

36. PALÆONTOLOGY of the COASTS of the ARCTIC LANDS visited by the late BRITISH EXPEDITION under Captain Sir GEORGE NARES, R.N., K.C.B., F.R.S. By R. ETHERIDGE, Esq., F.R.S., V.P.G.S., &c. (Read April 17, 1878.)

[PLATES XXV.-XXIX.]

INTRODUCTION.

It is no easy matter to parallel or attempt to correlate the older Palæozoic rocks of the northern extremity of British North America with the probably contemporaneous rocks extending as far northward as within 7° of the Pole, much more with those of Northern Europe and Britain.

The collection made by Capt. Feilden, Lieut. Aldrich, Drs. Copping and Moss, and Mr. Hart clearly shows that great masses of metamorphic and Palæozoic rocks occur, and occupy an extensive area, both in Grinnell Land, Grant Land, and Greenland. Whether these can be shown to be a continuous portion of the Laurentian\* or Huronian rocks of Canada, or the fundamental or oldest gneiss of the north-west coast of Scotland and the Western Islands, remains yet to be proved. There is every probability that these ancient hornblende schists do extend from North Britain to North America, and underlie the greater part, if not the whole, of the North Atlantic and Polar Sea.

Hitherto the Laurentian type of Canada has not been discovered in the British Isles, neither have we amongst the 'Alert' and 'Discovery' collections any specimens that can be said to agree with the Magnesian and Eozoonal conditions of this fundamental rock. The North-Atlantic Ocean, which occupies so large an area, may, indeed, rest upon a great expansion of our Hebridean Gneissose series, and Huronian or Cambrian and Silurian rocks may overlie this; and probably, if clear sections could be seen, and superposition determined, they would be found to pass upwards into the Potsdam or Lower Silurian series of America. The extensive collection of rock-specimens made indicates this probable succession; and few as are the Lower-Silurian fossils brought home, they are enough to show the succession to be much the same as in British North America and the British islands; and the Upper Silurian fossils of Dobbin Bay, Cape Hilgard, Cape Louis Napoleon, Offley Island, &c. confirm this unmistakably. Moreover we are enabled to correlate these Upper Silurian fossils with the Wenlock group of Britain; but, nevertheless, they have a facies allying them to the American types rather than to our own.

\* Laurentian rocks are noticed at pp. 324, 327, and 541 of the 'Arctic Manual.'

Succeeding these, in lat.  $82^{\circ} 40'$ , there appears to be a Devonian series, judging from the broad-winged *Spiriferæ* brought home from Cape Joseph Henry and Feilden Peninsula, lat.  $82^{\circ} 47'$ ; and probably much of the extreme northern coast of Grinnell Land contains a clearly developed Carboniferous-Limestone fauna identical with that so widely distributed over the North-American continent, and referable also to our British and Spitzbergen species. Of the Coal-measures above them (if they occur) we know nothing at present.

The large series of fossils obtained during the voyage of H.M. ships 'Alert' and 'Discovery' was placed in my hands for examination. The chief interest attached to the series arises from the fact that no previous expedition had reached so high a latitude, and certainly no collection ever exceeded in magnitude that under examination, which, including the rocks, comprises nearly 2000 specimens. Great credit is due to those who collected and succeeded in bringing or conveying them through the arduous sledge-journeys to their respective ships. The series collected by Captain Feilden are all so carefully noted, labelled, and localized, that their history is complete and satisfactory; so also with the fine series belonging to Dr. Copping: rarely, indeed, in the most accessible localities in Britain, have specimens been better or more carefully collected than by the officers of the Expedition. The fossils of Miocene age, collected by Messrs. Feilden and Moss from Discovery Bay, were sent to Prof. Ö. Heer, of Zurich, for determination; and that distinguished naturalist has furnished a valuable report upon the fragmentary remains of the fossil plants (chiefly leaves) occurring in the black shales that overlie the great coal-seam at Discovery Bay, which is undoubtedly of Miocene age and the same as that at Disco Island. Prof. Heer catalogues no less than thirty species, and has been enabled to correlate these with the Spitzbergen Miocene beds: about eighteen species are common to the Miocene flora of the Arctic zone; and, so far as the collection shows, the Discovery-Bay (Grinnell Land) Miocene beds are more nearly allied to the Spitzbergen deposits than to the Disco or Southern-Greenland beds,  $11^{\circ}$  further south. Species of *Equisetum*, *Torellia*, *Thuites*, *Taxodium*, *Pinus*, *Populus*, *Salix*, *Betula*, *Corylus*, *Ulmus*, *Viburnum*, *Nymphæa*, &c. occur in the black shales overlying the great coal-seam. None of the above genera now exist within the Arctic circle. A small collection of Silurian Mollusca and Corals from Cape Joseph Henry has also been sent to me by Dr. Moss, of the ship 'Alert.' A considerable number of the rock-specimens and minerals have been named by Mr. W. Rudler, and the remainder by myself; at present no deductions have been drawn from the result of this examination. Large numbers of specimens of fundamental gneiss, mica-schist, quartzites, slates, impure limestones, and conglomerates occur in the collection, affording complete evidence as to the geology and physical structure of the coasts on both sides of Smith Sound, Kennedy Channel, Hall Basin, and Robeson Channel, and round the north shore of Grinnell Land, the most northerly land ever yet reached. The series of rocks collected by Lieut. Aldrich, R.N., during the arduous journey made

by his party with the "Alert' and 'Discovery's' dog-sledges," may never again be obtained; they now illustrate the structure of the nearest known land to the Pole, in latitude  $83^{\circ}$ , and were brought back to the 'Alert' under the greatest difficulties and privations.

Much has been done relative to Arctic geology and palæontology by previous writers, with regard to the North-American continent, Spitzbergen, and Scandinavia, as well as in those latitudes bordering the Polar circle; still every new expedition or voyage increases our knowledge of the fossil fauna and flora of these regions, notably so the present, under the command of Captain Sir G. Nares, whose officers penetrated as far north as lat.  $83^{\circ} 6'$ , head or winter quarters being in lat.  $82^{\circ} 27'$ . During the memorable sledge-journeys from the 'Alert' and 'Discovery,' the most northerly land yet known was searched, and the practical result conveyed back to the ships in the shape of a large collection of rocks and fossils made along the northern shores of Grinnell Land, from Cape Joseph Henry, lat.  $82^{\circ} 47'$  N., long.  $63^{\circ} 50'$  E., to Cape Alfred Ernest, lat.  $82^{\circ} 15'$  and W. long.  $80^{\circ}$ , Feilden Peninsula, lat.  $82^{\circ} 50'$ , Point Hercules, lat.  $82^{\circ} 40'$ , and Cape Columbia,  $83^{\circ} 6'$ , the most northerly headland known; collections were also made at Port Foulke, Cape Isabella, Discovery Bay, Lincoln Bay, Cape Union, Offley Island, and Petermann Fiord; also at Hayes Sound, lat.  $78^{\circ} 50'$ , Cape Frazer, lat.  $79^{\circ} 44'$ , Cape Victoria, lat.  $79^{\circ} 12'$ , Walrus Island, lat.  $79^{\circ} 25'$ . At all these stations collections were made from rocks *in situ*, a matter of much importance to a right interpretation of the sequence or stratigraphical position of the specimens. It appears that a great thickness of unconformable and unfossiliferous Archæan (azoic) rocks, of younger date than the Laurentian or fundamental gneiss, but older than the Silurian series, occupy the east shores of Grinnell Land from Scoresby Bay to Cape Cresswell, lat.  $82^{\circ} 40'$ , and east of Robeson Channel, on the Greenland coast, equivalents in time of the great Huronian series of North America and Canada; whether continuous or not it is perhaps impossible to say at present. These "Archæan" rocks, which constitute the great Azoic series (Laurentian and Huronian), and preceded the Cambrian and Silurian, seem to occupy the position mentioned; for the present the name "Cape-Rawson beds" has been applied to them as applicable to the geographical position and distribution of these extremely northern azoic rocks, thus avoiding a strict and uncertain correlation with the known American "Archæan" rocks. No organic remains whatever have occurred in these Cape-Rawson slates, quartzites, grits, and impure limestones, which constitute masses of land 3000 feet high. The physical structure and aspect of these ancient schists have been described by Captain Feilden and Mr. De Rance, F.G.S.

Looking at the facies of the fossils in the collection, and comparing them with the fauna of North America and Canada on the one side, and that of Greenland, Spitzbergen, Scandinavia, Europe, and Britain on the other, it becomes a difficult question to which area and faunal type we may or can safely refer them; in other words, Are

the species in the Arctic collection more closely allied or equivalent to those of Arctic America, or to the fauna of the western hemisphere? or can they be equally referred to that of the northern part of the European continent, especially Norway and Sweden or the Scandinavian peninsula, or to the British islands? Many species are common to both areas, especially in the groups of the Cœlenterata and Brachiopoda, the latter markedly in the Carboniferous series.

It cannot be doubted that an extensive Silurian fauna is present from lat. 79° to lat. 82° N., illustrating the lower and upper divisions, the latter largely, especially the Wenlock series. A few Devonian *Spiriferæ* occur in the collection, succeeded by a characteristic series of Carboniferous-Limestone Mollusca (Cephalopoda, Gasteropoda, Brachiopoda, and Polyzoa)—all other Palæozoic rocks, so far as we know, being absent, no Coal-measure or Permian species occurring in the collection.

Our knowledge of the distribution of life through the rocks of the Arctic region and within the Polar circle, as well as our information relative to the general geology, mineralogy, and petrology of the Polar regions, has been largely added to by the collections made during the present expedition. A more general series of fossil Invertebrata has been collected, and a fine series of the rocks composing the Laurentian, most of which have been obtained *in situ*, others from the drift, or borne upon glaciers from higher regions, probably remote from the coast, or from the talus which abounds under the cliffs constituting so conspicuous a feature along the shores of Grinnell Land, Petermann Fiord, and Hall Land—in fact, on both sides of Robeson and Kennedy Channels. A large number of slabs and masses of limestone were also obtained from the last-mentioned sources; these contain organic remains, which plainly tell their age, but not their locality, though I believe that nearly all, if not all, the specimens are derived from localities both east and west, as well as north, depending upon the direction of the flow of the land-ice or glaciers on which they were carried, or possibly of the “ice-foot.”

#### AMERICAN AFFINITIES.

The presence in the collection of *Maclurea magna*, *Receptaculites Neptuni* or *occidentalis* and a new species of this genus, *Favosites gothlandicus*, *Halysites catenulatus*, *Favistella*, &c., all having a peculiar facies and mineral aspect, differing in many respects from the known European series, leads us to the belief that the fossil fauna of Grinnell Land and the north-western shores of Greenland must, on the whole, be correlated or affiliated with that of Arctic America; and although, as might be expected, many of the species, both of the Silurian and Carboniferous groups, are common to both continents, and probably derived from both areas during their life, nevertheless I believe the mass of the fauna belongs to the western hemisphere. The Scotch Silurian fauna has little or no affinity whatever with the Arctic species, neither do the Carboniferous series of Scotland appear to

have much affinity with those collected and brought home by the expedition. Their general facies is different, and few species are common to both areas. This is probably what we should expect, looking at the mass of land in Arctic America, and knowing that it is composed chiefly of Lower and Upper Palæozoic rocks. Little, however, if any thing, was known of the geological structure of that great region north of Parry Islands, North Lincoln, Ellesmere Land, and much of Grinnell Land until the present expedition explored the region of Grinnell Land called Grant Land, where a definite coast-line has been determined through the sledge-journey and observations of Lieut. Aldrich, who collected and brought back rock-specimens obtained *in situ* from Cape Columbia, &c., the most northerly land reached. Lieutenant Payer, the historian, and one of the leaders of the Austrian Arctic expedition of 1872-74, assigns to Cape Wien, Petermann Land, nearly the same latitude as to Cape Columbia; but Cape Fligely, the most northern point actually reached by him, is exactly one degree south.

The Carboniferous-limestone fossils brought home by Captain Sir G. Nares (collected by Captain Feilden) is as extensive, as regards species, as any Arctic series yet brought to this country, and from a much higher latitude, all being from north of lat.  $81^{\circ} 6'$ , chiefly from  $82^{\circ} 40'$ . The facies is North American and Canadian, although many of the species are British; this, however, we should expect, knowing how widely the Carboniferous-limestone fauna was distributed over the northern hemisphere. The Coral fauna (Actinozoa) is small, only two species occurring in the Carboniferous Limestone, the Silurian Actinozoa being represented by twenty-one genera and twenty-four species, or little more than one species in a genus. The Carboniferous Molluscoïda, through the Polyzoa, number four genera and ten species, the individuals being tolerably abundant. The Brachiopoda number eight genera and about twelve species, many of them British. No Lamellibranch, Gasteropod, or Cephalopod has occurred in the Carboniferous series, which is remarkable, and can only be accounted for from the circumstance that the collection represents the rocks in time rather than in space, or is vertical rather than horizontal, owing to the general surface of the country being now covered by snow and ice, so that only the cliffs or highly inclined beds can properly or really be examined and therefore collected from. These remarks apply equally to the smaller collection made by Mr. Hart, of the ship 'Discovery.' Mr. Hart's series consists chiefly of Silurian rocks and fossils obtained at Cape Hilgard, Bessels Bay, and Dobbin Bay.

Contrasting the Silurian collection with that from the Carboniferous Limestone, the species are much more numerous, the Actinozoa greatly so. The Cephalopoda, through the genera *Orthooceras* and *Cyrtoceras*, are tolerably abundant, but there are no Lamellibranchs whatever. The Silurian Brachiopoda number about five species, much fewer than would be expected from a comparison with the Upper Silurian facies of Britain, Scandinavia, and America, upon or about the same horizons.

My reference to the belief of a Devonian fauna south of Cape Joseph-Henry is based upon the presence of a few Brachiopoda of peculiar type. The Dana-Bay Carboniferous beds appear repeated by a fault along their strike, and therefore probably not exposing their base. These presumed Devonian fossils were obtained *in situ* from a ravine or torrent-course. The want of other fossils than plant-remains in Heer's Ursa stage precludes comparison here; and as we know that the well-determined horizon of his Ursa-stage flora is at the base of the Carboniferous series, or close of the Devonian epoch, it almost leaves in doubt the position I should assign to these few molluscan remains. Mr. Carruthers, F.R.S., believes that both the Bear-Island and Irish deposits, containing *Lepidodendron* (*Cyclostigma*), were of Devonian age; and I entirely agree with him, knowing at the same time how difficult it is to separate the Upper Devonian from the lowest Carboniferous when one group is conformable to the other.

The important and complete 'Manual of the Natural History, Geology, and Physics of the Arctic regions,' edited by Prof. Rupert Jones, F.R.S.\*, gives so complete a list of works and references to all the chief papers relative to Arctic literature, that any bibliography or enumeration of works of reference would here be superfluous. I therefore refer all interested in Polar natural history and geology to the portion of the Manual from page 324 to page 604, where every thing bearing upon these questions is cited.

We have no true evidence of the presence of any Permian rocks within the Polar area, although Toula† (1874-5) refers many of his Polyzoa and Brachiopoda to what he calls Permo-Carboniferous rocks, when the species are common to the two horizons; and he notices the Bell-Sound and Axel-Island species in Spitzbergen; De Koninck also believed that the Polyzoa of Bell Sound were of Permian age. Toula‡ describes species of *Fenestella*, *Polypora*, *Ramipora*, *Phyllopora*, and *Glauconome*§ from this so-called Permo-Carboniferous horizon. Nordenskiöld has also determined that the Spitzbergen true Carboniferous Limestone contains an admixture of species of Polyzoa occurring in other countries only in Permian strata.

No Triassic strata have been detected either in this or any previous expedition; whether, therefore, either the Permian and Trias seas, or both, aided in the denudation of the Carboniferous group, or their sediments were *deposited* and then denuded before the deposition of the Lias, which rests upon the Eglinton-Island Carboniferous Limestone, must still remain an undetermined question. It would

\* Manual of the Natural History, Geology, and Physics of Greenland and the neighbouring regions. Prepared for the use of the Arctic Expedition of 1875. Edited by Prof. Rupert Jones, F.R.S. &c. 1875.

† 'Permo-Carb. Fossilien von der West-Küste von Spitzbergen,' pp. 225-264, t. 5-10.

‡ *Vide* notes on bibliography in present paper by R. Etheridge, jun.

§ Proc. Imp. Acad. Sci. Vienna, June 1874, vol. lxx. p. 133.

therefore almost appear that it must have been a continental land, through elevation of the Carboniferous group, until the northern extension of the Liassic seas to these high latitudes. The complete absence (so far as we know) of Permian and Triassic strata in the Parry or Northern archipelago goes far to confirm this. Not a trace of any organic remains younger than the Carboniferous Limestone, and older than the Miocene, has occurred to Feilden and Hart, or to any of the other explorers during their researches in these high latitudes.

SILURIAN.

Kingdom PLANTÆ.

Subkingdom CRYPTOGAMIA.

Genus BUTHOTREPHIS, Hall, 1847.

BUTHOTREPHIS GRACILIS, Hall.

*Buthotrephis gracilis*, Hall, Pal. New York, vol. i. p. 62, t. 21. f. 1.

This may probably be the remains of a marine alga, originally forming filmy impressions or remains on the mud or sand when deposited. Hall's genus *Buthotrephis* may receive our specimen; it was established by him in 1847 to receive such peculiar and dubious markings. *B. gracilis* is the nearest form figured, and closely resembles our single specimen, which was collected by Capt. Feilden at Gould Bay in a fine-grained fissile sandstone. I therefore refer this to *B. gracilis*, Hall, as being almost, if not quite identical.

*Loc.* Gould Bay, lat. 79° 43'.

Kingdom ANIMALIA.

Class SPONGIDA.

Genus STROMATOPORA, Goldfuss, 1826.

Amorphous masses of this Sponge(?) occur in the white limestone of Bessels Bay, but so highly crystalline that nearly all traces of character are gone; the thin superimposed concentric layers, and the somewhat twisted, irregular, rugose base, can be made out; polished sections reveal scarcely any or no definite structure, owing to the altered state of the limestone. I have difficulty in clearly detecting (probably from the same cause) any vertical tubuli or oscula, so apparent in the Devonian species, *S. concentrica* &c., in which these tubuli radiate nearly at right angles to the mass, giving it an apparent fibrous structure vertical to the laminæ, and appear as pores upon the external surface. These characters are very well defined in the Devonian form. The genus *Stromatopora* must have

abounded in this area, and evidently grew in large parasitic, or incrusting, concentrically laminated masses, equalling in size *Haly-sites*, *Heliolites*, or *Favosites*. Although polished sections scarcely show the tubuli, still I am not justified in placing these specimens among the Corals or removing them from the Protozoa.

STROMATOPORA CONCENTRICA, Goldf.

*Stromatopora concentrica*, Goldf. Petref. Germ. vol. i. p. 22, t. 8. f. 5; Lonsd. Murch. Sil. Syst. p. 680, t. 15. f. 31; Hall, Pal. N. Y. vol. ii. p. 136, t. 37. f. 1, t. 37 A. f. 1.

This apparently amorphous sponge(?) is composed of infinitesimally thin concentric layers or laminae, pierced vertically by cylindrical tubes (tubuli), which when weathered have fibrous structure; considerable space occurs between the imbedded tubuli; the intermediate tissue appears to be solid, but the amorphous and crystalline condition forbids the original structure (and its replacement) being made out. One Devonian species comes very close, and may be taken for the Bessels-Bay form.

*Loc.* Bessels Bay, lat. 81° 6', in white limestone.

Genus RECEPTACULITES, DeFrance, 1827.

This remarkable Protozoon occurs somewhat abundantly in the Feilden-Nares collection, and is apparently of considerable size. Unfortunately most of the specimens are very fragmentary, all showing the great thickness of the body-wall, but scarcely allowing a correct opinion to be formed as to the dimensions and form, either of the base, summit, or sides, or even if it were a discoidal species. Should our specimens be the basal portions only of the body-wall of a discoidal form, it must have been of gigantic size, and certainly an unknown species. No portions of the specimens show the rounded protuberance or nucleated portion or primitive cell at the base; this would determine somewhat the size to which this species grew, and whether the base was concave or flat. The flat specimens of another form we possess may be only the basal portions of the body-wall of some discoidal species. Some show the base or underside with the point of convergence of the spirally arranged lines or rows of plates of the outer surface. The body-wall of some of the fragments also shows both the internal integument or endorhin, and external or ectorhin, and the closely arranged tubular or spicular skeleton between the walls; the thickness of the skeleton or space between the endorhin and ectorhin, as shown in vertical sections, is considerable, which causes the tubular system to occupy in the body-wall a space of three fourths of an inch. I have no means of knowing the original form our specimens tend to illustrate; but the description of the Canadian species by Messrs. Billings and Salter leads me to believe that the Cape-Frazer specimens are new, neither *R. Neptuni* nor *R. occidentalis* (if they are not conspecific) occurring half the size

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of our species. *R. Neptuni* and *R. occidentalis* are from the Trenton Limestone (our Caradoc and Bala series). Of the twenty species recorded, eighteen are Lower Silurian; only two (*R. hemisphericus*, Hall, and *R. subturbinatus*, Hall) appear to be from the Niagara series (Upper Silurian); and one (*R. infundibulum*, Hall) is said to be from the Lower Helderberg group (Devonian). Our specimens are, I believe, from the Lower Silurian series at Cape Frazer and Cape Louis Napoleon, where they are associated with *Maclurea magna*, *Asaphus*, &c. Dr. H. A. Nicholson, to whom I submitted our fragments, also believes them to be portions of a new and large species.

I propose to name it *Receptaculites arcticus*, its occurrence both at Cape Frazer (lat. 79° 45') and Cape Louis Napoleon (lat. 79° 38'), in Grinnell Land, showing its position so far within the Polar circle.

