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NOTES ON ARCTIC PALEOZOIC FOSSILS.

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(Contributions from the Paleontological Laboratory, Peabody  
Museum, Yale University, New Haven, Conn., U.S.A.)

ART. XLI.—*Notes on Arctic Paleozoic Fossils*; by CHARLES SCHUCHERT.

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It is becoming more and more apparent in the study of the paleogeography of North America that the lack of knowledge concerning the stratigraphy of Arctic lands is a great hindrance to a fuller realization of the geologic succession in the United States. In a broad way it is known that the Arctic faunas during the Ordovician, Silurian and Devonian spread far to the south, but as to the particular ones that attained the United States little is as yet established. In the hope of adding somewhat to this knowledge, the writer has recently examined the collections gathered by A. P. Low, C. F. Hall and J. G. McMillan, with a view to fixing more accurately the geologic horizons indicated by the various fossils. Deputy-Minister Brock was so kind as to loan for this purpose the fossils in the Victoria Memorial Museum at Ottawa, and Professor B. K. Emerson sent those he described many years ago, which were collected by Hall and are now at Amherst College. For these favors the author is very thankful.

It is the general belief that the Silurian formations are the most widely distributed of Paleozoic strata in Arctic America, and this is probably true. This distribution, however, is seemingly not so general as is held, for it is now known that Ordovician and Lower Devonian strata have been mapped as Silurian. In the end it may turn out that the Ordovician formations have the greatest distribution. Of these latter, two series appear to have equally wide range: (1) those of Black River-Trenton time, and (2) those of Middle Richmond time.

That the Devonian is well represented in Arctic America first became plain through the collections made by Per Schei of the Sverdrup Expedition in the "Fram," 1898-1902. Probably all of Devonian time is represented in Ellesmereland, from the earliest Lower Devonian (Keyser) to the middle of the Upper Devonian. The Lower and Middle Devonian are well recorded here. The former appears to be very much like the Helderbergian of the United States, but the Oriskanian so far is wanting in the collections. On the other hand, the Middle Devonian is of the Euro-Asiatic realm and not of the American province, a fact not fully realized in the work of Meyer (1913).

The following faunal lists record only the more conspicuous fossils. The localities are arranged from the south northward.

*Northernmost Labrador, Cape Chidley.*

Doctor A. P. Low spent the greater part of the years 1903-1904 in the Hudson Bay country and the Arctic islands. While at the trading post of Port Burwell, which is just around from Cape Chidley in Ungava Bay, Low made an interesting collection of fossils from drift pieces of limestone that he thought had been brought there by the ice from Akpatok Island, many miles to the west. Among these fossils are unmistakable Helderbergian species, and as such are unknown on Akpatok it is a question whether this island is the source of these loose limestones. They may be rather from the north and from not far away, on Baffin Island.

The fossils of Cape Chidley represent three distinct horizons, as follows:

## 1. ORDOVICIAN. From dark gray limestones.

*Labyrinthites chidlensis* Lambe. A coral suggesting *Halyssites*, and referred by Lambe to the Halysitidæ. The writer did not see the material. (Described by Lambe in Low 1906: 327.)

*Orthoceras*, sp. undet. In form like *Ormoceras tenuifilum* but with a small siphuncle about 0.25 inch in diameter at the septa.

*Endoceras* cf. *annulatum* Hall. A more slender form than *E. annulatum*, and with a smaller apical angle.

*Endoceras*, sp. undet. In shape like the last one, but without annulations.

*Spyroceras* cf. *vertebrale* (Hall). The annulations are about as numerous as in Hall's figures (Pal. N. Y., I) but less abruptly arched. The siphuncle does not show.

*Plectoceras* cf. *jason* (Billings). Ami labels this *P. obscurum* Hyatt?. It differs from Ruedemann's description of *P. jason* (Bull. 90, N. Y. State Mus.: 484) in that the siphuncle is smaller, but chiefly in that the living chamber occupies three-fourths of the last volution, instead of "less than one-half volution." Diameter of shell 8.5 inches. A large and fine fossil.

*Eurystomites*, n. sp. Ami labeled 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.

These cephalopods, as they all appear to occur together, indicate the lower part of the Black River formation as developed at Watertown, New York. It is probable that this horizon is also exposed on Akpatok Island in Ungava Bay.

2. ORDOVICIAN. A black, fine-grained, thin-bedded limestone.

*Basilicus canadensis* (Chapman). A large tail of this very characteristic trilobite is present.

