus (?) sp. ind., page 44

Fig. 10. A fragmentary mold of a pygidium. No. P 23358 Field Museum.



UPPER CANADIAN (BEEKMANTOWN) DRIFT FOSSILS FROM SCULPIN ISLAND, NORTHEASTERN LABRADOR

For explanation of plate see page 59

All figures enlarged three times