#### RECEPTACULITES ARCTICUS, Etheridge.

Body-wall thick; space between the endorhinal and ectorhinal walls nearly an inch in places; tubuli or spicula about six in the space of one inch, and about one eighth of an inch in diameter; interstices large, or nearly equal to the diameter of the tube; ectorhinal surface regularly covered with quadrangular or rhomboidal closely fitting plates, corresponding to the tubuli in places. Circular pores at the angles of the plates in endorhin not seen; tubuli more glass- or spindle-shaped, much more so than in *R. occidentalis*, where they are nearly columnar; the upper ends or terminations of the tubes do not appear to expand so much as in *R. occidentalis* and *R. Neptuni*; the entire wall and tubular system is so very crystalline that more intimate structure cannot be made out; and as the six fragments are not from one individual, accidentally broken in extraction, there is no means of determining the size; but portions of the wall showing the curve either of the base or sides would indicate that it must have been at least 12 inches in diameter.

It is evident that thickness alone of the wall and tubular system must not be insisted upon as a specific character; for in the same specimen the difference in this point is extreme, where the tubes of the basal part are short, especially near the nuclear portion becoming elongated at the sides, thus making the space between the ectorhinal and endorhinal walls of considerable thickness; or in the same specimen the walls will vary in thickness according to the portion examined\*.

This species apparently comes from the upper part of the Lower Silurian rocks of Cape Frazer, lat. 79° 45', and Cape Louis Napoleon, lat. 79° 38', associated with *Halysites catenulatus*, var. *Feildeni*, *Favosites gothlandicus*, *Maclurea magna*, *Asaphus*, and *Strophomena euglypha*.

*Loc.* Cape Louis Napoleon, lat. 79° 38', and Cape Frazer, lat. 79° 45'.

\* Polished sections show that the tubuli "radiate from the base, and assume a vertical position in ascending," as in *R. Neptuni*.

RECEPTACULITES OCCIDENTALIS, Salter.

*Receptaculites occidentalis*, Salter, Geol. Survey of Canada (Canadian Org. Remains), decade 1, p. 45, t. x. figs. 1-7.

*R. Neptuni?*, Hall, Pal. N. Y. vol. i. p. 68, t. 24. fig. 3.

We have several fragments of this species, enough, however, to determine them to be portions of *R. occidentalis*, Salter. Its discoidal form, quincuncially arranged, spiral, yet concentric lines of cells (engine-turned in pattern) upon the upper surface, and their rhomboidal form on the underside, with round columns having also interstitial spaces nearly equal to their diameter, all tend to correlate this with the Canadian species.

The much more robust or gigantic form which I have named *R. arcticus* cannot be any expanded portion of the side or side walls of this species; the tubuli between the endorhin and ceterhin are also different in shape. Salter remarks that "the thickness of the disk near the centre is but little; but this increases rapidly towards the margin, becoming in some cases half an inch thick at twice the distance from the centre." I refer to this character in case my species *R. arcticus* may be a variety of *R. occidentalis*.

*Loc.* Cape Louis Napoleon, lat. 79° 38'.

Class HYDROZOA.

Family MONOGRAPTIDÆ.

Genus MONOGRAPTUS, Emmons, 1856.

*Rastrites*, Salter.

MONOGRAPTUS CONVOLUTUS (His.), var. COPPINGERI, Ether. (Pl. XXV. fig. 1.)

*Prionotus convolutus*, Hisinger, Leth. Suec. p. 114, t. 35. f. 7.

*Graptolithus spiralis*, Gein., Leonh. & Bronn's Jahrb. 1842, p. 700, t. x. p. 20-29.

*Graptolithus convolutus*, Carr. Geol. Mag. vol. v. p. 127, t. 5. f. 1.

Two worn fragments of this subclass and family have been brought home, both unfortunately from the drift of Polaris Bay. Great interest is attached to them on account of the age of the rocks they probably illustrate and characterize. It is the first instance of any Graptolitic form occurring within the polar area; and only one species of *Monograptus* (*Rastrites*), and this from rocks of Caradoc age, seems to be known in America. These fragments appear to be portions of a large *Graptolithus* or *Rastrites*, evidently from fissile shales or thin calcareous bands in some argillo-calcareous rocks.

Although Mr. Carruthers has figured this species in the Geol. Mag. vol. v. t. 5. f. 1, yet I venture to do so again, on account of its occurrence in the Polar collection. Owing to the state of preservation the two spinous processes from the sides of the cell and

mouth cannot be seen; but the linear and isolated condition of the cells and other characters are manifest. We do not see the early or first cells, which should be long and slender; but their triangular form in advanced age is well shown.

The specimens occur in fissile, hard, argillaceous limestone.

The high latitude where these fragments were obtained (lat.  $81^{\circ} 40'$ ) tends to confirm the belief that the Llandeilo or Caradoc series is represented so far north, this being partly, if not entirely, confirmed by the presence of large *Maclurea* and *Receptaculites*, *Helicocotomæ* and *Heliolites*, &c. Barrande obtains *Rastrites* (*Graptolithus*) from his Étage E, or base of the Upper Silurian rocks of Bohemia.

*Loc.* Thank-God Harbour, lat.  $81^{\circ} 40' N.$ , in drift.

#### Class ACTINOZOA.

A large series of sclerodermic corals have been collected both by Captain Feilden and Dr. Coppinger, and many by Mr. Hart and Dr. Moss. The Bessels-Bay, Offley-Island, and Dobbin-Bay species were collected *in situ*. Those from Petermann Fiord, Cape Tyson, and Polaris Bay are all from the drift, talus, and the ice-floe. The two groups Rugosa and Tabulata are fairly balanced as regards number of species, but the chief tabulate coral numerically abundant is *Favosites gothlandicus*; it seems to occur everywhere in the Upper Silurian rocks of the arctic circle. The Tabulata include *Halysites* (the chain-coral) in three varieties, abundant also; *Heliolites* and *Syringopora* a few specimens only; *Alveolites* rare.

Among the Rugosa, we have in the collection *Favistella*, *Zaphrentis*, *Amplexus*, *Cyathophyllum*, *Arachnophyllum*, *Calophyllum*, *Strephodes*, and *Lithostrotion*.

These undoubted reef-forming corals of the Silurian epoch were just as much inhabitants of warm water in southern latitudes at that period as are the Sclerodermata of today in the Indo-Pacific and Atlantic Oceans; and as we know of no compound coral that will exist at a lower temperature than  $68^{\circ} F.$ , and as the surface-waters under the equator in the Pacific have a temperature of  $85^{\circ} F.$ , and in the Atlantic  $83^{\circ}$ , it seems clear that the range from  $68^{\circ}$  to  $85^{\circ} F.$  is best adapted to and not too high for the growth of the reef-making species. We may fairly assume that the temperature of the polar waters during Palæozoic times was as high as that of the Indo-Pacific and Atlantic now, where coral-reefs abound. We are not justified in supposing that the laws regulating oceanic life were very different then from those now existing (in the same groups) under the equator or between the tropics. These corals were forms of life which must have been tropical in habits and requirements. We know nothing of the ancient isotherms or isothermal laws that then, as now, through temperature greatly governed or influenced the distribution of life over the globe, whether upon land or in the sea. All is not due to supposed changes in the direction of the earth's axis or place of the pole. We have yet to learn some-

thing of the physical geography of the Northern Hemisphere during Palæozoic times, and the causes that produced the high temperature of the arctic seas during and between the Palæozoic and Miocene periods. We now know that both American and European species occur together in the rocks of King William's Island and Dépôt Bay &c. in Bellot's Strait, and, further north still, up Smith Sound along the shores of Grinnell Land and Greenland as far as 82° 43'.

*Favosites gothlandicus* and *Halysites catenulatus* seem to be universally distributed through the Silurian rocks of all northern latitudes, abundantly in the polar regions; *Heliolites* also thrived, if we may judge from the size of the coralla; and also *Favistella*, which, like *Favosites*, must have flourished at moderate depths. These Actinozoa were associated with *Receptaculites*, *Maclurea*, *Orthoceras*, and Trilobites. Additional proof of the abundance of life is shown by the formation of great deposits of limestone, both Silurian and Carboniferous, equalling in mass those in so-called warmer climates or latitudes.

The Lower Silurian series, through the Chazy, Trenton, Utica, and Cincinnati groups, is represented in the polar fauna by *Maclurea magna*, *M. Lojani*, *Ormoceras*, *Favistella*, *Syringopora*, *Halysites*, and Trilobites. The Upper Silurian is represented by the Niagara and Lower Helderberg rocks, containing *Stromatopora*, *Heliolites*, *Zaphrentis*, *Cyathophyllum*, &c., the species of which will be noticed in their respective places. The Cœlenterate fauna, therefore, of the Silurian polar seas, judging from the character and number of specimens collected by the naturalists of the Expedition, must have been a large and prolific one, which, it is hoped, will some day be thoroughly examined.

#### Group TABULATA.

##### Genus FAVOSITES, Lamk. 1812.

##### FAVOSITES GOTHLANDICUS (Fougt).

*Corallum gothlandicum*, Fougt, Amœn. Acad. 1749, vol. i. p. 106, t. 4, f. 27.

*Favosites gothlandica*, Lamk. Hist. Nat. vol. ii. p. 206; M.-Edw. & Haime, Mon. Brit. Sil. Corals, Pal. Soc. p. 256, t. 60, f. 1.

*Calamopora gothlandica*, Goldf. Petref. Germ. vol. i. p. 77, t. 26, f. 3.

Examples of this ubiquitous and typical coral are abundant; indeed it is the commonest coral in the collection, occurring in every locality and in fine preservation, although often too crystalline to show structure. *Favosites gothlandicus* must have been the chief and most abundant coral in the polar Silurian seas—I may say Upper Silurian seas. There is scarcely a single horizon in Britain, from the Caradoc to the Wenlock, in which it does not occur, its place being taken in the Devonian rocks of Europe by *F. Goldfussi*. These two species, belonging to the massive type, abound in their respec-

tive formations—*F. gothlandicus* in the Silurian deposits everywhere, and *F. Goldfussi* in the English, Rhonish, French, and Belgian Devonians.

The ramose forms are more widely distributed, but are few in the polar area. Possibly *F. alveolaris* occurs also; I have recorded it from one locality (Washington-Irving Island), but have difficulty in distinguishing the pores in the angles of the corallites. We record *F. gothlandicus* from twelve or fourteen different localities, and have nearly forty specimens of all sizes and habit of growth, some of the large circular convex masses with complete wrinkled epithecal bases being of considerable diameter. The individual specimens vary both as regards the width or size of the corallites (columns) and in the distance or spaces between the tabulæ.

I have not observed the variety *F. Troostii* in Captain Feilden's series. Although a common American form or variety of *F. gothlandicus*, it is distinguishable by usually having three rows of pores and longitudinal lines on the faces of the tubes or corallites and very close-set tabulæ; but so variable are the forms in *F. gothlandicus* that every shade of difference can be detected, and may be made the basis of a new species. It must be admitted that no more variable coral exists; and no rule can be given for the size of the cell-opening, number of pores, or number and distance of the tabulæ in a given vertical space. Again, the pores do not always possess the elevated rim or border. Little or no trace of the radiating septa or their spinose or tubercular representatives can be detected in the specimens, owing to the metamorphism of the limestones. Hall's *F. niagarensis* appears to be only a variety of *F. gothlandicus*. *Astrocerium*, Hall, and *Emmonsia*, Edw. & Haime, seem to be identical with *Favosites*. No less than eleven of the twenty-six species known are American, and four arctic, viz. *F. megastomus*, *F. perplexus*, *F. alveolaris*, and *F. gothlandicus*.

*Loc.* Washington-Irving Island, Polaris Bay, Cape Frazer, Bessels Bay, Offley Island, Dobbin Bay, Cape Tyson, &c., *in situ*. Common also in the drift.

#### FAVOSITES ALVEOLARIS (Goldf.).

*Calamopora alveolaris*, Goldf. Petr. Germ. vol. i. t. 26. f. 1.

*Favosites aspera*, M.-Edw. & Haime, Mon. Brit. Foss. Corals, Pal. Soc. p. 257, t. 60. f. 3.

One or two specimens of this coral in perfect condition have been received from the Wenlock rocks of Washington-Irving Island; it does not seem to occur elsewhere in the Arctic region. Hall identified the species in the Onondaga group, our Upper Wenlock, in 1843; but it does not seem to have been recorded from East or West Canada, either under this name or that of *F. asper*, D'Orb. *F. multipora*, Lonsdale, may be another form and name for this coral.

These Favositæ are troublesome species to determine unless the coralla are sufficiently well preserved to allow of sections being made for determination. *Favosites alveolaris*, like *F. gothlandicus*,

has a wide range in time as well as in space; it is found in the Lower and Upper Silurian series, ranging from the Caradoc to the Ludlow rocks inclusive, not only in the British Islands, but in Bohemia, Scandinavia, and Russia. It is now recorded from the Washington-Irving beds (lat.  $79^{\circ} 34'$ ).

FAVOSITES, sp.

One specimen of a globose mass resembling an *Alveolites* is among the other difficult things in the collection to determine; but the walls of the corallites are much thicker and the calices more regular than in *Alveolites*. The tabulæ are remote and faintly developed, and the walls perforated apparently in a single row.

*Sp. char.* Corallum massive, convex, growing in layers concentrically arranged; base concentrically rugose; calices small, polygonal or apparently six-sided; walls of corallites thick; mural foramina or perforations in single lines; no septa visible. Tabulæ thin, distant, and alternating with those of the adjoining corallites.

*Loc.* Cape Louis Napolcon, lat.  $79^{\circ} 38'$ .

Genus HELIOLITES, Dana, 1846.

HELIOLITES MEGASTOMUS (M'Coy).

*Palæopora megastoma*, M'Coy, Brit. Pal. Foss. p. 16, t. 1 c. f. 4.

*Parites megastoma*, M'Coy, Sil. Foss. Irel. p. 62, t. 4. f. 9.

*Heliolites macrostylus*, Hall, Pal. N. Y. vol. ii. p. 135, t. 36 a. f. 2.

*H. megastoma*, Édw. & Haime, Mon. Brit. Foss. Corals, Pal. Soc. p. 251. t. 58. fig. 2.

The slight development of the cœnenchyma and large closely-set corallites (as compared with other species of *Heliolites*) leads me to believe that this is M'Coy's species. The corallites are separated by reticulate cœnenchyma and possess rather thick tabulæ. Hall records this species from the Niagara group under the name of *Heliolites macrostylus* (Pal. N. Y. vol. ii. p. 135, t. 36 a. f. 2), and it appears also to be the coral referred to by M'Coy under the name of *Palæopora megastoma* (Brit. Pal. Foss. p. 16, t. 1 c. f. 4). This coral has a wide distribution, ranging from Britain to North America. All the Petermann-Fiord specimens are glacier-borne from the east.

Unfortunately the two specimens obtained were not found *in situ*, but were taken by Dr. Coppinger from the south-west shore of Petermann Fiord on No. 1 glacier, occurring in the talus with other fossils. They are portions of a hemispherical mass or corallum.

A *Pentamerus*, allied to *P. Verneuli*, and *Favosites gothlandicus* were collected at the same spot. These, like the Bessels-Bay and Offley-Island species, are Greenland forms, and derived either from rocks at the sides of glaciers or brought down from the interior of the country on the glaciers.

*Loc.* Petermann Fiord, lat.  $81^{\circ}$ .

Genus ALVEOLITES, Lamk. 1801.

ALVEOLITES, sp.

Two specimens of an *Alveolites* occur amongst the coral-fauna, one from Cape Frazer and the other from Cape Louis Napoleon, east of Dobbin Bay in Grinnell Land. Considering the number of known species in this genus in the Silurian and Devonian rocks of America and Europe (about thirty), it is singular that we have no better representatives than the two recorded.

I cannot refer them to any British species, owing to their bad state of preservation.

*Loc.* Cape Frazer, lat. 79° 45', and Cape Louis Napoleon, lat. 79° 38'.

Genus HALYSITES, Fischer, 1813.

*Catenipora*, Lamarck, 1816.

HALYSITES CATENULATUS (Linn.).

*Tubipora catenularia*, Linn. Syst. Nat. 12th ed. vol. i. p. 1270.

*Halysites catenularia*, M.-Edw. & Haime, Mon. Brit. Foss. Corals, Pal. Soc. p. 270, t. 64. f. 1.

*Catenipora escharoides*, Lamk. Hist. Nat. vol. ii. p. 207.

Our specimens are, without doubt, the true well-known "chain-coral" whose distribution through the Lower Palæozoic rocks is universal both in time and space (Llandeilo to the Ludlow rocks). The specimens resemble those of the Upper Silurian of Britain, and probably belong to the Wenlock group, and are associated with forms whose facies are of that series. The specimens collected by Mr. Hart from Dobbin Bay and Cape Hilgard appear to be true *H. catenulatus*.

There seems, however, to be considerable difference in some of the forms of *Halysites* brought home by the naturalists of the 'Alert' and 'Discovery'; if not specifically different, they should be noticed and recorded as varieties. The form *Catenipora labyrinthica*, Goldf., Petr. Germ. vol. i. p. 75, t. 25. f. 5, would answer to those having large interspaces or reticulations between the vertical corallites. I know it is scarcely possible to separate the extreme varieties *C. escharoides*, De Blainville, and *C. labyrinthica*, Goldfuss, as recorded and figured by Goldfuss; but as we appear to have them in the collection, it is necessary to draw attention to their extreme variation. No less than six species are recorded by the American and Canadian palæontologists.

*Loc.* Cape Hilgard, lat. 79° 41'; Cape Frazer, lat. 79° 45'; and Dobbin Bay, lat. 79° 40'. Upper Silurian.

HALYSITES CATENULATUS, var. FEILDENI, Eth. (Pl. XXVIII. fig. 1.)

Corallum massive; base concentrically and irregularly rugose; the corallites radiate horizontally from the centre of the base (resembling in habit those of *Favosites*), and then assume the vertical growth when at or near the outer edge of the corallum; tabulæ

thick and very closely arranged, which, on weathering, gives a very rugose appearance to the corallites; reticulations between the chain-like pattern on the upper surface of the corallum very small and polygonal; calices either elliptical or polygonal; and frequently only two or three corallites occur in the space or vertical wall constituting the reticulations.

The habit of this variety differs so much from that of the common form of *H. catenulatus*, or the more ramifying and taller-growing variety, that I am justified in giving it the varietal name. As an extreme variety it deserves recognition and description; I therefore name it after the indefatigable naturalist to the Expedition. Dana notices Hall's species *H. gracilis* from the Hudson-river group, Green Bay, Wisconsin, from a lower horizon than Captain Feilden's specimen. *H. catenulatus*, var. *Feildeni*, differs from the true *H. catenulatus*, Linn., from Cape Frazer and Dobbin Bay, by the extreme smallness of the reticulations, very closely arranged tabulæ, and compact habit of growth. *H. escharoides* (De Blainv.) is its nearest ally.

*Loc.* Cape Hilgard, lat. 79° 41'.

*HALYSITES CATENULATUS*, var. *HARTI*, Eth. (Pl. XXVIII. fig. 2.)

This form differs considerably from the usual habit of *Halysites catenulatus*, the chain-like rows of corallites constituting the corallum being very much more extended or enclosing larger interspaces or areas, and closely resembling the variety *Catenipora labyrinthica* of Goldfuss. The epitheca, too, and the walls are more coarsely rugose, the striæ being coarser than in *H. catenulatus* proper; this does not appear to be due to age only; the character is well shown in Goldfuss's figure (Petr. Germ. p. 75, t. 25. f. 5). Further the series of corallites in the winding loops are much more numerous than in the recognized forms of *H. catenulatus*. The whole corallum is also more robust in habit, and must have been of large dimensions vertically and laterally. I figure this amongst other variable species in the collection, as being a very aberrant form of *Halysites*.

*Loc.* Cape Frazer, lat. 79° 45'.

GENUS *SYRINGOPORA*, Goldfuss, 1826.

*SYRINGOPORA PARALLELA*, Eth. (Pl. XXVI. fig. 1.)

We have only one specimen of this genus; it much resembles *S. geniculata*, Phill., from our Carboniferous rocks. The corallites are cylindrical, tall, slender, nearly parallel, and closely arranged; the walls are covered by a thick epitheca; the horizontal connecting tubes rather numerous or closely set, although certainly not so much so as in *S. geniculata*; neither is it our Silurian species *S. bifurcata*, Lonsd., being more delicate in habit; and the corallites are more densely packed and more regularly parallel in their upward growth than in *S. reticulata*, although it much resembles that species. Weathered specimens show the infundibuliform tabulæ. Little geniculation takes



place at the origin of the transverse or connecting tubes, which certainly are more remote than in *S. reticulata*, His. It is not the so-called *S. multicaulis* of Hall, from the Niagara group, which is described as having from fourteen to sixteen rays. Neither is it Billings's *S. Maclurei* or var. *elegans* (to both of which there is resemblance) from the Corniferous Limestone of Ohio.

*Syringopora* much resemble each other in all the older Palæozoic rocks. Our species I believe to be new, and therefore venture to figure it.

*Loc.* Dobbin Bay, lat. 79° 40'.

Group RUGOSA.

Genus CYATHOPHYLLUM.

CYATHOPHYLLUM ARTICULATUM (Wahlenb.).

*Madreporites articulatus*, Wahlenberg, Nov. Act. Soc. Upsal. vol. viii. p. 97.

*Cyathophyllum articulatum*, M.-Edw. & Haime, Mon. Brit. Sil. Corals, Pal. Soc. p. 282, t. 67. f. 1.