This horizon is clearly in the lower part of the Collingwood as developed at Collingwood, Ontario, a formation of wide occurrence in that province. It is of wide distribution in southern Baffin Island and will probably be found generally throughout the Arctic region where Ordovician strata are exposed. It may also occur on Akpatok Island.

3. LOWER DEVONIAN. A light-colored, thin-bedded limestone replete with fossils. The following are the species:

*Zaphrentis roemeri* Edwards and Haime. Rare.

*Stropheodonta varistriata* (Conrad). The specimens are very small here.

*Strophonella* like *euglypha* (Dalman) of the Silurian.

*Leptaenisca concava* (Hall). This very characteristic thin-shelled brachiopod is present in many fragments. It attains a larger growth here than in New York. The species is now known to occur almost everywhere where the Helderbergian is exposed.

*Gypidula* (*Sieberella*) *pseudogaleata* (Hall)? Ami has given this the name of *Clorinda lowi* (nom. nud.).

*Gypidula* (*Sieberella*) *coeymansensis chidleyensis* Ami. Specimens of this form make up a slab of limestone, and differ from the New York species in being more decidedly plicated.

*Pleurotomaria labrosa* Hall?. The revolving and growth lines are finer in this specimen than in New York examples.

This geologic horizon is clearly Helderbergian and agrees remarkably well with the uppermost Coeymans division as developed in the United States. *G. pseudogaleata* in New York is, however, restricted to the uppermost Helderbergian (Beeraft), but at Dalhousie, New Brunswick, it occurs at a lower level and is there associated with *Leptaenisca concava* and other New Scotland fossils.

#### *Frobisher Bay Collections of Hall.*

A part of the collections made by Mr. C. F. Hall of New London, Connecticut, on his first expedition to the Arctic regions in 1860–1862 is now in the museum of Amherst College. This material was originally described by Professor Emerson and is that which was loaned the writer for the present study.

In southern Baffin Island the strata appear to lie horizontally. The Ordovician rocks and fossils are from widely scattered localities, extending from the eastern Hall's Islet into southwestern Fox Land. The locality, however, that has furnished subsequent collectors the largest results and the most definite stratigraphic information is at the head of Frobisher Bay at Silliman's Fossil Mount (see Schuchert 1900).

The Hall collections at Amherst also have Silurian fossils from the southwestern corner of Baffin Island. These are from Rescue Harbor in Cyrus Field Bay to the north of Blunt Peninsula.

Three general horizons can be made out in southern Baffin Island, as follows :

1. ORDOVICIAN. Dense gray to cream colored or whitish limestones, in some places approaching lithographic stone. In other places or other horizons the material is a fine-grained, light pinkish, magnesian limestone, but in general the color of all these limestones is the opposite of dark. As a rule fossils are absent in them. In the purer and less dense limestones very small fossils occur, chiefly Ostracoda. The latter were first identified by Professor Emerson, and have been recently restudied by Doctor R. S. Bassler, with the following results :

<i>Leperditia canadensis</i> Jones	}	These two species seem to Bassler to be other forms than those indicated by Emerson.
<i>Primitia muta</i> Jones		
<i>Primitia frobisheri</i> Emerson		= <i>Eurychilina frobisheri</i> .
<i>Beyrichia symmetrica</i> Emerson		= <i>Drepanella symmetrica</i> (related to the Richmondian <i>B. richardsoni</i> ).
<i>Krausella</i> cf. <i>anticostiensis</i> Jones	}	Identified by Bassler.
<i>Macrocypris</i> cf. <i>subcylindrica</i> Jones		

Other associated fossils are a small *Scenidium*, sp. undet. (= *Rhynchonella* Emerson, p. 578), a small *Plectambonites*, sp. undet. (= *Chonetes* cf. *striatella*, p. 578), and fragments of undeterminable trilobites (= Emerson's *Phacops* and *Asaphus*).

The fine-grained, light pink, magnesian limestone from Hall's Island has minute crystalline cavities that Emerson thought might be casts of *Tentaculites*. These the writer could not make out to be due to organisms. Other undeterminable fossils are *Buthotrephis* (p. 575, fig. 1), and *Stictopora ramosa*? (p. 577, may be burrows).

On the basis of the Ostracoda, the only reliable fossils present, the horizon appears to be of Richmondian time, a formation of very wide distribution in North America. Bassler thinks the horizon and faunal realm represented are those of the

English Head formation so well developed on the Island of Anticosti, Gulf of St. Lawrence.