Three specimens of this branching cyathophylloid coral come from the Upper Silurian rocks of Dobbin Bay. They agree in every particular with Wahlenberg's species *C. articulatum*. In *C. cæspitosum* of Lonsdale the corallum is fasciculate and the corallites closely arranged. The accretion-ridges are not quite so highly developed as in the British species; this, however, depends much upon the state of preservation of the corallites. Compared with our Wenlock forms no difference can be detected.

This coral was collected by Mr. Hart at Cape Hilgard, lat. 79° 41', and by Dr. Copping in Dobbin Bay, lat. 79° 40', in the Upper Silurian series.

Genus CHONOPHYLLUM, M.-Edw. & Haime, 1850.

CHONOPHYLLUM, sp. allied to MAGNIFICUM, Billings, Canadian Journal, 1859; E. Rominger, Geol. Surv. Lower Peninsula, Michigan, 1876, p. 116, t. 43. (Pl. XXVIII. fig. 3.)

Three portions of the calice of what must have been a very large coral, from 3 to 4 inches in diameter, occur in the collection.

On comparison with the figure of this species by E. Rominger (Geol. Lower Peninsula, Michigan, 1876, p. 116, t. 43), I have no doubt that these calcular pieces should be referred to *Chonophyllum magnificum*. The very coarse and equal septa and small but deep somatic cavity agree in every particular with this Upper Helderberg species.

*Sp. char.* Corallum conical; calice greatly expanded or explanate, flattened towards the edge; septa equal, linear, about ninety in number, thick or broad near the circumference of the corallite. Our specimens do not show the centre or somatic cavity of the

calice; probably the septa did unite to form a central fascicle or columella. Diameter of the calice 3 inches. The height of our specimens we are not able to determine, only the expanded calice being left; probably it was about the same as *Omphyma* or *Ptychophyllum*.

*Loc.* Dobbin Bay, lat. 79° 40'. Upper Silurian. Collected by Dr. Copping.

GENUS CALOPHYLLUM, Dana, 1848.

CALOPHYLLUM PHRAGMOCERAS, Salter.

*Calophyllum phragmocer*as, Salt., Sutherland's Journ. vol. ii. p. cexxx, t. 6. f. 4.

I refer this specimen to *Calophyllum phragmocer*as, Salt. The corallum occurs in clusters composed of conical corallites, which rapidly enlarge at the calice, and often measure an inch in diameter. The tabulæ are closely set and slightly concave; the edges of the calices are not crenulated, but have very short thin lamellæ or septa; the costæ equal the septal laminae in number, are coarsely or strongly marked and interrupted at intervals by transverse slightly indented lines. Our specimen shows no evidence of calicular gemmation within the edge of the older corallites.

This coral resembles in appearance externally a compound *Zaphrentis*, owing to the somewhat expanded nature of the calice and habit of growth. The surface or epitheca is commonly striated longitudinally, and intermittently constricted like *Zaphrentis*. The tabulæ I am not able to see, and therefore fail to notice the resemblance to *Amplexus* described by Salter, *loc. cit.* Dr. Sutherland's specimens came from Wellington Channel.

*Loc.* Cape Hilgard, lat. 79° 41'.

GENUS ARACHNOPHYLLUM, Dana, 1846.

ARACHNOPHYLLUM RICHARDSONI, Salter.

*Arachnophyllum richardsoni*, Salter, Sutherland's Journ. vol. ii. p. cexxxii, t. 6. f. 10.

Mr. Hart, of the 'Discovery,' obtained this fine species at Cape Hilgard; it was first discovered by Dr. Sutherland at Point Eden, south side of Baring Bay, lat. 76° 20'. It is well figured in the volume above mentioned. The range of this species in space is considerable, Mr. Hart having obtained his specimen at Cape Hilgard, in lat. 79° 40', on the east coast of Grinnell Land, 3° 20' further north than Dr. Sutherland. *Strephodes Austini*, Salter, and *Calophyllum phragmocer*as, Salter, appear to have been collected with *Arachnophyllum richardsoni* at Cape Hilgard, thus showing that the Baring-Bay beds must be upon the same horizon as those of Cape Hilgard, 3° further north.

Mr. Salter described and figured what appears to be this coral from the Sutherland collection, *loc. cit.* The genus closely resem-

bles *Phillipsastrœa*; but the obtuse, flattened, or depressed polygonal calices with numerous fine radiating lamellæ, which meet or are continuous with those of adjoining corallites, separate it from that genus. The absence of solid partitions or boundary-walls removes it from the compound *Strephodes*, and it differs from *Sarcinula* in not having the distinct septate corallites. Our specimen is a wavy expanded mass; the corallites circular, small, and steeply edged, irregularly scattered over the surface, with well-defined styliiform columellæ or axes; the margins of the calices are slightly elevated above the plane of the anastomosing lamellæ, resembling some *Isastrœæ*. Diameter of cells about 1 line. Base not seen; probably it was concentrically rugose.

*Loc.* Cape Hilgard, lat. 79° 41'.

Genus FAVISTELLA, Hall, 1847.

FAVISTELLA RETICULATA, Salter.

*Favistella reticulata*, Salter, Sutherland's Journ. vol. ii. p. cccxix, t. 6. f. 2.

The hexagonal cells, with rather thick walls and wavy tabulæ, and the alternately long and short septa or lamellæ, reaching about halfway from the wall to the centre of the calice, clearly define this species.

Dr. Sutherland collected his specimens at Cape Riley, Barrow's Straits, in lat. 74° 40'. Captain Feilden obtained his at Franklin-Pierce Bay, Walrus Island, and Cape Hilgard, lat. 79° 41', 5° further north than Dr. Sutherland.

*Loc.* Franklin-Pierce Bay, lat. 79° 25', and Cape Hilgard, lat. 79° 41'.

FAVISTELLA FRANKLINI, Salter.

*Favistella franklini*, Salter, Sutherland's Journ. vol. ii. p. cccxxxi, t. 6. f. 3.

This must have been a large coral, composed of elongated polygonal tubes mostly agreeing in size, and of equal diameter on the surface. The septa or lamellæ are almost obsolete; tabulæ very closely arranged and not quite horizontal.

We possess only a fragment or two, but enough to distinguish them to be *F. franklini*, Salter, as figured in the above reference.

*Loc.* Dobbin Bay and Cape Hilgard, lat. 79° 41'.

Genus SARCINULA, Lamk. 1816.

SARCINULA ORGANUM, Lamk.

*Sarcinula organum*, Lamk. Hist. Nat. vol. ii. p. 223; Goldfuss, Petr. Germ. vol. i. p. 73, t. 37. f. 10.

At first sight this specimen resembles *Favistella*, especially in the vertical section; but the calices are round or slightly subangular when polished, certainly not polygonal as in *Favistella*; again, there

do not appear to be any interstitial tubes, showing that development took place through lateral fission. Indistinctly the corallites appear to have two walls, as in *Acervularia*, although the crystalline condition of the cellular tissue quite prevents this being determined. A large and loosely twisted columella occurs in the centre, arising from the meeting of the septa, of which there are twenty. Tabulæ numerous and closely set, giving a highly reticulate character to the corallites.

*Loc.* Cape Hilgard, lat.  $79^{\circ} 41'$ .

SARCINULA, var. of ORGANUM.

A single specimen only of this variety occurs; it resembles *Lithostrotion irregulare* or *Martini* in its somewhat irregular growth; but the corallites are even less straight than in those species, and are more reticulate in structure.

*Loc.* Cape Hilgard, lat.  $79^{\circ} 41'$ .

#### Genus STREPHODES.

STREPHODES AUSTINI, Salter.

*Strophodes Austini*, Salter, Sutherland's Journ. vol. ii. p. ccxxx, t. 6. f. 6.

I refer this single specimen also to the above species. M'Coy was inclined to refer Dr. Sutherland's specimens to *Clisiophyllum*. Owing to the twisted condition of the columellar lamellæ, our specimen very feebly shows the twisting of the septa in the centre of the calices; they certainly were never so columnar or tent-like as in typical specimens of *Clisiophyllum*. I, however, can only refer Mr. Hart's specimen to the above species, with which it agrees in every particular. It was collected by Mr. Hart from the Upper Silurian beds at Cape Hilgard, lat.  $79^{\circ} 41'$ .

#### Genus ZAPHRENTIS, Rafinesque, 1820.

ZAPHRENTIS, sp.

This genus is unknown in Britain from the Silurian rocks. M'Coy records *Caninia* from the Wenlock Limestone near Wenlock; but the genus as restricted is chiefly confined, in Britain, to the Carboniferous Limestone. In North America, however, six or eight species occur in the Upper Silurian series.

The four specimens we have seem to me to be *Zaphrentis*, but their condition is so crystalline that hardly any septa can be detected; the costa are coarse and well preserved, the costal lines answering to the number of septa.

Polished sections afford no real aid, owing to the complete obliteration of the interior of the calices; but there can be no doubt as to the genus being well represented in the Polar seas. We now have it from the Upper Silurian of Offley Island, Bessels Bay, and Dobbin Bay, lat.  $79^{\circ} 41'$ .

ZAPHRENTIS OFFLEYENSIS, Eth. (Pl. XXVI. figs. 2, 2a.)

Corallum gently curved, pediculate, about an inch in diameter; calice slightly oval; septa numerous (forty-eight), half of which do not reach far into the calice; chief septa thick or strongly developed; the costæ appear to equal the septa in number; constrictions in the corallum numerous, becoming stronger with age; septal fossulæ not determinable.

The species are so numerous in this widely distributed genus, and they resemble each other so closely, that it is almost impossible to compare one with another, especially when widely separated in space; and their habit and growth so depend upon the circumstances under which they lived that, homotaxially or in time-horizons, little can be depended upon for determination.

I therefore name these after the locality where found (Offley Island), by way of drawing attention to the distribution of the genus. Only portions of two corallites occur, and the coral is so crystalline that most of its structure is obliterated.

*Loc.* Offley Island, lat. 81° 16'.

ZAPHRENTIS, sp. allied to *Z. PROLIFICA*, Billings, *vide* Rominger, Geol. Surv. of Michigan, vol. iii. 1876, p. 147, t. 53 (upper figures).

Of this stunted species we have two specimens; they both resemble *Z. Enniskilleni*, M.-Edw. & Haime, from the Carboniferous Limestone of Britain. The entire calice or septal system is not seen on either specimen; but the figures and description given by Rominger (*loc. cit.*) answer to Billings's species, and they are undoubted *Zaphrentes*. The corallum is turbinate, short, and pediculate, with an expanded calice; costæ coarse. Owing to the calices not being perfect, the number of septa remains unknown. Our specimens measure 1 inch and 1½ inch in height, and about 1 inch in diameter. Billings's species, *Z. prolifica*, occurs in the Corniferous Limestone of Port Colborne, the Upper Helderberg Limestone of Michigan, &c.

*Loc.* Dobbin Bay, lat. 79° 40'.

ZAPHRENTIS, sp. (Pl. XXVIII. fig. 5.)

This is the only single or simple coral found at Bessels Bay. It occurs in the crystalline white limestone which abounds with *Favosites gothlandicus*; but the same beds evidently occur at Offley Island and contain other species. I am not sure that this may not be a *Clisiophyllum*. In polished sections there appears to be a twisted columella; but the calice is so crystalline that the relation of the septal system at the edge of the calice cannot be well traced to the columella.

*Sp. char.* Corallum oval or compressed, nearly straight, tall, roundly constricted at intervals; costæ numerous, delicate, or more thread-like than in most *Zaphrentes*; columella (if any) slightly twisted; septa about sixty, intermediate septa not seen, nearly all structure being obliterated.

*Loc.* Bessels Bay, 81° 6'.

Genus AMPLEXUS, Sowerby, 1802.

AMPLEXUS FEILDENI, Ether. (Pl. XXVI. fig. 3.)

This single incomplete portion of a large *Amplexus* is, I doubt not, new, and must have been of considerable height or length, judging from the diameter of the corallum left, which measures more than  $1\frac{1}{2}$  inch.

*Sp. char.* Corallum tall, straight, constricted at regular intervals, or where the tabular floors cross the corallum; septa numerous, equally developed, rather wide apart and marginal; chief septa about thirty-six in number; but I cannot be sure that there are not alternately smaller, shorter, or intermediate septa; costæ numerous, double the number (seventy-two) of chief septa, thus rendering it probable that there are seventy-two septa (thirty-six primary and thirty-six secondary, comprising two cycles); tabulæ distant, very slightly concave and smooth, not always of the same size or occupying the same area. Now and then the septa on some of the tabulæ encroach upon the planes, and thus give them a smaller area; septal fossula not seen: we have not, perhaps, the last tabulæ, in which it is usually more distinct or better preserved.

This coral is remarkable for its size, the distance between the tabulæ, the well-developed costæ, the coarseness of the chief septa, and the reed-like habit of its growth, much resembling in appearance many *Calamites* from the Coal-Measures, especially *C. approximatus*.

Many specimens of *A. coralloides*, Sow., are as large as our *A. Feildeni*, but differ much in the arrangement and development of the septa upon the tabulæ near the edge of the corallite. De Koninck, in his 'Nouvelles Recherches sur les Animaux Fossiles du Terrain Carbonifère de Belgique,' p. 65, t. 5. f. 1, 1872, figures two specimens of *A. coralloides* equal to, and another double the diameter of, our species; but the thin disk-like condition of the tabular system entirely removes *A. Feildeni* from *A. coralloides*. Numerous as are the species in the Carboniferous rocks of Belgium, still none agrees with our species.

This and the following species were collected by Dr. Copping, of the 'Alert.'

*Loc.* Offley Island, lat.  $81^{\circ} 16'$ . Upper Silurian.

AMPLEXUS, sp. (Pl. XXVI. fig. 4.)

I cannot be sure that this is *Amplexus Feildeni*, although it might pass for a smaller individual. It is of much less diameter, and the costæ do not quite agree with those of that species; the septa are coarser for its size, and range further in upon the tabulæ, which, as in *Amplexus Feildeni*, are also far apart.

I am not justified in making it a new species. I figure it, however, to draw attention to the form.

*Loc.* Offley Island, lat.  $81^{\circ} 16'$ . Upper Silurian. Collected by Dr. Copping.

Class ECHINODERMATA.

Many of the limestones are literally made up of Crinoidal remains, chiefly stem-ossicula, yet in no instance has a really determinable specimen been obtained. We have portions of the stems of *Crotalocrinus* somewhat abundantly, but the limestones are so crystalline that all structure is obliterated.

The white limestones of Bessels Bay contain *Stromatopora* and a *Lithostroton* associated with these crinoidal fragments. No statuary marble is whiter than these perishable limestones, which readily fall to pieces upon handling.

*Loc.* Bessels Bay, lat. 81° 6'.

Class CRUSTACEA.

Order TRILOBITA.

Genus BRONTEUS, Goldfuss, 1843.

BRONTEUS, sp., allied to *B. HIBERNICUS*, Portlock, Geol. Rep. t. 5. f. 8.

Half only of the pygidium of this species occurs in the white limestone of Bessels Bay; it is much larger than the caudal shield of *Bronteus flabellifer* from the Middle Devonian of South Devon or the Eifel form. It was collected by Mr. Hart, of the ship 'Discovery,' from the white or pale-coloured limestones of the bay above mentioned. Comparison with *Bronteus hibernicus*, Portlock, Geological Report, t. 5. f. 8, shows great resemblance; but the single caudal somite, from which spring the fan-shaped pleuræ, is wanting, and only half the pleuræ are left. I have no alternative, however, but to refer it to that species for close comparison. Four species have been described from America—one from Nova Scotia, one from Anticosti Island, and two from New-York State.

*Loc.* Bessels Bay, lat. 81° 6'. Upper Silurian.

BRONTEUS FLABELLIFER, Goldf.

*Brontes flabellifer*, Goldf. Nova Acta Acad. Cæs. Leop. Nat.-Cur. vol. xix. pt. i. p. 361, t. 33. f. 3.

*Bronteus flabellifer*, Phill. Pal. Foss. Dev. & Cornw. p. 131, t. 57. f. 254.

I have no doubt about this single pygidium belonging to the above species; there is no difference whatever between it and our Middle Devonian *Bronteus flabellifer*. Mr. Hart collected this well-known species from Bessels Bay, associated with the series of Upper Silurian fossils found at that place; it needs no further notice. I believe, however, it is now recorded for the first time from the Upper Silurian rocks, never hitherto having been found below the *Stringocephalus* or Middle-Devonian series of Britain and Belgium.

*Loc.* Bessels Bay, lat. 81° 6'.

Genus *ASAPHUS*, Brongniart, 1822.

*ASAPHUS*, sp., like *A. TYRANNUS*, Murch. Sil. Syst. t. 24, t. 25. f. 1.

*Asaphus tyrannus*, Salter, Monogr. Sil. Trilobites, Pal. Soc. p. 149, t. 21, t. 22. f. 5-12.

Unfortunately only the pygidium or caudal shield has been left upon a slab of limestone; but no doubts are entertained as to the genus, although only so small a specimen. It agrees in every respect with the pygidia of small or young forms of *Asaphus tyrannus* and *Asaphus Powisii*: the axis may be narrower than usual in those species, being more uniform in width or diameter; but the pleuræ and broad caudal fascia all tend to convince me that it is closely allied to *Asaphus tyrannus*, although with us this is a Llandeilo form; indeed in Britain no species of *Asaphus* is known in the Upper Silurian rocks. There seems much doubt as to the horizon at Cape Louis Napoleon from which some fossils come; we certainly have Lower and Upper Silurian species in the series from this locality.

*Asaphus marginalis*, Hall, Pal. N. Y. vol. i. p. 24, t. 4. fig. 5, resembles this only in the narrowness of its caudal axis.

*Loc.* Cape Louis Napoleon, 79° 38'. From Upper Silurian.

Genus *CALYMENE*, Brongniart, 1822.

*CALYMENE*, sp.

? *Calymene senaria*, Conrad, Ann. Geol. Report, New York, 1841, p. 49; Hall, Pal. New York, vol. i. p. 238, t. 64. f. 3, a-n.

The cephalic portion of this species is wanting, and also much of the caudal shield; nevertheless I think I am right in referring it to the *Calymene senaria* of Conrad. Hall obtained his specimen from the Trenton series; it is very closely allied to our *Calymene Blumenbachii*, or one of its many varieties; twelve thoracic somites are distinctly preserved. The faceted pleuræ cannot satisfactorily be made out, the specimen being much weathered, and none of the cephalic portion remains. The figure and description given by Hall (*loc. cit.*) for the American species agree better with our specimen than that given by Salter in the Palæontographical Society's Memoirs, t. 9. figs. 6-11. Many forms of the variable *Calymene Blumenbachii* may be mistaken for the specimen I have referred to Conrad's species.

*Loc.* Dobbin Bay, lat. 79° 40'; furnishing another instance of the mingled condition or character of the series from this locality.

*CALYMENE*, sp.

Six thoracic segments with axis and pleuræ of some species of *Calymene* occur in the Silurian Limestones of Hayes Point, lat. 79° 42': fragments of some unknown Crustacean (?) are associated with it; these will be referred to in their places. If not *Calymene*,



these somites may belong to *Encrinurus lævis*; they much resemble each other in all parts but the cephalic region. See Journal of Voyage in Baffin's Bay and Barrow's Straits (Penny); Sutherland's Journal of Capt. Penny's Voyage to Wellington Channel, 1850-51, vol. ii. p. cexxi, t. 5. f. 14, for *Encrinurus*.

*Loc.* Hayes Point, lat. 79° 42'.

Genus ENCRINURUS, Emmerich, 1844.

ENCRINURUS LÆVIS (Angelin).

*Cryptonymus lævis*, Angelin, Palæontologia Scand. part 1, fasc. 1, p. 4, t. 4. fig. 10.

*Encrinurus lævis*, Salt. Sutherland's Journal, vol. ii. p. cexxi, t. 5. f. 14.

This genus, and probably the species now in the Arctic collection, was obtained somewhat abundantly by Dr. Sutherland during the Expedition under Captain W. Penny, 1850-51, associated with *Pentameri* from Cornwallis Island; the only species of *Pentamerus* then brought home was *Pentamerus conchidium*, Dalm., a form much resembling our *Pentamerus Knightii*, and similar to Greenland specimens. I have compared the imperfect remains from Dobbin Bay, collected by Dr. Coppinger and Captain Feilden, with those brought home by Dr. Sutherland, which Mr. Salter referred to *Cryptonymus lævis*, Angelin, and cannot detect any difference. The cephalic portion (glabella and cheeks) very closely resembles our *Encrinurus variolaris* (Brongn.); the pygidium, however, differs essentially from the same part in that species, being more massive, and the segments of the axis not ornamented with tubercles.

I cannot see any difference between the several imperfect portions in our collection; I therefore refer them all to Angelin's species.

Dr. Sutherland's specimens were found at Cape Riley, on Griffith's Island, Cornwallis, Seal, and Dundas Islands; it appears to have been abundant at Griffith's Island, lat. 75°.

Dr. Coppinger collected his specimens at Dobbin Bay, lat. 79° 40', associated with *Receptaculites*, *Favistella*, *Halyssites*, and *Favosites gothlandicus*.

Genus PROETUS, Steininger, 1830.

PROETUS, sp.

One specimen, comprising parts of five thoracic somites and the pygidium, is all we have of what I believe to be the genus *Proetus*; it occurs in a dark-grey earthy limestone from Cape Leidy, lat. 79° 38'. I can do no more than record this form as occurring in the collection.

*Loc.* Cape Leidy, lat. 79° 38'. From Upper Silurian.

CRUSTACEAN REMAINS.

A number of specimens were collected by Captain Feilden at Cape Louis Napoleon which have every appearance of being portions of some large crustacean, probably fragments of a gigantic *Illænus* or *Isotelus*. Here and there on the specimens there are slightly wavy or undulating lines or striae, such as occur upon the shelly carapace of the *Illæni* and *Asaphi*, yet upon microscopical examination no definite structure can be determined. On one or two of the rock specimens we have portions of what appear to be the carapace of undoubted *Illæni* (rostral shield and posterior spines); and the greatly compressed state of the specimens, be they what they may, is clearly shown in section; but being crystalline, their structure is obliterated. Sections of the axes and pleuræ of *Pterygoti* and *Eurypteri* would have much the same appearance as the compressed and flattened parts of what appear to be segments; indeed dismembered parts of the Merostomata would probably suggest an explanation of their history. Remains of *Eurypteri* are abundant in the Waterlime group (Upper Silurian) of New-York State and Oncida county, lying beneath the Lower Helderberg group. I have suggested the Merostomata as being the most likely group to comprise these singular sections. *Platynotus* and *Homalonotus* amongst the Trilobita, when broken up, may equally suggest their nature. I have submitted these fragments to crustaceologists; but no true light has been thrown upon them. I was disposed to regard them as portions of the plant called *Palæophycus*; but the structure of the outer edges of the compressed bodies, when subjected to microscopical examination, forbids that: they are still left for determination.

*Loc.* Cape Louis Napoleon, lat. 79° 38'.

Class BRACHIOPODA.

Comparatively few Brachiopoda occur in the Silurian series collected by the naturalists of the Expedition; only five out of fifteen families and forty-seven genera are represented, which, considering the number of specimens of shelly fossiliferous limestones (many crowded with species), is singular, this class being abundant in the Upper Silurian rocks of Britain, Scandinavia, and Spitzbergen. No *Lingulæ*, *Crania*, *Discina*, or *Terebratulæ* have been detected. Species of the genera *Anastrophia*, *Pentamerus*, *Chonetes*, *Rhynchonella*, *Atrypa*, *Meristella*, and *Strophomena* occur, but only one or two species in each genus. America yields no less than 1120 species; *Atrypa*, *Orthis*, *Rhynchonella*, and *Strophomena*, as with us, predominating. Looking at the collection of Corals, Polyzoa, Gasteropoda, &c., we should have expected on bathymetrical grounds a larger assemblage of associated Brachiopoda.

The Carboniferous fossils brought home are mostly of this class and a few Polyzoa, the two families Productidæ and Spiriferidæ

being fairly represented. Deep-sea forms (non-articulate genera) are absent in both the Silurian and Carboniferous rocks; but doubtless the difficulty in collecting from ice-covered horizontal areas prevented their being observed in any quantity. It is, however, evident that a large Brachiopod fauna exists both in the Upper Silurian and Carboniferous series as far north as 82° 43'.

Feilden Isthmus abounds in Carboniferous species; a rich harvest could be obtained from this locality, and doubtless the Devonian forms could be largely added to from the same area.

Genus PENTAMERUS, Sowerby, 1813.

*Pentameri* were brought home by Dr. Sutherland from Wellington Channel, and found by him at Cornwallis Island. Salter referred the specimens to *Pentamerus conchidium* (Dalm.), the same shell being noticed by De Verneuil in Geol. Russ. t. 1. f. 2. This shell much resembles the well-known *Pentamerus Knightii* of the Aymestry Limestone.

The Coppinger collection from Offley Island and Bessels Bay contains two, if not three, species certainly not referable to Dalman's *Pentamerus conchidium*. One form is allied to the *Pentamerus galeatus*, Dalm., of our Upper Silurian rocks, but is not so tumid, and is evidently a smoother species.

Dr. Coppinger also collected at Petermann Fiord, in talus on the south-west glacier, on the floe, and under cliffs on the north-east shore of the Fiord, numerous specimens allied to *Pentamerus* or *Anastrophia Verneული*, Hall, from the Lower Helderberg beds (our Wenlock and Ludlow groups). With these *Pentameri* there occur (in the talus) *Heliolites megastomus* (McCoy) and *Favosites gothlandicus* (Linn.), abundantly. Petermann Fiord is upon the west coast of Greenland, therefore in all probability these species are derived from higher land to the east in Greenland; the species would seem to indicate that they are from a higher horizon than those collected at Offley Island. Not being, however, found *in situ* we cannot arrive at any just conclusions as to their stratigraphical position. Eighteen species of *Pentameri* occur in the American rocks, and ten in the British Islands; Bohemia has twenty-two. I record one new species from Offley Island, collected by Dr. Coppinger.

PENTAMERUS COPPINGERI, Ether. (Pl. XXV. figs. 2, 3.)

This shell, from Offley Island, I am not able to refer to any known species, either in America or Europe, although it resembles *Pentamerus galeatus* (Dalm.), from our Wenlock series; it is, however, much more elongated than *Pentamerus galeatus*, and has a less incurved umbonal region to the ventral valve. Shell somewhat elongated, longer than wide, sides subparallel.

*Ventral valve* gibbous, much arched near the umbonal region, about as deep as the dorsal valve, with a shallow mesial fold commencing about the upper half of the valve.

*Dorsal valve* slightly gibbous; umbo incurved, less so than in *Pentamerus galeatus*; umbonal space wide; the area between the two

valves much greater than either in *Pentamerus galeatus* or *P. oblongus*; fissure not seen; lateral margins smooth, anterior margin nearly straight or faintly rounded; surface of both valves nearly smooth or concentrically marked, some specimens more strongly than others.

Our shell differs from *Pentamerus galeatus* in the absence of ribs upon the mesial fold of both valves, and the wavy crenulations upon the lateral portions of the shell, and also in the much wider umbonal space between the two valves. *P. Verneuli*, Hall, from the Lower Helderberg, is a strongly ribbed shell, and the umbo is completely hidden. From *Pentamerus Knightii* our species differs in the want of ribs; but in shape the valves of the two species fairly agree. We have no specimens showing the interior; seven specimens occur.

*Loc.* Offley Island, lat.  $81^{\circ} 16'$ . From Upper Silurian, probably Wenlock Limestone.

PENTAMERUS, sp.

This specimen occurs on a block of limestone of considerable size, said by Captain Feilden to have been obtained from a drift boulder in lat.  $82^{\circ} 30'$ , at an elevation of 40 feet above the sea. This ventral valve I have called *Pentamerus*; it closely resembles *P. conchidium*, Dalm. In drift boulder, lat.  $82^{\circ} 30'$ .

Genus RHYNCHONELLA, Fischer, 1809.

RHYNCHONELLA NUCULA (Sow.).

*Terebratula nucula*, Sow. Sil. Syst. t. 5. f. 20.

Only one species of the genus occurs in the collection. It agrees with the above species, so far as I am enabled to determine from one specimen; at all times a troublesome shell, and in every variety, it has the widest distribution, in Britain occurring in almost every locality where the Upper Silurian occurs, from the Llandovery rocks upwards, ceasing only in the Upper Ludlow.

*Loc.* Bessels Bay, lat.  $81^{\circ} 6'$ . Upper Silurian.

Genus CHONETES, Fischer, 1837.

CHONETES STRIATELLA (Dalm.).

*Orthis striatella*, Dalm. Kongl. Svenska Ak. Handl. 1827, p. 111, t. 1. f. 5.

*Leptaena lata*, Sow. Sil. Syst. p. 610, t. 5. f. 13.

*Chonetes striatella*, Dav. Monogr. Sil. Brach., Pal. Soc. p. 331, t. 49. f. 23-26.

One individual only; but it is nevertheless enough to declare the presence of this common shell, which in Britain everywhere highly characterizes the Wenlock and Ludlow rocks. The hinge-spines are worn or denuded away (as is generally the case), but the other characters are well preserved.

This is the *Leptaena lata* of Von Buch and of the 'Silurian System' (*loc. cit.*), one of the most abundant shells of the Ludlow group, especially in the upper division. In Scandinavia, Russia, and North America this is also a very abundantly distributed shell.

*Loc.* Cape Louis Napolcon, lat.  $79^{\circ} 38'$ .

Genus ATRYPA, Dalman, 1827.

ATRYPA PHOCA (Salt.).

*Rhynconella phoca*, Salt. Sutherland's Journal, vol. ii. p. cccxxvi, t. 5. f. 1-3.

Several specimens of this species occur in the collection. Mr. Salter referred Dr. Sutherland's specimens to the genus *Rhynconella*. More accurate knowledge of the Brachiopoda has clearly defined those characters that essentially typify the genera. Mr. Salter particularly noticed the resemblance of this shell to Jurassic forms; and it certainly does approach the globose group of the Terebratulidæ in the Oolitic series. The absence of the umbonal foramen and deltidium, however, removes it at once from the *Terebratula* or *Rhynconella*, our shell being imperforate. Dr. Sutherland obtained his specimens from Cape Riley, Cornwallis, Leopold, Griffith's, and Seal Islands; Mr. Hart collected his from Bessels Bay (lat.  $81^{\circ} 6'$ ), and Dr. Coppinger obtained it from Bessels Bay and Dobbin Bay (lat.  $79^{\circ} 41'$ ), in much higher latitudes. There can be no doubt about this species being the same as those collected by Dr. Sutherland at the above places.

ATRYPA MANSONII (Salt.).

*Rhynconella Mansonii*, Salt. *loc. cit.* p. cccxxi, t. 5. f. 5.

We have two or three specimens of this species of *Atrypa*; it is a much smaller and flatter species than *A. phoca*, and has the mesial fold more pronounced and sharper. The description by Salter in the appendix to Sutherland's 'Journal' contains all that need be said relative to this species.

*Loc.* Bessels Bay,  $81^{\circ} 6'$ .

ATRYPA RETICULARIS (Linn.).

*Anomia reticularis*, Linn. Syst. Nat. ed. 12, vol. i. p. 1152.

*Atrypa reticularis*, Dav. Mon. Brit. Sil. Brach., Pal. Soc. p. 129, t. 14. f. 1-22.

This shell is found everywhere throughout the Upper Silurian series of the Arctic circle; it is as common there as in the Wenlock series of Britain, Scandinavia, and North America. The forms vary (as with us) according to locality, life, and condition. The variety *aspera* appears to be amongst them; but of this I cannot be sure, the species altogether being so variable. No Palæozoic shell has a wider space or geographical range, or greater range in time. With us it characterizes the Silurian rocks from the Lower Llandovery to the Upper Ludlow, and passes up into the Devonian; and this holds

good throughout Europe, wherever the Upper Silurian and Devonian series are represented. It is abundant everywhere in Canada, North America, and the American Arctic rocks, Scandinavia, Russia, Bohemia, and even in Australia, occurring in all stages of the Upper Silurian series, and culminating in the Devonian. Sixty-two species occur of the genus *Atrypa* in the State of New York alone.

*Loc.* Cape Hilgard, lat.  $79^{\circ} 41'$ ; Dobbin Bay lat.,  $79^{\circ} 40'$ , &c. Upper Silurian.

Genus STROPHOMENA, Rafinesque, 1825.

STROPHOMENA EUGLYPHA (Hisinger).

*Leptæna euglypha*, Hisinger, Anteckn. t. 6. f. 4.

*Strophomena euglypha*, Salter, Siluria, t. 20. f. 9; Dav. Monogr. Brit. Sil. Brach., Pal. Soc. p. 288, t. 40. f. 1-5.

This abundant shell in the British Upper Silurian series is now determined to be present in rocks of the same age in the Arctic regions; it has been found both at Cape Hilgard and Cape Louis Napoleon in beds which contain many Wenlock species. There is no doubt of this shell being the above species. We wonder no more specimens have occurred, considering its ubiquity and wide range, being common in the Llandovery, Wenlock, and Ludlow formations of Britain and of the north of Europe.

*Loc.* Cape Hilgard, lat.  $79^{\circ} 41'$ , and Cape Louis Napoleon, lat.  $79^{\circ} 38'$ .

STROPHOMENA SILURIANA, Dav.

*Strophomena siluriana*, Dav. Monogr. Brit. Silurian Brach., Pal. Soc. p. 303, t. 47. f. 1-4.

I cannot see any difference between our single specimen and Mr. Davidson's figure. Ours is the ventral valve; none of the hinge-area is exposed; and although the horizon of Mr. Davidson's species is somewhat lower or older than that of our form may be, still in a species so variable (especially with age), and having only one specimen, it is not well to be positive either as to stratigraphical position or actual species.

*Loc.* Cape Leidy, lat.  $79^{\circ} 38'$ .

Genus MERISTELLA, Hall, 1860.

MERISTELLA TUMIDA (Dalm.).

*Atrypa tumida*, Dalm. Vet. Akad. Handl. 1828, p. 134, t. 5. f. 3.

*Meristella tumida*, Dav. Mon. Brit. Sil. Brach., Pal. Soc. p. 109, t. 11. f. 1-13.

A large, but solitary, specimen occurs in the collection. *Meristella* is abundant in the Upper Silurian rocks of both hemispheres, ranging in Britain from the Caradoc to the Wenlock rocks, and occurring in America in the Lower Helderberg, Clinton group, and Pen-

*tamerus*-limestone. *M. tumida* is a Scandinavian as well as a British species; the American form is usually referred to *M. Mariae*, and occurs in the Niagara group. Our species, "*M. tumida*," is known in Britain, Gothland, Bohemia, and New-York State; we now record it from the Polar area, associated with Wenlock forms.

Genus STROPHODONTA, Hall\*, 1852.

STROPHODONTA FEILDENI, Ether. (Pl. XXV. fig. 4.)

Of this gigantic shell we have only the ventral valve. It is probably the largest species of *Strophodonta* known (if it be *Strophodonta*); it measures 4 inches along the hinge-line by 3 inches in depth. Our single valve may almost be definitely referred to *S. magnifica* of Hall; but owing to its structure being badly preserved its identity may be doubtful; this also prevents my seeing the crenulated hinge-line characteristic of the genus: I name it, however, after Captain Feilden, who so carefully collected the many specimens brought home from the Expedition.

Shell very large, semielliptical, rounded at the extremities of the hinge; hinge-line nearly straight or slightly sloping from the umbo to the two extremities, less than the width of the shell, which is about 4 inches; umbo very small; concentric lines of growth are traceable; also longitudinal impressions or remains of slender ribs passing from the umbo to the ventral margin, but not so pronounced as in the genus *Streptorhynchus*. I know of no shell in the European Palæozoic rocks at all resembling this species. The genus is well represented in the Lower Helderberg and Oriskany series of New York, no less than thirty-four species being known to the State geologist. Our specimen might almost be regarded as a gigantic *Orthis* or *Chonetes*. I, however, prefer referring it to *Strophodonta*.

Hall's species, *S. magnifica*, occurs in the Oriskany Sandstones (Lower Devonian) of New York and Maryland; other species occur in the Hamilton group, Iowa.

*Loc.* Cape Hilgard, lat. 79° 41'. Upper Silurian.

Class LAMELLIBRANCHIATA.

Not a single species of this class has occurred in the Silurian or Carboniferous series under examination; and, singular as it may appear, no bivalve shell has been collected, so far as I can ascertain, by any previous Arctic expedition either from rocks of the Silurian, Devonian, or Carboniferous series: yet it cannot be supposed that no forms of

\* A group of Strophomenoid shells possessing a crenulated hinge-line and no foramen in the ventral valve; the valves closely interlock, and the two valves closely follow each other.

Pelecypod Mollusca lived within the Arctic circle during the long ages of Palæozoic time. Five genera and 150 species of Silurian *Monomyaria* are known in the North-American area, and 27 genera and about 230 species of *Dimyarian* forms, yet none have been collected north of lat. 60°. Only three species have been found in Newfoundland—two in the Calciferous group and one in the Chazy series, and in the Levis formation only two. Adding this to the few Gasteropoda found, it almost appears that littoral conditions scarcely existed through these eras over a very large area north of lat. 70°, a circumstance somewhat confirmed by the rich Coral fauna, Polyzoa, Heteropoda, Brachiopoda, and Cephalopoda (deep or open sea or pelagic forms) occurring so persistently in all the collections made. We could scarcely have failed to recognize the presence even of portions of the shells of this division of the subkingdom Mollusca proper had they occurred. As above stated, none have been found either in the Silurian or Carboniferous series in high latitudes. This cannot in any way be due to temperature, as the fossil fauna now represented as far north as 82° 43' could not have existed at low temperatures. Probably along the coast it was fiord-like, with the water deep; and littoral conditions may not have existed to any extent, there being no true beaches. The Coral fauna living in the deeper portions of the sea were associated with the Brachiopoda and Polyzoa. The Cephalopoda and Heteropoda being pelagic would readily account for their presence with the other classes mentioned. In no other way can we account for the absence of the Lamelli-branches. We have now existing in the highest latitude an abundant and characteristic Lamellibranchiate fauna, which occurs also in Post-Tertiary beds as high as latitude 82° 30', at Shift-Rudder Bay, where in the "grey mud deposits," up to an altitude of 200 feet, *Astarte borealis*, *Mya truncata*, *Saxciava rugosa*, *Cardium islandicum*, *Leda arctica*, *L. pernula*, and *Pecten groenlandicus* abounded. At Lincoln Bay, Grinnell Land, lat. 82° 8', the same species occur 50 feet above sea-level, the shells covering an area of many miles. At Dumb-bell Harbour, lat. 82° 30', and 400 feet above sea-level, Feilden found the same Mollusca and calcareous "rods of *Funicularia quadrangularis*" abundantly distributed. This species, according to Mr. Norman, occurs at Oban, and was dredged by the 'Porcupine' in the Minch (1869); it is also found in the Kattegat, in the Scandinavian seas. Again, on the plateaux at Floeberg Beach, lat. 82° 27', and at an elevation of 800 feet, the valves of *Mya truncata* occur; even up to an elevation of 1000 feet, at Watercourse Bay, lat. 81° 44', these mud beds with scratched erratics and *Mya truncata*, *Saxciava rugosa*, *Astarte borealis*, and *Pecten groenlandicus* were met with. Thus through the presence of these Mollusca we obtain clear evidence of the continuous elevation of the Polar land (1000 feet) since the close of the Miocene epoch, or that age when our modern Arctic and boreal fauna became established. The causes influencing the paucity of species, as compared with individual abundance, can only be accounted for by a knowledge of the physical conditions under which life was and is sustained within



the Polar area; that they must have been very different, so far as the Lamellibranchiata are concerned, during the deposition of the Carboniferous and Silurian rocks appears evident, for we find none.

### Class GASTEROPODA.

Very few species of this class have been collected, and with one or two exceptions all are small species—not that they are dwarfed forms through low temperature or paucity of food or other causes; the whole group seems to be poorly represented, so far as the collections made are any test. Large species of the genus *Murchisonia*, one or two *Loxonemæ*, and species of *Macrocheilus* and *Holopella*, *Rhaphistoma* or *Euomphalus*, *Acroculia*, and *Platyceras* seem to be all that occur in the collection. Amongst the Carboniferous-limestone series not a species occurs. It is seldom that Gasteropoda and Brachiopoda are associated together, and in the Carboniferous series they are mostly of the latter class; hence, perhaps, the horizons collected from were not favourable to the Gasteropoda during their deposition. I can hardly imagine a great paucity of species in this class in these Upper Silurian rocks, considering that the bathymetrical conditions must have been favourable to their life, development, and distribution.

Considering the fauna of the Silurian rocks of North America and Canada, as well as that of our own country, from rocks of the same age, associated as they are with a similar assemblage of Cœlenterata, Crustacea, and Brachiopoda, we should expect to find more species. Doubtless the difficulty in collecting was great, horizontal extension, or *space*, and vertical distribution, or *time*, being two elements in the collecting not easily realized under the adverse climatal circumstances and other difficulties attending such an expedition; for it could only have been from the faces of the cliffs where the beds were exposed that fossils could be obtained *in situ*. As regards Post-Tertiary species, very few of this class occur in the living molluscan fauna of the Polar area, *Trochus umbilicatus*, *T. olivaceus*, and *Cylichna striata* being amongst the chief species. The last-named delicate shell (*Cylichna striata*) occurs in a fossil state at Spitzbergen and in the Clyde beds, as well as in the State of Maine. *Trichotropis borealis*, *Pleurotoma Trevelyana*, *Trophon clathratum*, and *Buccinum tenue* are the chief forms of Gasteropoda in the Post-Tertiary deposits; but none came home in the Carboniferous collection.

### Genus MURCHISONIA, D'Archiac and DeVerneuil, 1841.

MURCHISONIA LATIFASCIATA, Ether. (Pl. XXVII. fig. 1.)

Fortunately we have a small portion of the shell on this single specimen which shows enough structure to enable me to say that I know no shell like it, or rather cannot find either description or figure that agrees with it. These shells, which resemble elongated *Pleurotomariae*, are at all times difficult to determine: in the present case we have only two whorls, the body-whorl and that adjoining;

the aperture is not seen, neither is the columella, or the outer lip, complete, so that I have to base my determination upon the body-whorl.

The fascia, or band, is a quarter of an inch wide, having gently curved concave lines of growth or deposit, *i. e.* concave or thrown backwards with relation to the lip; the upper and lower areas of the body-whorl (above and below the fascia) are marked by delicate lines of growth in reverse position, and lying at an angle of  $30^\circ$ , that above the fascia being to the right, that below to the left; the shell must have been 5 or 6 inches in length. Billings, in the "Geology of Canada" (Geol. Survey of Canada, vol. i. Palæozoic Fossils, p. 234), figures from the Chazy series a shell he calls *M. Augustina*, which quite equals in size the above species, but wants the broad fascia.

*Loc.* Offley Island,  $81^\circ 16'$ . Dr. Coppinger's collection.

MURCHISONIA, ? sp. (Pl. XXVII. fig. 2.)