2. ORDOVICIAN. Black, impure, thin-bedded, fine-grained limestones and black limy shales that weather yellowish white, with scattered small fossils as follows :

*Climacograptus bicornis* (Hall). Common at French Head in Cyrus Field Bay and in Fox Land on western Baffin Island. (Also called *Diplograptus dentatus* by Emerson, p. 576.)

*Leptobolus lepis* Hall (= *Lingula curta*, p. 578).

*Cyclora parvula* (Hall) (= *Cyclonema bilix*, p. 578).

"*Endoceras proteiforme* Hall" (p. 579). Not seen by the writer.

"*Orthoceras laqueatum*?" p. 579. Too poor and fragmentary to make out even the genus.

*Conularia trentonensis* Hall, p. 578. A small fragment of a *Conularia* is present.

*Triarthrus beckii* Green. Common in fragments. It is probable that the Collingwood *T. magnificus* Twenhofel is also present (the tails are labeled *Calymene senaria* by Emerson, p. 582).

*Cyphaspis* (?) *frobisheri* Emerson, p. 583, fig. 11. Based on a free cheek ; the genus is not determinable.

*Ampyx*? (Emerson's trilobite sp., p. 583, fig. 10).

*Leperditia alta* (Conrad). This is not Conrad's Silurian species but appears to be a new form of *Leperditia*.

This horizon, on the basis of the above fossils and the further fact that *Basiliscus canadensis* (= *Asaphus canadensis* Chapman) occurs not far to the south at Cape Chidley, Labrador, seems to correlate with the Collingwood formation of Ontario. The same black shale is also present at Countess Warwick Sound, Blunt Peninsula, and probably as well at the head of Frobisher Bay.

3. SILURIAN. Gray, fine-grained dolomites of Rescue Harbor, Cyrus Field Bay, have *Orthis* cf.  *davidsoni*, *Halysites catenularia*, and a pentamerid, probably the same as the next species. Further west in Frobisher Bay in the identical dolomite occurs *Conchidium nysius tenuicostatum* (Hall), a form first described from the Falls of the Ohio. The *Cyathophyllum pickthorni* identified by Emerson (p. 577) are too poor to determine.

This horizon is well up in the Silurian, probably in the lower Lockport, and about the horizon of the Louisville as developed at Louisville, Kentucky.

*Silliman's Fossil Mount, Frobisher Bay.*

Schuchert in 1900 described the fauna of seventy-two species occurring at this interesting locality. None of it had, however, been collected stratigraphically, and as most of the widely distributed species agreed with identical or similar forms occurring in the Galena formation of Minnesota and Iowa (57 per cent) he concluded that all the fossils came from strata of about Galena-Trenton time. On the other hand, the many corals found at Silliman's Fossil Mount he interpreted as "an early introduction of Upper Silurian genera." Since then he has collected the same corals at a much higher horizon, in the Richmond formation on Anticosti Island, and has seen them as well at other places in this country and in Norway and Esthonia, always above the Galena-Trenton equivalents. It therefore follows that the Richmond must also be present at the head of Frobisher Bay.

The above mentioned fauna is kept in the U. S. National Museum and has been restudied by Bassler (1911: 32-36). The latter writes: "There is just as much if not more reason for believing that the Black River, Trenton and Richmond rocks are actually present in the section as for assuming that only Trenton strata occur. . . The Richmond age of the corals was further evidenced by the fact that two very characteristic brachiopods, a variety of *Platystrophia acutilirata* and of *Plectambonites sericeus* came to light when I carefully searched a fragment of limestone adhering to one of the corals. This particular variety of *Plectambonites* is highly characteristic of the Richmond in America and Europe. It is distinguished by the occurrence of small teeth along the edge of the cardinal area of the dorsal valve."

In conclusion, the writer agrees with Bassler that there are at least two Ordovician horizons represented at Silliman's Fossil Mount, namely, (1) a lower one containing the bulk of the fauna and equivalent to the Lower Trenton of Minnesota, and (2) an upper fauna here essentially made up of corals and the equivalent of that of Middle Richmond time. It is probable that the Black River equivalent is also present at the Mount, though less well exposed and on or below the débris-covered lower slope of the Mount.

*Southampton Island, Hudson Bay.*

Doctor A. P. Low on his first expedition in 1903-1904 collected fossils on Southampton Island along "the southern half of the west coast of the island" (1906: 211). Two horizons are clearly indicated, as follows:

1. ORDOVICIAN. Gray to white, dense, magnesian limestone with a scarcity of organisms.

*Rafinesquina alternata* (Emmons). Small specimens up to one inch across.