Whether this is a *Macrocheilus* or a *Murchisonia* I am at a loss to know: the shell measures  $4\frac{1}{2}$  inches in length, and must have had seven or eight whorls; four interior moulds of the lower whorls are left to us, but no outer shell remains to aid in the determination or description of the species. Many large Canadian and North-American forms have been described and figured by Billings and Hall &c. from rocks about the same horizon; it is not, however, safe to refer our single specimen to them: it does not possess any fascia or band round the whorls, a character peculiar to *Murchisonia*; but we have no true shell remaining.

*Loc.* Offley Island, lat.  $81^\circ 16'$ . In white limestone, collected by Dr. Coppinger.

#### GENUS RHAPHISTOMA, Hall, 1847.

RHAPHISTOMA ÆQUALE (?), Salter.

*Raphistoma æquale* (?), Salter, Murchison's Siluria, ed. 4, p. 197, foss. 40. f. 2.

*Helicites qualteriatius*, Schloth.

*Platyschisma*, *Euomphalus*, *Scalites*, *Rhaphistoma*, *Helicotoma*, and flattened forms of *Pleurotomaria* so resemble each other when crushed or in the form of casts, that it is no easy matter to distinguish them, all appearing much the same when masked by the matrix in which they occur. Although we have only one specimen from Cape Hilgard, there can be no doubt about the genus. *R. æquale*, Salter (*Helicites Gualteriatius*, Schl.), seems to be our shell. It is associated with *Maclurea magna*, *Halysites catenulatus*, *Favosites gothlandicus*, and *Favistella*. I refer it to *R. æquale*, which it more nearly resembles than any American form I am able to find. The upper surface of some of the acuminate forms of *Maclurea*, which have the margin of the whorl extremely acute, would pass for this shell; but the last whorl when exposed is not so deep as in *Maclurea*, it is flatter and more acute and discoid also. Again, the subtrigonal

mouth and closely fitting sutures between the whorls distinguish *Rhaphistoma* from *Maclurea*.

*Loc.* Hayes Point, lat.  $79^{\circ} 42'$ .

Genus *HELICOTOMA*, Salter, 1856.

*HELICOTOMA NARESII*, Ether. (Pl. XXVII. fig. 3.)

This very discoidal shell is the only representative of what I believe to be the genus *Helicotoma*. Hall has described (Pal. N. Y. vol. i. p. 9, t. 3) a shell he terms *Euomphalus uniangulatus*, which, in some respects, resembles our species, but certainly is not the same.

*Sp. char.* Shell discoidal, depressed, almost flat, composed of five or six whorls gradually increasing in size, the inner edge of each whorl bevelled on the concave or umbilical side at an angle of  $15^{\circ}$ ; surface of the shell strongly marked by transverse lines of growth, which arch forward on the sides of the whorls, but are reflected backwards along or near the sutural junctions; umbilicus open, all the whorls exposed; a spiral band appears to run along the middle of the whorl; the aperture not seen, owing to compression; the spire must have been greatly depressed, probably level with the surface of the shell.

The genera *Euomphalus* and *Ophileta* might well receive our shell; yet I prefer referring it to *Helicotoma*; but its preservation is such as to preclude strict determination. Billings figures a shell which he calls *Ophileta? bella* (Geol. Canada, Pal. Foss. p. 30, f. 301), which very closely resembles our form; he refers this to Hall's *Euomphalus (Helicotoma) (Ophileta) uniangulatus*, but comments upon the flatness and more moderate concavity of the umbilicus. *Maclurea crenulata* and *M. speciosa*, Bill., simulate our species, showing how closely allied are these Euomphaloid forms. As before stated, we cannot compare either the entire aperture of *Maclurea*, or ventral sinus and notch in *Ophileta*, on account of the state of preservation; and our remarks are confined to a single specimen. Both Billings's and Hall's shells occur in the upper part of the Quebec group; about fifteen species are known on the American continent\*.

*Loc.* Offley Island, lat.  $81^{\circ} 16'$ . Associated with *Pentamerus Coppingeri*, *Favosites gothlandicus*, *Macrocheili*, and large *Cyrtocerata*.

Genus *HOLOPELLA*, M'Coy, 1855.

This genus occurs here and there on some of the shelly slabs of Silurian Limestone taken from the cliff-talus and drift at Hayes

\* Meek, in his Report on the Geological Survey of Ohio, vol. i. pt. 2 (Palæontology), p. 220, t. 19. f. 3, t. 20. f. 1, describes and figures a species of *Euomphalus (E. De Cewi, Billings)* which much resembles our shell. Billings obtained his from the Corniferous group (Devonian), Co. Haldinand, Canada West; Meek from Kelley's Island, Lake Erie. Billings described this species in the 'Canadian Journal' (July 1861), p. 358; Dev. Foss. Canada West, p. 94, f. 131, 132, woodcuts. It is the *Euomphalus Conradi*, Hall, Report, 1861, p. 107.

Point, lat.  $79^{\circ} 42'$ , and Cape John Barrow. They resemble forms common in the Ludlow, Wenlock, and Upper Silurians generally of Britain, especially *H. gregaria*; no characters occur to distinguish them; but the entire peristome and numerous gradually increasing smooth whorls leave no doubt as to the genus. None are sufficiently well preserved to enable me to describe them; their stratigraphical value is also lost owing to their being drifted specimens. *Orthoceras*, *Strophomena*, *Rhynchonella*, and *Macrocheilus* occur on the slabs.

*Loc.* Hayes Point, lat.  $79^{\circ} 42'$ , and Cape John Barrow, lat.  $79^{\circ} 48'$ .

Genus ACROCULIA, Phillips, 1841.

ACROCULIA HALIOTIS (Sow).

*Nerita haliotis*, Sow. Sil. Syst. t. 12. f. 16; Murchison, Siluria, t. 24. f. 9.

Many examples of this shell are in the collection, and, as usual, as many varieties; for no two are alike. *A. prototypa*, Phill., may in some cases be referred to *A. haliotis* (Sow.); but, as a rule, it is naticoid rather than neritoid in form. Capt. Feilden's specimens are in excellent preservation; and although so much variation is known to occur in the species of this group, yet I am disposed to refer some specimens to a new species to be next described. *A. haliotis* occurs at Bessels Bay and Dobbin Bay (lat.  $79^{\circ} 40'$ ), and is widely distributed, ranging from Bohemia and Thuringia to Britain and Ireland; and I believe the specimens collected by Dr. Coppinger are the same species. No less than eighty species are known in the Silurian rocks of the two hemispheres, recorded under the names *Capreolus*, *Platyceras*, *Pileopsis*, and *Acroculia*. Forty species are American and twelve German; the remainder are distributed generally through the European Silurians.

Genus PLATYCERAS, Conrad, 1840.

PLATYCERAS NATICOIDES, Eth. (Pl. XXVII. figs. 4, 4a.)

I cannot find any species of *Platyceras* or *Acroculia* answering to this, which I term *P. naticoides* from its extreme resemblance to many species of that genus as well as many forms of *Platyostoma*; but, strong as is the general resemblance, still the apex of the spire, indented suture, and abnormal body-whorl remove it from *Acroculia*. The extensive genus *Platyceras* of Conrad receives forms so varied and abnormal that almost any Palæozoic naticoid shell may be placed within its limits. Forty species are recognized by Hall as coming chiefly from the Helderberg group of America. Our Upper Silurian *Platyceras* has not occurred above the Silurian rocks of the west. The genus *Strophostylus* of Hall may receive these thin shells with expanded volutions (especially the last or ventricose body-whorl) and small spires; but I prefer referring them to *Platyceras*.

*Sp. char.* Shell subglobose, somewhat elongate in the direction of

the spire, or obliquely conical; spire small, loosely or irregularly coiled; volutions few, rounded, usually four, contiguous, the sutures varying in individuals; body-whorl large; peristome expanded and entire, slightly sinuous; surface of shell finely striated, near the peristome rather coarsely so, or lamellose and reflected backwards; columella not seen in any of the specimens; the peristome appears entire.

Our species would belong to that division of *Platyceras* having the whorls contiguous, not free.

Hall's genus *Platystoma* contains shells resembling these acroculiform and *Pileopsis*-like species. Dr. Coppinger collected these at Bessels Bay.

*Loc.* Bessels Bay, lat. 81° 6'.

#### HETEROPODA (NUCLEOBRANCHIATA).

This order of Pelagic Mollusca is represented by two genera of the family Atlantidæ (*Bellerophon* and *Maclurea*); both are widely distributed. The former genus is known to contain about 140 species, ranging from and through the lowest Silurian rocks up to the Carboniferous Limestone. Our two specimens of *Bellerophon* are from the Upper Silurian of Bessels Bay. Seventy species occur in the Palæozoic rocks of North America and Canada alone, 150 in Britain and Europe.

The Atlantidæ are all provided with a well-developed shell, which in the older genera was inflated or discoidal and symmetrical; in *Maclurea* the aperture of the shell was closed by an operculum. Both *Bellerophon* and *Maclurea* occur in the series of fossils brought home by Captain Feilden—*Bellerophon* from Bessels Bay and *Maclurea* from Cape Frazer, Cape Hilgard, and Cape Louis Napoleon. *Maclurea* is associated with *Receptaculites* in each locality, as well as with the large specimens of *Halysites* referred to in this commentary. I can only determine one species of *Bellerophon* amongst the 'Discovery' collection made by Dr. Coppinger, the forms occurring being, I think, the same—neither of them in good condition. I notice them, but leave specific determination.

These two heavy-shelled Nucleobranchs predominated in the Silurian seas of America, Grinnell Land, and probably Greenland—*Bellerophon* being the Bessels-Bay genus, *Maclurea* characterizing the beds at Cape Louis Napoleon, Cape Hilgard, and Cape Victoria.

#### Genus *MACLUREA*, Lesueur, 1818.

Lesueur's genus is numerically well represented in the collection, and probably by two if not three species.

In the British Islands we know this shell only from the Lower Silurian rocks, not ranging higher than the Caradoc (*M. macromphala*, M'Coy), the Arenig and Llandeilo series being its chief horizon. At Durness, the most northerly part of Sutherlandshire, N.W. Highlands, *M. Peachii* occurs abundantly in beds that are equivalent

to the Arenig or lowest Llandeilo series at Quebec. *M. Logani*, Salter, occurs also in the calcareous schists of the same series at Aldeans, Ayrshire, with *M. magna*; and the small *M. macromphala* ranges into the Caradoc rocks at Craig Head near Girvan. It is interesting to find *M. magna*, which is abundant in the United States, occurring in the Aldeans Limestone rocks of the same age in Scotland. We do not know this genus in England or Wales; yet no less than twenty-two species occur in North America, and ten in North Britain and Europe. The Aldeans Limestone and Arenig rocks of Durness in North Scotland contain five species, through three of which we are allied to North America and Canada, viz. *M. magna*, Lesueur, *M. Logani*, Salter, and *M. matutina*, Hall.

**MACLUREA MAGNA, LESUEUR.**

*Maclurea magna*, Lesueur, Journ. Acad. Nat. Sci. Philad. vol. i. p. 312, t. 13. f. 1-3; Hall, Pal. N. Y. vol. i. p. 26, t. 5, 6; M'CoY, Brit. Pal. Foss. p. 300, t. 1-4. f. 13.

Several specimens of this large species occur in the collection made by Captain Feilden at Cape Louis Napoleon, Cape Hilgard, Cape Frazer, and Victoria Head. Those brought home quite equal in size Hall's figures in the 'Pal. New York,' vol. i. t. 5. f. 8, which occur in the Chazy Limestone or "Canadian" division of the Lower Silurian of North America (United States). This shell ranges from the N.E. of York State to Kentucky and Tennessee, and N.W. to Lake Superior (lat. 48°). Now we have it from lat. 80°, or 32° further north. Doubtless wherever this division of the Lower Silurian rocks appears, from New York to Cape Louis Napoleon, this characteristic shell will be found.

Mr. Salter was inclined to consider *M. magna* and *M. Logani* to be the same species. *M. magna* was first found in Britain at Knockdolian Quarry and at Aldeans (Ayrshire); its great interest then as now, in this country, as in America, consists in its limited geological range, being, in America, confined to the Chazy Limestone (our Arenig group). We have no means of knowing its geographical range here, as the Scotch rocks containing *M. magna* strike out to sea under the Atlantic in Ayrshire. The Inch-nanff and Durness Limestones near Cape Wrath, containing the same genus, are a mere remnant of a once widely extended group of rocks, and undoubtedly the same as the Quebec group, so rich in Graptolites.

Mr. Billings names and describes (but does not figure) a species he terms *M. ponderosa*, closely allied to *M. magna* from the Levis formation above the Chazy; but it evidently is not the same shell. We possess *M. magna* from the Aldeans Limestone of Scotland, and *M. Peachii* from the Durness beds—rocks probably of Arenig age, or ranging from that to Caradoc. This wide geographical range of *M. magna* is important, and tends to show the relation of the Scotch Silurian fauna to that of North America, just as the Carboniferous series of Newfoundland may also be correlated with those of Scotland.

*Loc.* Cape Louis Napoleon, lat.  $79^{\circ} 38'$ ; Cape Hilgard, lat.  $79^{\circ} 41'$ ; and Victoria Head, lat.  $79^{\circ} 12'$ .

MACLUREA LOGANI, Salter.

*Maclurea Logani*, Salter, Report Brit. Assoc. 1851, Trans. Sect. p. 63; Quart. Journ. Geol. Soc. vol. vii. p. 166, t. 8. f. 7; Geol. Surv. Canada (Canadian Organic Remains), decade 1, p. 1, t. 1.

This shell is decidedly distinct from *M. magna*, although in many respects closely allied. It agrees with our British species in every particular. It is well figured and described by Salter in the Memoirs of the Geol. Survey of Canada, Figures and Description of Organic Remains, decade 1, pp. 1-10, t. 1. f. 1-6. *M. Peachii*, Salter, from the Durness and Inch-na-Danff Arenig rocks, may be taken for this shell. *M. Logani* becomes nearly as large as *M. magna*; but differences exist which cannot be discussed in a general notice. No opercula have appeared in the series collected. *M. Logani* often measures  $3\frac{1}{2}$  inches across or in width, and differs from other species by its extreme flatness on the lower or umbilical side, and few whorls, as well as great depth of the whorl, which often exceeds the width.

Mr. Hart and Dr. Coppinger collected this species at Bessels Bay, lat.  $81^{\circ} 6'$ .

#### Genus BELLEROPHON, Montfort, 1808.

BELLEROPHON, sp.

We have two specimens, probably of two species, of this genus, but neither of them complete; and whether the mouth-aperture was much expanded cannot be determined. The median keel was evidently well developed, and strong lines of growth pass off nearly at right angles to the keel and are reflected backwards towards the umbilicus.

Our specimens may both be inner portions of the shell, or the first portions of the spiral coils. We can therefore do little more than record the occurrence of *Bellerophon*. The American Silurian rocks contain thirty species of this genus, and the European sixty species, seven of which are common to the two hemispheres.

*Loc.* Bessels Bay, lat.  $81^{\circ} 6'$ .

#### Class CEPHALOPODA.

Few Cephalopoda have been collected, four species of *Orthoceras* and one *Cyrtoceras* being all brought home. The distribution of the order Tetrabranchiata in time is a problem of great interest. The seas of the globe during every epoch from the Silurian to the present day have held this Order. It is the oldest of the two, and attained its maximum in the Palæozoic periods, being now represented only by one species (*Nautilus pompilius*), confined to the warm seas of

the equatorial regions. The true Nautilidæ and Orthoceratidæ are essentially Palæozoic. The latter, through two genera (*Orthoceras* and *Cyrtoceras*), survived or lived on to Mesozoic times, dying out in the Triassic seas. No Dibranchiate Cephalopod has yet occurred or been found in any group of Palæozoic rocks; but the oldest of the two sections in this order (the Decapoda) contains the extinct family Belemnitidæ, commencing in the Trias and ranging up to the close of the Cretaceous period. Few if any Octopoda are known fossil.

The Silurian rocks of Bohemia, the British islands, Scandinavia, and America have yielded nearly 2000 species of Tetrabranchiata, America alone 450. We must probably, therefore, look to the American continent for the source of the Cephalopod fauna of the Palæozoic rocks constituting the shores of the Arctic seas. Hitherto only eight species have occurred in Arctic America, viz. one *Cyrtoceras*, one *Lituites*, five *Orthocerata*, and one *Actinoceras*. I am now able to add three more species to the list of Arctic Tetrabranchs—two *Orthocerata* and one *Cyrtoceras*. There are other fragments which probably would illustrate more had the materials been better.

Bohemia exceeds all areas in having yielded to the researches of Barrande no fewer than 830 species of Silurian Tetrabranchiate Cephalopoda.

Genus ORTHOCERAS, Breynius, 1732.

ORTHO CERAS IMBRICATUM, Wahlenberg.

*Orthoceratites imbricatus*, Wahlenb. Nova Acta Upsal. 1827, p. 89.

*Orthoceras imbricatum*, Hall, Pal. N. Y. vol. ii. p. 291, t. 61, 62; Siluria, t. 29. f. 7.

A vertically divided half or completely crushed specimen of an *Orthoceras* from Cape Louis Napoleon I refer to *Orthoceras imbricatum*. It occurs in the Niagara group of North America, and in the Ludlow series of Wales. Our specimen measures 4 inches in length; but the diameter appears increased, owing to flattening. Nothing can be determined as to the position or nature of the siphuncle, owing to the crushed state of the shell.

*Loc.* Cape Louis Napoleon, lat. 79° 38'; east of Dobbin Bay, Grinnell Land.

Another specimen (marked D 12'), from the Upper Silurian of Dobbin Bay, I take to be the same species. This shows the internal portion, where the concave septa correspond in distance to those in the weathered outer portion of the vertical half above described. Four other portions from Offley Island I also refer to *O. imbricatum*; they are considerably smaller, but in every other particular are the same.

*Loc.* Offley Island, lat. 81° 16', in white limestone. Cape Louis Napoleon, lat. 79° 38'. Upper Silurian.



ORTHO CERAS NUMMULARIUM, Sow.

*Orthoceras nummularius*, Sow. Sil. Syst. p. 632, t. 13. f. 24 ; Siluria, t. 26. f. 5.

*O. cochleatum*, Schloth.

*O. crassiventris*, Wahlenb., His. Leth. p. 30, t. 10. f. 3.

Sowerby's figure in the Silurian System, t. 13. f. 24, and the repeated figure in Siluria, t. 26. f. 5, in every particular resembles our single specimen collected by Dr. Coppinger from the Upper Silurian series of Bessels Bay. It appears to be the *O. cochleatum* of Schlothheim, and probably the *O. crassiventris* of Wahl. (His. Leth. p. 30, t. 10. f. 3). Although Schlothheim has priority as to date, I still retain Sowerby's name. The figure is good, and agrees with our fragment, which shows 6 siphuncular chambers. The want of radiating plates determines this not to be an *Actinoceras*, nor can I detect any inner or central inflated tube within the chambers as in that genus; and the siphuncular beads having no constriction removes it from *Huronina*. I draw attention to these differences from the unsatisfactory state of the fragment under description. Both by description and figure it is Sowerby's *O. nummularium*.

*Loc.* Bessels Bay, lat. 81° 6'.

GENUS CYRTO CERAS, Goldfuss, 1832.

CYRTO CERAS, sp.

Only fragments of what must have been a large species have been brought by Dr. Coppinger from Offley Island. It appears to be a portion from near the centre of the curved shell, measuring 9 inches, and the diameter 4 inches; the siphuncle is subspherical.

This species must have been of considerable size; the chambers are as closely arranged as those of *O. imbricatum*; and, but for the curvature, it might be mistaken for that form. Sixty species occur in the American Silurian rocks, and 293 in Europe; of these latter, 254 are Bohemian and 20 Russian. Next to *Orthoceras*, which contains 704 species, this genus possesses the greatest number. As before stated, Arctic America has yielded 8 species of Cephalopoda—*Lituites*, *Actinoceras*, and *Cyrtoceras* 1 species each, and *Orthoceras* 5. Bohemia, on the other hand, heads all areas in having yielded to the researches of Barrande no less than 830 forms.

*Loc.* Offley Island, lat. 81° 16'.

CARBONIFEROUS.

The only series of Carboniferous-limestone fossils obtained during the Exploration were collected at Feilden Isthmus, lat. 82° 43', the highest latitude attained; consequently the Carboniferous series are the nearest known fossiliferous rock to the Pole; they are underlain by a patch of Devonian, which appears to be faulted against the Cape-Rawson beds, which occupy so large an area on Grinnell Land, and underlie the whole of the fossiliferous rocks north of latitude 78° or

80°. The strike of these Carboniferous Limestones is towards Spitzbergen and Franz-Joseph Land, whence a rich fauna of this age is known and described by Toula.

Rocks of this age were not determined eastwards of Robeson Channel or on the extreme northern shores of Greenland as far as Cape May. Neither did Lieut. Aldrich obtain any evidence of such (according to the rocks brought home) during his memorable sledge journey to the westward and round Cape Columbia to Cape Alfred Ernest. Looking at the collection obtained from Feilden Isthmus, composed chiefly of Brachiopoda and Polyzoa, and the mode of their occurrence, I should be disposed to regard it as a highly typical one, and as indicating the presence of Carboniferous strata, which upon careful research and examination would yield a large fauna. The present collection was obtained under great difficulties, and is therefore by no means numerically representative\*. Four species of Actinozoa, four or five genera and twelve species of Polyzoa, and five genera and twelve species of Brachiopoda occur in the collection; but there were no Lamellibranchiata in either the Carboniferous or the Silurian series brought home.

Class ACTINOZOA.

Group TABULATA.

Genus SYRINGOPORA, Goldfuss, 1826.

SYRINGOPORA, sp.

This universally distributed genus of corals in the Carboniferous rocks of Europe and America is only represented in the Polar collection by two specimens.

The Halysitinae are a variable family, and unless the species are well preserved they are better left undetermined. *Syringopora* is ubiquitous, the abundant forms in Britain being *S. ramulosa*, *S. reticulata*, and *S. geniculata*. Keyserling, Bronn, and D'Orbigny have described this genus under the name of *Harmodites*. Twelve species are known in the Devonian rocks of North America and Canada, three in the Carboniferous of North America, and twelve in Europe, *S. reticulata* being the species common to the two continents; eight species occur in the Carboniferous rocks of Russia (four of these in the Ural chain), five in Belgium, and three in France, *S. ramulosa*, *S. reticulata*, and *S. geniculata* being common to all European areas.

*Loc.* Feilden Isthmus, lat. 82° 43'.

\* It is much to be regretted that by far the greater portion of the Carboniferous collection made by Captain Feilden at Joseph-Henry Peninsula during the sledge journey was left behind, owing to the inability of the crew to drag the increased weight on the sledge. Considerably more than one half were abandoned; only the few secured and brought away by the energetic persistency of the weakened explorers, and noticed in this communication, were saved.

Genus CHÆTETES.

(*Monticulipora*, D'Orb. 1850.)

CHÆTETES, sp. allied to *C. TUMIDUS* (Phillips).

*Calamopora tumida*, Phill. Geol. Yorksh. vol. ii. p. 200, t. 1. f. 49-57.

*Favosites tumida*, Portlock, Londonderry, p. 326, t. 22. f. 4.

*Monticulipora tumida*, De Kon. Nouv. Rech. sur les Anim. Foss. Terr. Carb. Belg. p. 143, t. 14. f. 3.

Eight or ten portions of this branching species are in the collection; they much resemble *Chætetes* (*Monticulipora*?) *inflatus*, De Koninck, from the Carboniferous Limestone of Visé (Belgium); they are also equally near *C. fruticosus*, Hall, from the Hamilton group of North America. This is evidently a very variable species, differing to almost any extent in size and habit.

*Sp. char.* Corallum branching, the branches round or subcylindrical or subdepressed; corallites prismatically arranged; calicular openings nearly at right angles to the axis or very oblique to the exterior surface, or in their upward growth they are nearly vertical, until bent or inclined to the face of the corallum, where they (the calices) become nearly horizontal. The ramose and branching habit of this species of *Chætetes* (*Monticulipora*) is clearly shown in the fragments collected, and, judging from their diameters, it must have been of considerable size.

The Chætetinae, as a group, have received many dissimilar and doubtful genera. The restricted genus *Chætetes* alone absorbs ten genera; the species *C. tumidus* has about forty synonyms, and *C. inflatus* ten. I refer the specimens collected by Captain Feilden to *C. tumidus*, as being its nearest ally.

*Hab.* Feilden Isthmus, lat. 82° 43'.

Group RUGOSA.

Genus LITHOSTROTION, Fleming, 1828.

LITHOSTROTION JUNCEUM (Fleming).

*Caryophyllea juncea*, Flem. Brit. Animals, p. 509.

*Siphonodendron sexdecimale*, M'Coy, Brit. Pal. Foss. p. 109.

*Lithodendron sexdecimale*, Phill. Geol. York. vol. ii. p. 202, t. 2. f. 11-13.

The genus *Lithostrotion*, through three species, connects, with other genera, the Carboniferous Cœlenterate faunas of America and Europe. No less than twenty-eight species are European and five American, three of which are common to both continents, viz. *L. basaltiforme*, *L. cœspitosum*, and *L. floriforme*. From our single specimen, *L. junceum* is now recorded for the first time from the western hemisphere, and at the most northerly land known (lat. 82° 43'). The corallites are too small for its allied species, *L.*

*irregulare*; no transverse or connecting tubes, as in *Syringopora*, can be made out: this and traces of the columella, two essential characters, remove it from *Syringopora*. The diameter of the coralites differs, as in the British species. M'Coy's genus *Siphonodendron* is clearly a modification of Fleming's older genus *Lithostrotion*, although M'Coy dwells upon the mode of development or increase by lateral budding in *Siphonodendron*, as distinguished from lateral division of the old calice and dichotomous fissure of the stem, also on the simple axis and conoidal transverse diaphragm in *Siphonodendron*, the axis in *Lithostrotion* being large and cellular and there being no diaphragm.

Captain Feilden collected this one specimen at Feilden Isthmus, lat. 82° 43', in a grey limestone.

### Class ANNELIDA.

#### Genus SERPULITES, MacLeay, 1839.

SERPULITES CARBONARIUS, M'Coy, Carb. Foss. Ireland, p. 170, t. 23. f. 32 (or allied to this species).

The order Tubicola is represented in the collection only by this one species; it is badly preserved, but there is enough to show that it may be the *Serpulites carbonarius* of M'Coy, *loc. cit.* It was collected at Rawling Bay.

### Subkingdom MOLLUSCOIDA.

#### Class POLYZOA (BRYOZOA).

The Polyzoa collected by Captain Feilden are both numerous and important and demand careful notice, especially as they are from rocks of the highest latitude in which fossils have yet been obtained, viz. Feilden Peninsula, between lat. 82° 43' and 82° 50' N. The specimens, too, are finely preserved, and capable of comparison with known Carboniferous-limestone species from America, Spitzbergen, and Europe.

I append, through the aid of Mr. R. Etheridge, Jun., a valuable bibliography and description of the species collected, so far as their preservation will allow. All the specimens are Carboniferous, and therefore the group needs no reference under the Silurian portion of this paper. It is singular that we have no Silurian forms of Polyzoa in the collection, considering that, bathymetrically, we should expect to find them associated with the numerous corals and Brachiopoda.

The bibliography and descriptions will greatly aid in the study of the characters of the Carboniferous Polyzoa of the northern hemi-

sphere, especially as so much has been done by the American naturalists, notably by Hall, Meek, and Worthen, and by Geinitz, Dr. Nicholson, and others who have investigated the Polyzoa on that continent.

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It may not be out of place, in the first instance, to notice what is already known in relation to the subject of Arctic Palæozoic Polyzoa. With this end in view I have drawn up the following bibliography, and regret not being able to offer a more extended account.

1828. In the "Topographical and Geological Notices" forming Appendix I. to Franklin's 'Narrative of a Second Expedition to the Polar Seas in the years 1825-27 &c.'\*, Dr. J. Richardson describes the limestone of Lake Winnipeg, and mentions its fossil contents, amongst which are Corallines †. The Winnipeg limestone, with that of the Elk and Slave Rivers, is considered by Dr. Richardson to be Carboniferous.

1830. An article on Arctic geology was given by Prof. Jameson in the 'Edinburgh Cabinet Library' ‡, in which were described specimens from Cape Fanshawe, in that part of Spitzbergen called New Friesland by the officers of Captain Parry's Expedition. The specimens in question consisted of Madreporas, Retepores, *Orthoceratites*, *Terebratulites*, and *Cardites* §.

1839. The geology contained in the Zoology of Captain Beechey's 'Voyage &c. to the Pacific and Behrings Straits performed in His Majesty's Ship 'Blossom' &c.'|| was contributed by Prof. Buckland. A limestone was found at Cape Thomson, on the north-west coast of North America (lat. 67° 6' N., long. 165° 45' W.), "abounding with organic remains similar to those of the limestone of Derbyshire" ¶. Amongst the specimens collected are mentioned "the *Producta Martineæ* and other *Productæ* . . . . . and other specimens of *Flustræ*"\*\*.

1846. Count von Keyserling gave descriptions of a number of Polyzoa from the Palæozoic rocks of the remote and arctic region of Petschora Land, in N.E. Russia ††. The forms there described are:—

*Ceripora bigemmis* ‡‡, *Keys.*, p. 184; atlas, t. 3. f. 13.

*Fenestella antiqua*, *Goldf.*, p. 186; atlas, t. 3. f. 9, *a* & *b*.

„ *carinata*, *M' Coy*, p. 186; atlas, t. 3. f. 12, *a* & *b*.

\* Page i.

† Page lv.

‡ 'Narrative of Discovery and Adventures in the Polar Seas and Regions, &c.' by Profs. Jameson, Leslie, and Hugh Murray. Edinburgh, 8vo, 1830, p. 399.

§ Page 402.

|| London, 4to, 1839, p. 157.

¶ *Loc. cit.* p. 171.

\*\* *Ibid.* p. 172.

†† Geognostische Beobachtungen, wissenschaftliche Beobachtungen an seiner Reise in das Petschora-Land im Jahre 1843, 4to, 1846: atlas, folio.

‡‡ This is probably a *Rhombopora*, Meek.

- Ptylopora pluma*, *M' Coy*, p. 187; atlas, t. 3. f. 11.  
*Polypora orbicribrata*, *Keys.*, p. 189; atlas, t. 3. f. 7.  
,, *bifurcata*, *Fisch.*, p. 189; atlas, t. 3. f. 8, *a* & *b*.  
,, *infundibuliformis*, *Goldf.*, p. 190.  
,, *biarmica*, *Keys.*, p. 191; atlas, t. 3. f. 10.  
*Coscinium cyclops*, *Keys.*, p. 192; atlas, t. 3. f. 5, *a* & *b*.  
,, *stenops*, *Keys.*, p. 193; atlas, t. 3. f. 6, *a-c*.

In the same year Prof. de Koninck published a paper, "Notice sur quelques Fossiles du Spitzberg"\* , in which he mentioned a *Fenestella* resembling *F. anceps*, Schl., in the size of its fenestrules. The fossils from Bell Sound were thought by Prof. de Koninck to be of Permian age.

1847. A translation of a memoir by Baron von Buch, "Ueber *Spirifer Keilhavii*, über dessen Fundort und Verhältniss zu ähnlichen Formen," appeared in the Quarterly Journal of the Geological Society for 1847 †, in which it is stated that *Fenestella antiqua* was found in blocks of Carboniferous Limestone fallen from the top of Mount Misery, Bären Island.

1850. Dr. C. Grewingk in a work, 'Beitrag zur Kenntniss der orographischen und geognostischen Beschaffenheit der Nordwest-Küste Amerika's,' &c. ‡, gives in the first Appendix §, "On the Fossil Fauna and Flora," a list of fossils from Cape Thomson. An encrinital limestone is there mentioned containing *Lithostrotion basaltiforme* and *Flustra*; the latter name probably comprehends what we now know as *Fenestella*.

1852. During this year the late Mr. J. W. Salter contributed two papers devoted to Arctic palæontology. The first consisted of a Geological Appendix to Dr. P. C. Sutherland's work ||, in which a number of fossils from the neighbourhood of Wellington Channel and other localities are described—amongst these a species of *Fenestella* with curved and zigzag interstices ¶, and another species of the same genus with small cells and only two to a fenestrule\*\*.

The second of Mr. Salter's papers was an account of the Arctic Carboniferous fossils contained in Sir E. Belcher's 'Last of the Arctic Voyages' ††, and included only one species of Polyzoa, *Fenestella arctica*, Salter ‡‡, allied to *F. martis*, Fischer, and *F. crebrioculata*, De Vern., from Dépôt Point. This form occurs amongst Capt.

\* Bull. de l'Acad. Royale des Sc. &c. de Belgique, t. xiii. 1846, pt. i. pp. 592-596.

† Q. J. G. S. iii. pt. ii. p. 48; also see Abhandl. k. Akad. Wissensch. zu Berlin aus dem Jahre 1846, p. 65.

‡ St. Petersburg, 8vo.

§ Page 270.

|| Journal of a Voyage in Baffin's Bay and Barrow Straits in the years 1850-51, performed by H.M. Ships 'Lady Franklin' and 'Sophia.' London, 8vo, 1852, vol. ii. App. p. cexvii.

¶ P. cexxvii, t. 6. f. 1.

\*\* P. cexxvii.

†† London, 1855, 2 vols. 8vo, vol. ii. pp. 377-391, t. 36; reprinted, with remarks, in the 'Manual and Instructions for the Arctic Expedition,' 1875, p. 551.

‡‡ P. 385, t. 36. f. 8.

Feilden's fossils, and is one of much interest; I have some doubts as to the propriety of referring it to the genus *Fenestella*. It is probably identical with that noticed in the preceding abstract as possessing curved and zigzag interstices.

1853. The 'Quarterly Journal' for this year contains a third paper by Mr. Salter, "On Arctic Silurian Fossils"\*; attached to Dr. Sutherland's memoir "On the Geological and Glacial Phenomena of the coasts of Davis Strait and Baffin's Bay"†. The fossils are Upper Silurian in character, and chiefly from the neighbourhood of Wellington Strait. At the S.W. end of Seal Island, a rock in Baring Bay, a white crystalline limestone yielded a small species of *Fenestella*, figured in Sutherland's Journal‡; the same species is also probably found at Leopold Island, Barrow Straits.

1855. Mr. A. K. Isbister contributed a paper to this year's 'Quarterly Journal,' "On the Geology of the Hudson's Bay Territories, and portions of the Arctic and North-western Regions of America," &c. §, in which he gave copious lists of Upper Silurian fossils from the Wellington Channel district, Baring, Lake Winnipeg, and the Slave Lake, and also from the Carboniferous series of the Mackenzie. One species of *Fenestella* is mentioned.

1856. In the 'Report of the British Association' for 1855 || appeared a paper by Mr. Salter, "On some Additions to the Geology of the Arctic Regions," which contains a good general account of Arctic geology. The coast-line of Albert Land, in lat. 78° N., is strewn with blocks containing numerous fossils, which "prove to be all Carboniferous types; corals of the genera *Clisiophyllum*, *Zaphrentis*, *Lithostrotion*, *Stylastræa*, *Michelinia*, Brachiopod shells, *Producti*, and Spirifers, with *Fenestella* &c." ¶.

1858. An interesting appendix to a paper by Rear-Admiral M'Clintock was given by the Rev. Samuel Haughton, F.R.S., entitled "Descriptions of the Plates to illustrate the Geology of Captain M'Clintock's Ice Travels," in the 'Journal of the Royal Dublin Society' \*\*. A figure is given of a unique specimen from Garnier Bay, Griffith's Island, "probably a Bryozoan coral" ††.

1859. This form is again referred to as an "undescribed Bryozoan zoophyte" by Dr. Haughton in his "Geological Account of the Arctic Archipelago, drawn up principally from the specimens collected by Captain F. L. M'Clintock from 1849 to 1859" ††.

1860. The foregoing paper also appeared in the 'Journal of the

\* Quart. Journ. Geol. Soc. ix. p. 312; and reprinted in the 'Manual and Instructions for the Arctic Expedition,' 1875, p. 531.

† *Ibid.* p. 296.

‡ T. 6. f. 1.

§ Quart. Journ. Geol. Soc. xi. p. 497.

|| Pt. 2, p. 211.

¶ *Loc. cit.* p. 212.

\*\* Vol. i. p. 239.

†† *Loc. cit.* p. 243, t. 7. f. 6.

†† M'Clintock's 'Narrative of the Discovery of the Fate of Sir J. Franklin,' &c., Append. iv. p. 372.

Geological Society of Dublin'\*, where the fossil in question is stated to be of Silurian age, and is called an undescribed Bryozoan zoophyte.

In Mr. J. Lamont's "Notes about Spitzbergen in 1859"† an appendix on the specimens is given‡, wherein is recorded the occurrence of rounded fragments of grey compact limestone in Ryke-Yse Islands, and of fragments of argillo-siliceous dark grey rock at an island in Bell Sound, containing *Fenestella* and corals.

Mr. J. W. Salter also contributed some remarks§ on Mr. Lamont's paper. The Fenestellidæ from the island in Bell Sound, mentioned by the latter, consist, according to Mr. Salter, of two species of *Fenestella*, "one with very large meshes." From an undefined locality there is also recorded "a new genus, in all probability of the Fenestellidæ, consisting of thick stems branching regularly from opposite sides, the smaller branches also opposite, and coalescing with their neighbours so as to form a quadrangular network. But for this coalescence, it might be a gigantic *Thamniscus* or *Ichthyorhachis*." The general facies of the fossils was thought to be Carboniferous; and the size of both the shells and Polyzoa Mr. Salter considered to be remarkable, the latter being "larger than the corresponding species in our own Mountain Limestone." Three localities are represented, viz. Bell Sound at 400 feet above sea-level, island in Bell Sound at 250 feet, and Black Point, south-east angle of Spitzbergen.

1861. The above remarks were contributed by Mr. Salter as an appendix to Mr. Lamont's work, 'Seasons with the Sea-Horses,' &c. ||, in almost identical words.

1874 and 1875. In the 'Neues Jahrbuch' for 1874, Dr. F. Toula gave a list of fossils ¶ from Bell Sound and Axel Island, Spitzbergen, which were described in detail in the 'Jahrbuch' for the following year (1875) under the title "Permo-Carbon-Fossilien von der West-Küste von Spitzbergen"\*\*. The Polyzoa described in this memoir are the following; and, as it is an important paper, I shall give a few detailed notes on the species:—

1. *Fenestella*, sp., allied to *F. Geinitzii*, D'Orb., and *F. tenuiflora*, Phill.; the stems are thicker than the branches, and there are three cells on each side the former within the space comprised by each fenestrule or mesh. Dr. Toula thinks this may be new.

2. *Fenestella*, sp., allied to *F. retiformis*, Schl., and *F. carinata*, M'Coy.

\* Vol. viii. p. 196. This and the foregoing papers by Prof. Haughton were reprinted in the 'Manual and Instructions for the Arctic Expedition,' 1875, pp. 442-550.

† Quart. Journ. Geol. Soc. xvi. p. 428.

‡ *Loc. cit.* p. 436.

§ "Note on the Fossils from Spitzbergen," *loc. cit.* p. 439.

|| London, 8vo, p. 307.

¶ "Verzeichniss der von ihm beschriebenen Versteinerungen aus Spitzbergen," p. 904.

\*\* Pp. 225-264, pls. 5-10.



3. *Polypora*, sp.; a form branching less regularly than *P. dendroides*, M'Coy, but otherwise closely corresponding with the latter.

4. *Polypora*, sp., allied to *P. fastuosa*, De Koninck; possesses oval fenestrules, thin striated dissepiments, and four cells in each oblique cross row.

5. *Polypora grandis*, Toula; a large and boldly formed species, with flat interstices carrying oblique cross rows of five or six cells in each; the dissepiments are thin, oblique, and striated.

6. *Polypora*, sp., with a funnel-shaped frond, resembling in some points *P. biarmica*, Keyserling; the cells, however, are three or four in each oblique cross row.

7. *Ramipora*, Toula (nov. gen.).—Under this name Dr. Toula separated a *Symocladia*-like polyzoan, in which a main stem gives off large branches at the same level on opposite sides, trending upwards. These lateral or secondary branches themselves give rise to shorter and slighter dissepiments on each side, which, projecting towards one another, meet and form an arched fenestrule. Both the main stem and branches are keeled on each face of the polyzoarium, but the cells open only on one, and are placed in longitudinal rows. The type and only species described is *R. Hochstetteri*, Toula. I shall have occasion to refer again to this form.

8. *Phyllopora Laubei*, Toula; a characteristic *Phyllopora*, in which the reticulation is coarser or larger than in *P. Ehrenbergi*, King.

1875. Another excellent paper by Dr. Toula, "Eine Kohlenkalk-Fauna von den Barents-Inseln (Nowaja-Semlja, N.W.)" \*, contains numerous descriptions of Polyzoa, which it is necessary to notice in detail. He there describes:—

1. *Glaucanome*, sp., near *G. pulcherrima*, M'Coy, and *G. trilineata*, Meek, from Höfer Island. It is a mere fragment.

2. *Polypora biarmica*, Keyserling, var. Specimens from Höfer Island are considered by Dr. Toula to be a variety of Keyserling's Russian form. American specimens from Nebraska city were referred to this species by Dr. Geinitz, for which the latter was rather severely criticized by the late Mr. F. B. Meek; however, Dr. Toula appears to consider that even the American variety may be brought to agree with the typical form by the aid of the Nova-Zembla specimens.

3. *Polypora fastuosa*, de Koninck, from Höfer Island and Scheda Island, is considered by Dr. Toula to be allied to *P. bifurcata*, Keyserling.

4. *Polypora laxa*, Phillips, from Scheda Island; a form possessing an irregular network, like that of Phillips's species.

\* Sitz. d. k. Akad. d. Wissenschaften zu Wien, 1875, lxxi. pp. 562-574.

5. *Polypora subquadrata*, Toula; a species not possessing any peculiarly distinctive characters.

6. *Polypora*, sp., near *P. marginata*, M'Coy. It appears to differ from the type in the absence of the particularly characteristic broad flat margin of the branches &c.

7. *P. crassipapillata*, Toula, from Höfer Island, as pointed out by the author, appears to be closely related to *P. papillata*, M'Coy. I much doubt if it is more than a variety.

8. *P. pustulata*, Toula, near *P. pustulata*, mihi. A well-marked and peculiar form from Höfer and Scheda Islands. It is compared by Dr. Toula with *P. fastuosa*, De Koninck. There is a very marked difference between the size of corresponding portions in the respective species.

9. *Polypora*, sp., near *P. dendroides*, M'Coy. The same form mentioned by the author in his paper on Spitzbergen in the 'Neues Jahrbuch,' previously referred to.

10. *Archimedes arctica*, Toula. The extension of this peculiar subgenus of *Fenestella* into the rocks of the Arctic regions is an interesting fact, as it appears to have hitherto been found chiefly in the Warsaw and Keokuk limestones of Illinois, Indiana, and Missouri. Höfer Island.

11. *Fenestella retiformis*, Schlottheim, Barents Island; a Permian form; also found in Spitzbergen rocks (Toula).