*Rafinesquina alternata loxorhytis* (Meek) ?. Much smaller than the typical specimens.

*Leptaena nitens* (Billings). Common.

*Zygospira*, n. sp. Reminds of *Z. cincinnatiensis*, but is more coarsely plicated.

*Rhynchotrema*, sp. undet. Recalls small *R. perlamellosum* but no lamellæ show.

*Leperditia* sp. A large form 9<sup>mm</sup> in width.

*Encrinurus* sp.

This formation is clearly the Richmond, and of about the same zone as the ostracod limestone of southeastern Baffin Island.

2. SILURIAN. In a crystalline, slightly granular limestone.

“*Streptelasma robustum* Whiteaves.” Grows to a diameter of 2.5 and a length of upward of 7 inches. A transverse section is not round but oval, with the septa much twisted in the center into a false columella. No fossula is to be seen. In some ways these specimens look like *Streptelasma* and in others like *Zaphrentis*. If they are associated with the undoubted Silurian corals listed below, they are not Whiteaves' species, but as the Richmond formation is also present on Southampton Island it is possible that they are from the Ordovician and then related to *S. robustum*. Lambe has labelled them *S. robustum*, a form common in the Richmond formation of Lake Winnipeg, Manitoba.

“*Pycnostylus elegans*.” As the specimens are molds of the exterior this identification is not yet established.

*Syringopora verticillata* Goldfuss. The corallites are here larger than is usual for this species.

*Plasmopora follis* Edwards and Haime.

*Halysites catenularia* (Linné). As usual there is also here considerable variation in the size of the corallites.

*Favosites gothlandicus* Lamarck. Very common in the typical form with small corallites.

*Favosites gothlandicus* variety. Also very common. Here the corallites are nearly twice as large as in the typical forms of this species. As there are no transition specimens between this and the typical forms of the species, it may be a distinct species.

*Favosites favosus* (Goldfuss). Rare. Here the corallites do not attain the larger sizes of this species seen elsewhere.

*Clathrodictyon vesiculosum* (Nicholson and Murie). This characteristic hydroid is present in three specimens.

“*Pentamerus oblongus* Sowerby ?.” A fragment of a dorsal valve too poor to identify.



*Clorinda*, n. sp. A very large form with relationship nearest to *C. barrandei*, but larger and less plicate.

*Strophonella euglypha* (Dalman) ?.

*Actinoceras*, said to be *A. keewatinense* Whiteaves. Very large annulate siphuncles, completely filled with deposits of lime, up to 1.5 inches in diameter. Very much like but larger than the siphuncles of *A. infelix* of the Silurian of Anticosti Island.

These fossils are clearly from the Silurian and the majority of species are indicative of a horizon of about Clinton time, as developed on Anticosti Island.

*Winter Harbor, south side of Melville Island.*

*Ordovician.*—McMillan, with Captain Bernier on the latter's expedition to the Arctic islands and Hudson Strait in 1908–1909, found in a drift piece of limestone a very large *Tripteroceras* that originally had a length of one foot. Forms similar to this occur in the Trenton of Iowa, Minnesota and Manitoba. The horizon and faunal realm appear to be in harmony with those of the Galena-Trenton of Iowa and Minnesota. It is unfortunate that this interesting fossil has no direct stratigraphic value because of its drifted source on an island whose native rocks are of Carboniferous age. For other details see Lambe in Bernier 1910 : 485.

*Beechey Island, southwestern corner of North Devon Island.*

*Lower Devonian.*—At Cuming Creek in the center of the southern shore of North Devon Island, Low states that the Archean gneisses are unconformably overlain by horizontal formations consisting of "red and purple arenaceous shales and thin-bedded sandstones having an aggregate thickness of fifty to one hundred feet. These in turn were succeeded by beds of impure limestone of light gray or creamy color. The beds are usually under two feet in thickness, and separated by thinner beds containing a considerable amount of clay. These light-colored limestones have a thickness of over 1000 feet in the cliffs on both sides of the creek. . . . Fossils are only found in the beds immediately overlying the dark shales and sandstones of the base." The limestone cliffs rise above the sea up to 1200 feet. Farther inland they rise in steps to nearly 2000 feet.

"Similar conditions prevail in the cliffs at Beechey Island [at the southwestern corner of North Devon Island], where a large collection of fossils was obtained from the lower limestone beds, while others, picked up loose, but evidently fallen from the cliffs above, showed that the upper beds passed close to if not into the Devonian.