12. *Fenestella*, sp., near *F. Shumardi*, Prout. Under this name are grouped several forms—one not easily distinguished from *F. flabellata*, Phillips; another related to *F. plebeia*, M'Coy; a third having the cup-like form and anchoring rootlets of *F. membranacea*, Phill.; a fourth nearer to the typical *F. Shumardi*, Prout, but for which, from the minute nature of the pores and fenestrules, Dr. Toula proposes the varietal name of *minima*. A fifth and last form is included, possibly allied to *F. carinata*, M'Coy. So far as I understand Dr. Toula's remarks, these all appear to be regarded as varieties of one form.

13. *F. inconstans*, Toula. A form in which there appears to be little division between the interstices and dissepiments, and the fenestrules are irregular in outline. The cells occur in circlets round the fenestrules in a rather peculiar and uncommon manner, giving to the polyzoarium, as Dr. Toula himself remarks, somewhat the appearance of a *Phyllopora*, King.

14. *F. undulata*, Phill.? Fragments of a form somewhat allied to this British species were noticed.

15. *F. tenuifila*, Phill. Specimens exhibiting a very delicate network render it probable that this species also occurred in the Barents-Island collection.

16. *F. Goldfussiana*, De Koninck.

In addition to the foregoing, Dr. Toula describes amongst the Actinozoa of his paper two species which I consider to be probably Polyzoa; they are:—

17. *Rhombopora (Ceriopora) bigemmis*, Keyserling.

18. *Millepora (Pustulopora) oculata*, Phillips.

1876. Prof. A. E. Nordenskiöld, in his 'Sketch of the Geology of Ice Sound and Bell Sound, Spitzbergen'\*, gives a note on the Carboniferous-Limestone fossils collected by Dr. Lindström during his expedition of 1868, from which it appears that out of a total of sixty-three species, seven were Polyzoa. Nordenskiöld concludes that the strata yielding the fossils are of Mountain-Limestone age, but containing an admixture of species occurring in other countries only in the Permian.

1878. In concluding this bibliographical notice of hitherto described Arctic Palæozoic Polyzoa, so far as known to me, I have to notice the species recorded by my friend Dr. J. J. Bigsby in his recently issued 'Thesaurus Devonico-Carboniferus.' Within the pages † of this remarkable epitome of the organic remains of the Devonian and Carboniferous epochs is given a list of fossils from Feilden Isthmus, lat. 82° 43' N., collected by Captain Feilden and communicated by my father. They are:—

*Fenestella arctica*, Salter.

— *cribrosa*, Hall.

— *intertexta*, Portlock?

— sp., near *F. bicellulata*, mihi.

*Polypora biarmica*, Keyserling.

— *grandis*, Toula.

— *megastoma*, De Koninck.

*Ramipura Hochstetteri*, Toula.

#### *Description of the Species.*

Genus FENESTELLA (Miller), Lonsdale, 1839.

*Fenestella*, Murchison, Sil. System, p. 677; restricted by King, Permian Foss. England, 1850, p. 35.

FENESTELLA? ARCTICA, Salter.

*Fenestella arctica*, Salter, Belcher's Last of the Arctic Voyages, vol. ii. 1855, p. 385, t. 36. f. 8.

*Sp. char.* Polyzoarium flat, in one plane; interstices thicker than broad, zigzag, angular on the obverse face, rounded on the reverse or non-celluliferous face; dissepiments short, quite horizontal, of equal breadth with the interstices, and similar in character; fenestrules hexagonal, large, broad; here and there one may be found smaller and more irregular than the others, but, as a rule, they retain their size and form with great regularity; cells opening on the angular faces of the zigzag dissepiments in two alternating lines, one on each side; reverse smooth to the naked eye, but finely striated when magnified.

\* Geol. Mag. dec. 2. iii. p. 63.

† P. 426 f.

*Obs.* The zigzag interstices give to this species a peculiarly distinctive character; whilst, as remarked by Mr. Salter, their size and great regularity, with that of the fenestrules and the almost vertical series in which the latter are disposed one under the other, render *F. arctica* a conspicuous species. Salter saw only the non-poriferous face; and, although I have the opposite or celluliferous in some of the present specimens, the characters are so obscured that I should not like to give any definite details; however, the obverse is strongly carinate, and the cells appear to be arranged in several rows on each side the keel, in a similar manner to the form I have described under the name of *Goniocladia cellulifera*; and if the reverse is rounded, as above stated, and not angular, it will not surprise me also if, as I have some reason to believe, *F. ? arctica* should ultimately be proved to be a species of *Goniocladia*. This, however, is a question I cannot settle with the material at my disposal. Mr. Salter compared *F. ? arctica* with *F. martis*, Fischer; but as I have not access to Fischer's rare 'Oryctographie,' I cannot enter into details on this point. Mr. Salter also compared *F. arctica* with *F. crebrioculata*, Vern., in which he states there is "neither so flat a surface nor such large perforations."

*Loc.* Dépôt Point, Albert Land (*Salter*); Feilden Isthmus, lat. 82° 43'. In Carboniferous Limestone.

FENESTELLA, sp.

(Compare *F. cribrosa*, Hall, Pal. N. Y. 1862, ii. p. 166, t. 40 n. f. 3 a & b; Nicholson, Report Pal. Ontario, 1874, p. 106, f. 43 a & b.)

*Obs.* Although the single specimen amongst the Arctic fossils is only a decorticated fragment showing the basal layer, with projecting casts of the cells, still the characters are so marked and regular that I think there can be little doubt of the identity of the specimen in question. There are two cells in the length of every fenestrule on each side of the keel of the interstices, and one opposite the base of each dissepiment, characters which agree particularly well with those assigned by Prof. Nicholson to this species. *F. cribrosa* need not be confounded with a small form described by myself as *F. bicellulata*, in which there are also two cells to the length of each fenestrule; but they are invariably placed in the angles formed by the union of the dissepiments and interstices, and deeply indent the borders of the otherwise nearly square fenestrules. There is also an entire absence of the cell at the base of each dissepiment. *F. cribrosa* is probably closely allied to *F. Norwoodiana*, Prout\*; but of this we unfortunately do not possess a figure. The normal condition of this species appears to be that of one cell at the base of each dissepiment, and one in the length of each fenestrule, although variation occasionally takes place. Prof. James Hall described the non-celluliferous face of *F. cribrosa* from the Niagara limestone (Upper

\* Trans. St. Louis Acad. i. p. 233.

Silurian), and Prof. H. A. Nicholson a specimen, showing the cells, from the Hamilton group (Upper Devonian). The condition of the example in Capt. Feilden's collection does not enable me to add any further details.

*Loc.* Feilden Isthmus, lat. 82° 43'.

FENESTELLA, sp.

*Obs.* Amongst some finely preserved remains on the surface of a piece of limestone, two small fragments occur which bear a close resemblance to a species I described from the Scotch Carboniferous limestone as *Fenestella bicellulata*\*. The essential characters are the oblong fenestrules, alternate in contiguous series, with two cells only to every fenestrule on each side the angular interstice, placed in the angles formed by the junction of the interstices and dissepiments. These characters are as strongly marked in the Arctic as in the Scotch examples; but the marked indentation of the sides of the fenestrules by the aperture of the cells, and the strong median keel, with its line of nodes visible in *F. bicellulata*, do not appear to be present in the Arctic form. Furthermore, the prominent mouths of the cells are also absent in the latter. A comparison may also be instituted with *Polypora intermedia*, Prout † (which, I think, should perhaps be more properly regarded as a *Fenestella*); but the fragments are small, and the preservation not all that could be desired, so that we can do little more than give a mere notice of such a form, to be used in future investigations. It must not be forgotten that Mr. Salter mentions the occurrence of a *Fenestella*, with only two cells in the length of the fenestrule, in Dr. Sutherland's collection.

*Loc.* Feilden Isthmus, lat. 82° 43'.

FENESTELLA, sp.

*Obs.* A specimen of a *Fenestella* with a fan-shaped polyzoarium has been split in two in a longitudinal direction; and as the external characters are not shown, specific determination is quite out of the question. The interstices and dissepiments were arranged in a very regular and definite manner; the former straight, narrow, and seldom bifurcating, the latter short and thin. The fenestrules enclosed by them are long and narrow, and the whole appearance of the polyzoarium recalls to us that of *F. plebeia*, M'Coy ‡, of our own Carboniferous rocks. The cells were, so far as I can make out, from four to six in the length of a fenestrule; in fact the whole aspect is that of *F. plebeia*. Had the cells been less in number it might also have been compared with *F. membranacea*, Phill.§

*Loc.* Feilden Isthmus, lat. 82° 43'.

\* Mem. Geol. Surv. Scotl. Explanation-sheet 23, 1874.

† Trans. St. Louis Acad. i. p. 272, t. 15. f. 5.

‡ Synop. Carb. Foss. Ireland, 1844, t. 29. f. 3.

§ Synop. Carb. Foss. Ireland, 1844, p. 202 (M'Coy's description).

Genus POLYORA, M'Coy, 1844.  
(Synop. Carb. Foss. Ireland, 1844, p. 206.)

POLYORA GRANDIS, Toula ?

*Polyora grandis*, Toula, N. Jahrbuch, 1875, p. 230, t. 9. f. 7.

*Sp. char.* Interstices flat, broad, and increasing in size previous to bifurcation; dissepiments thin, usually oblique and striated; fenestrules large, elongate obliquely and rhomboidal, narrow, occasionally irregular; apertures of the cells arranged on the interstices in oblique rows, five or six to the row.

*Obs.* The broad flat interstices and narrow, much elongated fenestrules will, I think, be sufficient to separate the two specimens I have recorded under this name and those I have placed under *P. fastuosa*, De Koninck. Whether they are *P. grandis*, Toula, however, is a point open to discussion. The specimens in question agree with Dr. Toula's description and figures in the broad, flat, conspicuous interstices and narrow elongated fenestrules; but, on the other hand, the dissepiments are not so regularly oblique in our form, but are, for the most part, horizontal. As I am averse to creating a new species when a reference to a known one can possibly be made, even by a slight extension of its characters, I provisionally place these specimens under Dr. Toula's species.

*Polyora grandis*, in the size of its interstices and fenestrules, is allied to *P. (Retepora) laxa*, Phill.\*, and again, irrespective of the generic differences, to *Fenestella coassa*, M'Coy. In *P. ? laxa*, however, the network of the polyzoarium is much more irregular than in *P. grandis*, although this is less marked in Phillips's second and later figure of his species †.

*Loc.* Feilden Isthmus, lat. 82° 43'.

POLYORA MEGASTOMA (De Koninck ?).

*Fenestella megastoma*, De Kon. Quart. Journ. Geol. Soc. 1863, xix. p. 5, t. 2. f. 3.

*Sp. char.* Polyzoarium expanding, inclined to be irregular; interstices subparallel, slightly thicker than the dissepiments, bifurcating at intervals, with very little apparent thickening at each bifurcation; dissepiments horizontal, subalternate in contiguous rows, here and there nearly opposite; fenestrules parallelogrammic, with rounded angles, longer than wide, sides not indented or overhung by the cell-apertures; cell-apertures numerous, arranged regularly in quincunx and confined to the interstices; reverse striate.

*Obs.* I cannot find any more fitting reference for the form represented than Prof. de Koninck's Indian species. One of the specimens I so refer is of about the same dimensions as, the other somewhat smaller than the Indian form; but in both there are to be observed the essential characters assigned by Prof. de Koninck to his species—the interstices and dissepiments of equal dimensions,

\* Geol. Yorksh. 1836, ii. p. 199, t. 1. f. 26-30.

† Pal. Foss. Devon, 1841, p. 23, t. 12. f. 34.

the parallelogrammic fenestrules with rounded angles, the striated reverse, and with it all a somewhat irregular appearance. If my reference to Prof. de Koninck's form is correct, it will necessitate the transference of the species from the genus *Fenestella* to *Polypora*; for although the state of preservation is not good, still there is quite enough evidence to show that it is a *Polypora*, possessing the above characters in common with *F. megastoma*, De Kon.; and it must be borne in mind that the celluliferous face of the latter was unknown to Prof. de Koninck.

Very closely approaching to *P. megastoma*, De Kon., is one of Dr. Geinitz's figures\* of *P. marginata*, M'Coy; but I am sorry that I cannot agree with so eminent an authority as Dr. Geinitz in his reference of the Nebraska forms to M'Coy's species; for the figures in question do not appear to me to agree with M'Coy's description at all.

*Loc.* Feilden Isthmus, lat. 82° 43'.

*POLYPORA BIARMICA*, Keyserling. (Pl. XXVIII. fig. 4.)

*Polypora biarmica*, Keyserling, Reise in das Petschora-Land, 1846, p. 191, t. 3. f. 10; Geinitz, Dyas, 1861, p. 117; Gein. Carbonformation u. Dyas in Nebraska, 1861, p. 68, t. 5. f. 13; Prout, Trans. St. Louis Acad. i. p. 450; Toulou, Sitz. k. Akad. d. Wissensch. zu Wien, 1875, lxxi. p. 562, t. 3. f. 15, *a-c*; Miller, American Pal. Foss. 1877, p. 99.

*P. spindel*, Meek, Hayden's Final Report Geol. Survey of Nebraska, 1872, p. 155, t. 7. f. 6.

*Sp. char.* Polyzooarium widely funnel-shaped, expanding; interstices strong and robust, often bifurcating, as broad as, or broader than the fenestrules, and nearly flat on the celluliferous or obverse face, of less breadth on the reverse and more convex; dissepiments short and narrow on the obverse, sometimes becoming almost lost, but on the reverse they are longer and wider and on the same level with the interstices, whilst on the obverse they are somewhat below the latter; fenestrules variable in outline on the obverse, funnel-shaped, increasing in breadth towards the reverse, where they are, as a rule, quite circular or sometimes a little elongated; on the obverse the fenestrules are, as a rule, very narrow and sometimes quite slit-like, but always with the sides indented by the apertures of the cells: apertures of the cells circular, arranged in oblique rows on the interstices and devoid of projecting or prominent margins; the normal number in each row is three, sometimes four, and immediately before bifurcation of the stem takes place the enlarged dissepiment may carry six.

*Obs.* The form which I have assumed to be *P. biarmica*, Keyserling, is a most interesting one, from the peculiar change the polyzooarium appears to undergo with age and increased growth. The obverse and reverse differ so materially in appearance that they might easily be mistaken for distinct species, were it not for

\* Carbonformation und Dyas in Nebraska, t. 5. f. 2.

their constant occurrence together in close proximity, and also that some of the fragments are so fractured as to show the gradual passage from the broad flat interstice of the obverse to the narrower and more convex stems of the reverse. The broad depressed interstices are well shown in the enlargement of Count von Keyserling's figure and in that given by Dr. Geinitz. The fenestrules, as seen on the obverse face, are nearly elliptical; but there is apparently a tendency to close up caused by a widening-out of the depressed interstices, so that their form becomes more and more contracted laterally and slit-like, till at last almost complete coalescence of the interstices takes place and the fenestrules nearly disappear. Furthermore, on some parts of the polyzoarium the apertures of the cells appear to close up; and when this takes place, in addition to the impinging of the interstices on the fenestrules, we have presented to us a surface unbroken except by the remains of a few obscure slits arranged in vertical lines. On the other hand, when the cells remain open, the apertures are clear and well marked, but without raised margins. The dissepiments on the obverse are very short, and as the gradual closing of the fenestrules takes place, their individuality is quite lost; they are sometimes celluliferous to the extent of one or two cells.

Now many of the points here mentioned, although not described by Keyserling and others, are nevertheless to be seen in their figures. For instance, the broad, almost flat interstices, the gradually disappearing dissepiments, and the obscured fenestrules are all, to a certain degree, discernible in the before-mentioned enlargement of Keyserling's figure. After a lengthened examination of the specimens, and careful consideration of all the facts, I believe *Polyppora biarmica* is better fitted for the reception of several of the Arctic Polyzoa possessing the above characters than any other figured species known to me. The specimens in question resemble *P. biarmica* in the breadth of the interstices being equal to and sometimes greater than that of the fenestrules, in the number and arrangement of the cells and in their plain margins, in the oval form of the fenestrules, and, lastly, in the fact that, as Keyserling remarks, the latter are sometimes so narrow as to be almost overlooked, a point which I consider quite coincides with the closing of the fenestrules which I have above described. On the other hand, the sides of the fenestrules are certainly rendered irregular by the impingement over them of the lateral row of cell-apertures on each side, which I do not find mentioned or figured by those authors who have written on this species. Again, in our specimens there is certainly no trace of the obscure and slightly granular wrinkles of the reverse mentioned by Keyserling; but, on the whole, I think the evidence is more confirmatory than otherwise of their relation to *P. biarmica*. The best of our specimens, exhibiting the reverse face, agrees exceedingly well, in the round or oval form of the fenestrules, with the figure of the specimens from Nova Zembla given by Dr. Toula, and to a certain extent with that of *Polyppora Shumardiana*, Prout\* : but it must be

\* Trans. St. Louis Acad. i. p. 271, t. 16. f. 3.



observed, in conclusion, that the dimensions of the specimens now under consideration are greater than those of any of the figures quoted in the foregoing synonymy.

*P. biarmica* was originally described by Keyserling from Petschora-land; by Geinitz from beds in Nebraska, which he considered to be of Permo-Carboniferous age (Dyas); by Prout from the Upper Archimedes limestone of Chester, Illinois; by Meek from the Nebraska-city section of the Nebraska Upper Coal-measures (=Dyas, Geinitz); and by Dr. Toula from Carboniferous beds at Barents Island, Nova Zembla. Some difference of opinion existed between Dr. Geinitz and Mr. Meek as to the identity of the Nebraska fossils with *P. biarmica*, Keyserling; but on this point I am inclined to agree with Dr. Toula, that the various forms may be all included under the one name.

*Loc.* Feilden Isthmus, lat. 82° 43'.

POLYPORA, sp.

*Obs.* A species possessing strong interstices, with oval, almost round fenestrules; in fact the interstices and dissepiments at times almost lose their individuality, and with the round fenestrules give to the polyzarium a decidedly *Phyllopora*-like appearance. Two of the specimens exhibit the non-celluliferous face, with the bases of the cells shown through the abrasion of the basal layers. The other specimen is a badly preserved example of the obverse face; the cells are arranged in three oblique rows on the dissepiments, increasing in number at the points of bifurcation of the latter, and apparently separated by vertical, obscure, wavy ridges. The specimens have some characters in common with those I have described in *P. biarmica*, but they are probably distinct. The dissepiments appear to be occasionally cell-bearing, and when so there is generally a large cell at the base of the dissepiment on each side. The vertical wavy ridges, and some other minor points, recall to us *Polypora tuberculata*, Prout\*; but in this species the dissepiments are quite devoid of cells, whilst the oval or almost circular fenestrules again bring before us *P. Shumardiana*, Prout. The celluliferous dissepiments resemble those of *Fenestella ampla*, Lonsdale† (*Protorettepora ampla*, De Koninck‡); and, in fact, one specimen in particular recalls to us this species very forcibly, with this exception, that in the Australian form the fenestrules are more elongated and more truly oval than in the Arctic individuals.

The specimens at my disposal are not of sufficient size to enable me to form an opinion whether the celluliferous face is internal or external; if the former, the resemblance to *P. ampla* would be strengthened, and the reference of them to the genus *Protorettepora* indicated, although one of the characters possessed by our specimens,

\* Trans. St. Louis Acad. i. p. 449, t. 18, f. 3.

† Strzelecki's Phys. Descript. N. S. Wales, 1845, p. 268, t. 9, f. 3.

‡ Foss. Pal. Nouv.-Galles du Sud, 1877, pt. 3, p. 180, t. 8, f. 5, a-d. Prof. de Koninck includes in his genus *Protorettepora*, besides *F. ampla*, Lonsdale, *Polypora Shumardiana*, Prout, and some other forms.

the occasional celluliferous dissepiments, has an opposite tendency, according to the diagnosis of *Protoretetpora* as laid down by Prof. de Koninck.

*Loc.* Feilden Isthmus, lat. 82° 43'.

Genus RAMIPORA, Toula, 1875.

*New Genus*, Salter, Quart. Journ. Geol. Soc. 1860, xvi. p. 441.

*Ramipora*, F. Toula, N. Jahrbuch, 1875, p. 230.

*Gen. char.* Polyzoarium reticulate, spreading, consisting of a stem or interstice, seldom, if at all, bifurcating, and primary branches, about equal to it in size, arising from the former at regular intervals and on the same level with one another. The primary branches do not show any trace of alternation with one another on opposite sides of the stem, but curve upwards from each side of the latter; both are divided by an obtuse median keel. The primary branches are united with one another by smaller secondary branches or dissepiments, which likewise arise opposite one another, and either curve upwards, meeting one another in the middle line, or are continued direct from branch to branch without any arching. The fenestrules thus enclosed are either irregularly and obliquely quadrangular, or of a peculiar six-sided or double V-shaped form. Both the stem and the primary and secondary branches are celluliferous, but on one aspect of the polyzoarium only, the obverse. All apertures arranged in longitudinal series on both sides the median keels. Reverse of the polyzoarium keeled, but not celluliferous.