“Similar Silurian limestones constitute the island of Cornwallis, to the westward of North Devon” (220–221).

The following fossils were gathered by Low on Beechey Island in 1904 and again by McMillan on the expedition of 1908–1909. It was on Beechey Island, it will be remembered, that Franklin and the crews of the “Erebus” and “Terror” came to their sad end. From dark-colored, thin-bedded limestones replete with fossils but in no great variety were found the fossils listed below. This is the widely distributed *Lissatrypa phoca* fauna and may be, as noted by Høltedahl, somewhat younger than the Ellesmereland fauna noted beyond. (For other details see Ami in Low 1906:329, and Lambe in Bernier 1910:479.)

“*Strophodes pickthornii*” (Salter). This common cup coral looks to the writer more like *Zaphrentis roemeri* Edwards and Haime.

*Favosites* cf. *helderbergiae præcedens* Schuchert. Small hemispheric masses. Has been erroneously labeled *F. gothlandicus*.

*Boreaster lowi* Lambe. A *Favosites*-like coral with septa as in *Calapcecia*. Described in Low 1906:323.

*Acervularia austini* (Salter). Very common and in colonies of up to 10 inches across. They are found in the lowest 50 feet of the limestones following the basal shale series. A very similar species occurs rarely in the basal Devonian limestones of New York and Maryland.

*Atrypa phoca* (Salter). Common. A smooth atrypoid to be placed in *Lissatrypa*, a new genus to be defined by Twenhöfel, and based on a much older species found on Anticosti Island. *L. phoca* and *Acervularia austini* are the guide fossils to the basal Devonian strata of North Devon.

*Meristella*, sp. undet. A small species that is exceedingly common and erroneously labeled by Ami as *Atrypa phoca*.

*Hormotoma* and *Holopea*. Small forms that remind much of those found in the Manlius of New York.

*Leperditia*, sp. undet. A large form up to 0.5 inch in width. It may be identical with *L. elongata* Weller, found in the Rondout of New Jersey and Keyser of Maryland.

This horizon is in the Lower Devonian and of about the time of the Keyser of the Maryland section (see Lower Devonian volume of the Maryland Survey, 1913). The writer could not have made out this correlation if he had not had the advantage of studying another collection made further north by Per Schei of the Sverdrup expedition of 1901–1902. This material has just been described by Doctor Olaf Høltedahl of the University of Kristiania, Norway, where the Per Schei collections are kept, in a work noted beyond. Ami in Low's report has listed a fauna of thirty-five species.

*Ellesmere Island.*

An excellent stratigraphic work by Hortedahl of the University of Kristiania has just appeared, dealing with the fossils collected by Per Schei in his "series B" on Goose Fiord, which is at the southwestern corner of Ellesmere Island. Overlying the brown limestones of the Silurian, here of great thickness, are dark, more or less thin-bedded limestones about 1000 feet thick, which, so far as can be judged from the fossils at hand, are determined by Hortedahl to be of Lower Devonian age, that is, equivalent to the Keyser of Maryland, and apparently entirely beneath the New Scotland of the New York Helderbergian. It is, however, possible that the Coeymans may be represented in the upper strata of series B. Even though but a few of the Keyser species can be determined in the Arctic region, it is remarkable that any are found there, since the two areas are more than 35 degrees of latitude or about 2400 miles apart.

Hortedahl describes a fauna of forty-three species, of which twenty-one are named, and of these nine are new. The more important of these fossils are as follows (those marked\* also occur in Maryland, and those marked† have closely related representation):—

\* *Favosites* cf. *helderbergiæ* Hall.

\* *Cladopora rectilineata* Simpson.

*Thecia swinderenana* (Goldfuss).

*Monograptus* allied to *Pristiograptus colonus* Barrande. There is also a form of *Monograptus* in the New Scotland of New York.

*Stropheodonta patersoni antiqua* Hortedahl. This species occurs in New York in the Onondaga.

\* *Gypidula coeymanensis prognostica* Schuchert.

† *Stenochisma deckerense arcticum* Hortedahl. This species occurs in Maryland.

† *Camarotoechia litchfieldensis angustata* Hortedahl. Also found in Maryland.

*Lissatrypa scheii* Hortedahl. Closely related to *L. phoca*.

† *Spirifer modestus striatissimus* Hortedahl. This species is common in Maryland.

\* *Spirifer vanuxemi prognosticus* Schuchert.

\* *Loxonema fitchi* Hall.

† *Leperditia symmetrica* Hortedahl. Large forms of this genus are characteristic of the American Lower Devonian.

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