*Obs.* The genus *Ramipora* was established by Dr. Toula for a peculiar form of Permo-Carboniferous Polyzoa from Spitzbergen, related to *Synocladia*, King, *Ptylopora* (Sculer), McCoy, and *Glauconome* (Goldf.), Lonsdale. It appears to differ from the first of these in the absence of dichotomization of the stem and primary branches, so far as the remains of it are known to us; in the bilateral symmetry of the latter; thirdly, in the fact that the cells all open on the same plane on each side the median keels, whereas in *Synocladia* the stems and branches are divided longitudinally by several carinae, between which the cell-apertures occur. Again, in *Ramipora* both aspects of the polyzoarium are carinate, but in *Synocladia* only one. Lastly, in *Synocladia* the dissepiments all appear to be regularly celluliferous, but in *Ramipora* this does not appear to hold good to the same extent; it is, however, a character of lesser importance. In the presence of the principal thick stem and bilaterally symmetrical primary branches we have characters uniting *Ramipora* and *Ptylopora*; but the arrangement of the cells in the two genera is wholly different, and the form of the cross bars or dissepiments, as a rule, distinct. In *Glauconome*, Lonsdale (= *Acanthocladia*, King), it will be remembered, there is a stem giving off lateral branches, alternate or subalternate with one another on opposite sides, and trending upwards at various angles, upon which the cells are variously arranged according to the species; but there

does not appear to be any union by cross bars or dissepiments between these branches, and in consequence the polyzoarium is non-fenestrate. In the latter character we have an essential difference between *Ramipora* and *Glaucanome*. Again, in the latter the polyzoarium is carinate only on one aspect, unlike that of *Ramipora*; there is likewise a different arrangement of the cells, irrespective of other minor points which might be entered upon. In the genus *Tanio-pora*, Nicholson\*, there is a bicarinate polyzoarium, as in *Ramipora*; but it forms flattened linear expansions, and branches dichotomously, the branches proceeding from the main stems alternately. Lastly, the polyzoarium in *Goniocladia*, mihi, is carinate on the celluliferous face only, and in the general arrangement of the cells resembles *Ramipora*; but in my genus there is no clear division into interstices and dissepiments, and the meshes or fenestrules are all more or less irregular points, which at once separate it from Dr. Toula's form. One of the most marked characters of *Ramipora* is the upward arching of the secondary branches or dissepiments; and the resulting peculiarly formed fenestrules are of *Synocladia*-like character. It appears to me that *Ramipora* stands in about the same relation to *Synocladia* that *Ptylopora* does to *Fenestella*; i. e. in *Ramipora* we have an aberrant *Synocladia*, in which there is one chief stem giving off branches, assuming the typical character, more or less, of the latter; whilst in *Ptylopora* we see, to all intents and purposes, a *Fenestella*-like expansion spreading out on each side of a well-marked median rib. Again, another interesting link between several already established genera is Prof. de Koninck's recently described *Dendricopora*†, a close ally of *Ptylopora* (Scouler), M'Coy, but differing from the latter in the presence of a number of lateral branches resembling the main stem or rib, in addition to the secondary ones forming the plumose expansion as in *Ptylopora*. The generic value of *Dendricopora* very much depends upon the characters of the perfect polyzoarium in *Ptylopora*; for, so far as I am aware, we at present know only the fragment figured by M'Coy. A glance at the respective figures of *Ramipora* and *Dendricopora* will show the distinction between them. Were it necessary to pursue this subject further, we might institute a comparison with M'Coy's genus *Ichthyorhachis*.

In concluding these remarks on *Ramipora*, I think it is quite within the bounds of possibility, indeed probability, that it was a specimen of this Mr. Salter had before him when he wrote as follows concerning one of Mr. Lamont's fossils:—"A new genus, in all probability of the Fenestellidæ, consisting of thick stems branching regularly from opposite sides, the smaller branches also opposite, and coalescing with their neighbours so as to form a quadrangular network," &c. The fossils described by Dr. Toula, accompanying *Ramipora*, are evidently of a Permo-Carboniferous facies; the Polyzoa, with the exception of *Phyllopora Laubei*, Toula, possess a

\* Geol. Mag. 1874, dec. 2, i. p. 121; Rep. Pal. Prov. Ontario, 1874, i. p. 107.

† Foss. Pal. Nouv.-Galles du Sud, 1877, pt. 3, p. 169, t. 8. f. 4.

decidedly Carboniferous aspect; whilst the Brachiopoda, on the other hand, such as *Productus horridus*, indicate Permian affinities.

One species only has been described, *R. Hochstetteri*, Toula.

RAMIPORA HOCHSTETTERI, Toula.

*Ramipora Hochstetteri*, Toula, N. Jahrbuch, 1876, p. 230, t. 10. f. 1, a & b.

*Obs.* It is unnecessary to describe this further, as the foregoing characters will suffice for it. There are in the collection four specimens which I refer to *R. Hochstetteri*; two of them may, however, form a second species, judging from the less compact manner in which the polyzoarium is held together; but the material is insufficient and the preservation indifferent.

This species strongly resembles *Synocladia* from the Permian rocks; but the bilateral connecting processes or branches in that genus are more arcuated than in *R. Hochstetteri*, and the main or chief and also the secondary branches in *Ramipora* are much more delicate.

*Loc.* Toula's specimens were collected on the west coast of Spitzbergen (Axel Island); Captain Feilden's at Cape Joseph Henry, lat. 82° 50'.

Genus PHYLLOPORA, King, 1849.

(Annals Nat. Hist. 1849, iii. p. 389; Permian Foss. England, 1850, p. 40.)

PHYLLOPORA, sp.?

*Obs.* A few fragments are mixed with the other Polyzoal remains on the black limestone previously mentioned, which I believe to be referable to *Phyllopora*, King. The portions of the frond or polyzoarium remaining consist of rounded interstices anastomosing one with the other, after the manner of *Phyllopora*, and producing a series of oval or rounded-oval meshes or fenestrules. The cells are numerous, with prominent margins, and are scattered over the surface of the so-called interstices; for there is no proper division into celluliferous interstices and non-celluliferous dissepiments, hence the reference to *Phyllopora*. Did the polyzoarium possess true non-celluliferous dissepiments there would exist a close resemblance between the Arctic form and *Polypora gracilis*, Prout\*, of the Keokuk group of Illinois. So far as I can judge from the fragments I have seen, the resemblance to *P. Laubei*, Toula, from Nova Zembla, is only a general one.

*Loc.* Feilden Isthmus, lat. 82° 43'.

#### Class BRACHIOPODA.

Only five genera with twelve species of this group occur in the Carboniferous collection. The genera are *Spiriferina*, *Spirifera*, *Productus*, *Streptorhynchus*, and *Rhynchonella*. The two genera

\* Illinois Geol. Report, ii. t. 21. f. 1.

† N. Jahrbuch, 1875, t. 9. f. 1.

*Spirifera* and *Productus* contain (as might be expected) the greatest number of individuals, yet the species are few—in *Spirifera* four, *Spiriferina* one, *Productus* five, *Streptorhynchus* one, and *Rhynchonella* one. All the species are British except *Spirifera Grimesi*, an American form, the others named having a wide distribution. Feilden Isthmus must be a prolific locality, if thoroughly searched; for it is evident that a rich Carboniferous-limestone fauna reaches this high latitude,  $82^{\circ} 43'$ , and would indicate that the true Coal-measures may be under the waters and ice of the Polar sea. Four genera with ten species of Polyzoa from the same locality accompany the Brachiopoda; but only one or two Corals came home in the collection—a *Syringopora* and a *Lithostrotion*, evidently from the same beds.

Genus SPIRIFERA, Sow. 1815.

SPIRIFERA DUPLICICOSTA, Phill.

*Spirifera duplicicosta*, Phill. Geol. York. vol. ii. p. 218, t. 10. f. 1; Dav. Monogr. Carb. Brach., Pal. Soc. p. 24, t. 3. f. 7-10, t. 4. f. 3, 5-11.

This variable species corresponds with the description and figures given by Mr. Davidson in his valuable Monograph upon the Carboniferous Brachiopoda (*loc. cit.*). It does not appear to be common in the Arctic rocks, only three specimens occurring in the collection. One specimen resembles also *Spirifera striata* (Martin), which is a closely allied species. Keyserling has described a species (*Spirifer fasciger*) from Petschora Land (Wissenschaftl. Beobacht. Petschora-Land, t. 8. f. 3), which certainly is the same as our British form and the *Spirifera duplicicosta* brought from Feilden Isthmus.

This species is common and abundant, in space and time, through the Carboniferous series; occurs everywhere in Britain, and in many places in Ireland, Belgium, &c.

*Loc.* Feilden Isthmus, lat.  $82^{\circ} 43'$ , in rough grey limestone.

SPIRIFERA, sp., allied to *S. GRIMESI*, Hall, Geol. Iowa, vol. i. pt. 2, p. 604, t. 14. f. 1-5. (Pl. XXV. fig. 5.)

We only possess a portion of the ventral valve of this species, which admirably shows the muscular impression; in the ventral valve none of the outer shell occurs; therefore whether it can be referred to Hall's species is perhaps really doubtful. It appears to have had a strongly incurved umbo. Hall's specimen came from the Burlington Limestones of Iowa, lat.  $40^{\circ}$ . Captain Feilden's single ventral valve is from Feilden Isthmus, lat.  $82^{\circ} 43'$ , a latitudinal difference of more than  $40^{\circ}$ .

No description can be given of this portion of the shell, nor can I refer it to any other known species: comparison with Hall's figure (*loc. cit.*) will show the close affinity. I figure it, however, for the sake of reference and for the peculiarity of its great muscular system.

*Loc.* Feilden Isthmus, lat.  $82^{\circ} 43'$ .

SPIRIFERA, sp., allied to *S. LAMELLOSA* (M'Coy).

*Cyrtia lamellosa*, M'Coy, Syn. Carb. Foss. Ireland, p. 137, t. 21. f. 4.  
*Spirifera lamellosa*, Dav. Mon. Brit. Carb. Brachiopoda, Pal. Soc. p. 36, t. 7. f. 17-22.

This shell (only one specimen) closely resembles M'Coy's species, to which I refer it. Our specimen does not satisfactorily show the scale-like imbricated laminae owing to the surface being much denuded. The *Spirifera hystericæ*, De Kon., and *Spirifera speciosa* (M'Coy), are, without much doubt, the same as our Arctic form. We regret having to record only one specimen of this species.

*Loc.* Feilden Isthmus, lat. 82° 43'.

SPIRIFERA OVALIS, Phill.

*Spirifera ovalis*, Phill. Geol. York. vol. ii. p. 219, t. 10. f. 5; Dav. Monogr. Carb. Brach., Pal. Soc. p. 53, t. 9. f. 20-26.

This is an abundant shell at Feilden Isthmus, and one of the best defined species in the collection. Though it greatly resembles many forms of *Spirifera pinguis*, Sow., the deep and gibbous ventral valve and shallow sinus near the beak or umbo, as well as the short and small hinge-area, well characterize this shell. This species seems cosmopolitan, ranging from Belgium to Iowa; it is common to England, Scotland, and Ireland. It was not collected by M'Clintock during the voyage in search of Franklin, although much Carboniferous country was then passed over. It is one of the abundant shells in the collections of the Nares expedition.

*Loc.* Feilden Isthmus, lat. 82° 43'.

Genus SPIRIFERINA \*, D'Orbigny, 1847.

SPIRIFERINA CRISTATA (Schloth.) (? var. *S. octoplicata*, Sow.).

*Spiriferina cristata* (Schloth.); Dav. Monogr. Brit. Carb. Brach., Pal. Soc. p. 38, t. 7. f. 37-47; ib. p. 226, t. 52. f. 9, 10.

Only one specimen of this variable species has occurred in the 'Alert' collection. It has the nearest affinity to this of any *Spiriferina* known to me; one specimen, however, is scarcely reliable in so varying a group as the Spiriferidæ.

*Loc.* Cape Joseph Henry, lat. 82° 43'.

Genus PRODUCTUS, Sowerby, 1814.

PRODUCTUS SEMIRETICULATUS (Martin).

*Anomites semireticulatus*, Mart. Petrif. Derb. p. 7, t. xxxii. f. 1, 2.

*Productus scoticus*, Sow. Min. Con. t. 69. f. 3.

*P. sulcatus*, Sow. l. c. t. 319. f. 2.

*P. semireticulatus*, Dav. Monogr. Brit. Carb. Brachiopoda, Pal. Soc. p. 149, t. 43. f. 1-11, t. 44. f. 1-4.

\* The canals or perforations in the shells composing this genus, as well as the large elevated mesial septum in the ventral valve, separate it from *Spirifera*.

This variable and ubiquitous shell is tolerably abundant and occurs at Feilden Isthmus; the specimens agree in every particular with the Scotch, Russian, Spitzbergen, and American examples. It seems to be abundant in Illinois and Iowa with other widely spread species; finding this in lat.  $82^{\circ} 43'$  tends to show clearly the connexion and continuity of the North-American Carboniferous fauna northwards and towards Grinnell Land. Our specimens, six in number, are from Feilden Isthmus, the most northerly land known.

*Loc.* Feilden Isthmus, lat.  $82^{\circ} 43'$ .

*PRODUCTUS*, sp., allied to *PUNCTATUS*, Martin, *Anomites*, Petrif. Derb. t. 37. f. 6.

*Productus punctatus*, Dav. Monogr. Brit. Carb. Brach., Pal. Soc. p. 172, t. 44. f. 9-16.

*P. tubulispinosus*, M'Chesney, Descr. New Sp. of Foss. from the Pal. Rocks of the Western States, p. 37.

So many forms have been referred to this species by British and foreign authors that some excuse may be made for referring a solitary specimen in a denuded state to so variable a shell. *Productus punctatus* and *Productus fimbriatus* much resemble each other, the lines of growth varying in both, being either wide apart or closely set; the hair-like spines on *Productus punctatus* are much more numerous than on *Productus fimbriatus*.

This shell occurs everywhere in Britain, is abundant on the Continent, and has received the name of *Productus tubulispinosus* by M'Chesney for specimens occurring in the Western States of America. Only two specimens have occurred in the Arctic collection. I doubt not the species.

*Loc.* Feilden Isthmus, lat.  $82^{\circ} 43'$ .

*PRODUCTUS MESOLOBA*, Phill.

*Producta mesoloba*, Phill. Geol. Yorkshire, vol. ii. p. 215, t. 7. f. 12, 13; De Kon. Anim. Foss. du Terr. Carb. Belg. t. 12. f. 8; De Vern. Russia and Ural Mountains, vol. ii. t. 16. f. 8; Dav. Monogr. Carb. Brachiopoda, Pal. Soc. p. 178, t. 31. f. 6-9.

The projecting articulate expansions which constitute the attenuated cardinal extremities, and rounded lateral margins, characteristically distinguish this shell from all other species. The ventral valve is singularly gibbous at the umbo or beak. A few tubercles on the surface of the shell show the position of small tubular spines. Like most of the *Producti* in the collection, this is also a widely distributed species; it ranges from the Ural chain at Ilinsk to North America and the Polar regions, where it was collected by Captain Feilden at Feilden Isthmus, lat.  $82^{\circ} 43'$ .

*PRODUCTUS FIMBRIATUS*, Sow.

*Productus fimbriatus*, Sow. Min. Con. vol. v. p. 85, t. 459. f. 1; Dav. Monogr. Brit. Carb. Brach., Pal. Soc. p. 171, t. 33. f. 12-15.

We possess only one specimen of this species; it is a more finely

marked variety than usual, nevertheless it can be no other than the above species. Like *P. mesolobus* this shell is found over the northern hemisphere, both in Europe and America, as far north as land is known. Collected by Capt. Feilden at Feilden Isthmus, lat.  $82^{\circ} 43'$ .

*PRODUCTUS COSTATUS*, Sow.

*Productus costatus*, Sow. Min. Con. vol. vi. p. 115, t. 560; De Verneuil, Russia and the Ural Mountains, vol. ii. t. 15. f. 13; Dav. Monogr. Carb. Brach., Pal. Soc. p. 152, t. 32. f. 2-9.

This is the most abundant and at the same time most variable species in the collection of the Carboniferous Brachiopoda, no less than fourteen specimens occurring from the beds at Feilden Isthmus. De Verneuil has noticed this species from many places in Russia; it also occurs at Visé, in Belgium. It is abundant in the Scotch and Irish Carboniferous Limestones. Settle, Richmond, and places in Northumberland also yield this species. Doubtless it must be very abundant in the limestones of Feilden Isthmus; it is the commonest form in the collection. In North America it is widely distributed through the limestones of Kansas, Missouri, Iowa, Illinois, and Indiana, also in Nova Scotia. We should therefore expect to find it extending northwards, in the original great spread of the Carboniferous series towards the Pole. With *P. Cora*, *P. Flemingii*, *P. punctatus*, and *P. semireticulatus* it has the widest range of any species on the American continent, and is associated with the last two at Feilden Isthmus.

*Loc.* Feilden Isthmus, lat.  $82^{\circ} 43'$ .

*PRODUCTUS WEYPRECHTI?*, Toula.

*Productus Weyprechti?*, Toula, Sitzungsberichte der kais. Akad. der Wissenschaften in Wien, p. 138, t. 1. f. 4.

The determination of this shell has given me much trouble. I can refer it to no other than the above species of Toula's. Much as it resembles some forms of *P. costatus*, it is not, however, that species, the sulcus in the ventral valve being deeper and wider in proportion, and extending along the central portion of the valve in nearly uniform width and depth. It may readily be taken for *Productus horridus*, from the Permian series; but the greater depth and squareness of the ventral valve, also the pronounced sulcus and apparent greater solidity of the shell, remove it from that species. When, however, we know the extreme variations these shells (especially *P. horridus*) undergo, and only three imperfect specimens are in the collection, it is not an easy matter to determine their specific identity. I refer them, however, to one or other of the above species, *P. Weyprechti* or *P. horridus*. Toula's specimens came from Spitzbergen, and were collected during the Austrian expedition to the Polar regions.

*Loc.* Cape Joseph Henry, lat.  $82^{\circ} 50'$ .



Genus STREPTORHYNCHUS, King, 1850.

STREPTORHYNCHUS CRENISTRIA (Phill.).

*Spirifera crenistria*, Phill. Geol. Yorksh. vol. ii. t. 9. f. 6.

*Orthis umbraculum*, Portlock; De Kon. Anim. Foss. du Terr. Carbon. Belg. p. 222, t. 13. f. 4-7.

*Strophalosia striata*, Morris.

*Orthis keokuk*, Hall, Report Iowa, t. 19. f. 5.

*Streptorhynchus crenistria*, Dav. Monogr. Carb. Brachiop., Pal. Soc. p. 124, t. 26. f. 1, t. 27. f. 1-5, t. 30. f. 14-16.

No more variable shell is known in the Upper Palæozoic rocks than the species under notice. It is also cosmopolitan, occurring almost everywhere in the European and American Carboniferous rocks. Only two specimens are known to me in the collection; but there is no doubt about them. In North America it ranges through Iowa, Illinois, Indiana, Ohio, Tennessee, and Nova Scotia; and occurs everywhere in Britain. Its varieties, *Strept. arachnoides*, *S. senilis*, and *S. radialis*, are common in the British Carboniferous rocks, also in France and Belgium.

Few shells have received more careful study than this species, owing to its extreme variation and universal distribution. It is also one of the few species connecting the Upper Silurian, Devonian, and Carboniferous group of rocks. As a Carboniferous form it ranges through every stage and division of these rocks, and in every country where developed, each author recognizes it under a different name. Spitzbergen and Australia, India and America, Britain and Europe, all lay claim to *Streptorhynchus crenistria*. Now we obtain it from the limestones of Feilden Isthmus, lat. 82° 43'.

Captain Feilden's specimens were collected at Feilden Isthmus, lat. 82° 43'.

Genus RHYNCHONELLA, Fischer, 1809.

RHYNCHONELLA PLEURODON (Phill.).

*Terebratula pleurodon*, Phill. Geol. Yorksh. vol. ii. p. 222, t. 12. f. 25-30.

*Rhynchonella pleurodon*, Dav. Monogr. Brit. Carb. Brach., Pal. Soc. p. 101, t. 23. f. 1-15, 16-22.

Our single specimen seems to be a characteristic *Rhynchonella pleurodon*, according to Phillips, although I know how uncertain it is to refer single specimens to any species; this, however, is another link in the evidence of the wide distribution of forms occurring in the Carboniferous rocks, both European and American. Russia, Belgium, Australia, and America claim this shell, occurring, as it does, almost as profusely at the antipodes as with us in the Carboniferous Limestone. We now record it from Feilden Isthmus, lat. 82° 43'.

DEVONIAN.

It is only through a few fossil Brachiopoda that I venture to determine the presence of the Devonian rocks immediately south of

Cape Joseph Henry and Feilden Isthmus, at Ravine, Dana Bay, head of Porter Bay ( $82^{\circ} 42'$ ), and apparently faulted against the Cape-Rawson series. The facies of the few species occurring differs essentially from the Carboniferous, but they are not numerous enough to allow of generalization or correlation; still undoubtedly they are of American affinities. The want of fossil Invertebrata in the Scotch Old Red Sandstone at once removes them from comparison or correlation with that area; only to the North-American types therefore can we compare them, where a magnificent marine fauna exists equivalent to the Devonian of Devonshire, Rhenish Prussia, Belgium, and France, intervening between the summit of the Silurian and the base of the Carboniferous rocks. The typical Devonian rocks of Europe, Britain, and North America are the deep-sea deposits of the Devonian period; whereas the Old Red Sandstones of Britain, and the corresponding Gaspé group of Eastern Canada, may be the shallow-water or near-shore deposits of the same period. I have no means of determining to which section of the Devonian series our few specimens belong; but the *Spirifera* would lead me to infer that they were Upper Devonian. There is no evidence of Heer's "Ursa stage" above these, and no plant-remains of any kind have occurred. This is the first notice of the probable existence of a Devonian fauna so far north. Heer's determination of the Ursa-stage flora within the Arctic zone, at Bear Island, and the age of the sandstones of Parry and Melville Islands\*, tend to show how widely the Upper Devonian series is distributed, when it embraces the Irish, Rhenish, and St. John's, New Brunswick, floras of a group of rocks below the Carboniferous Limestone, or even the Carboniferous series of Scotland. We are able to trace this same group of either Upper Devonian or Lower Carboniferous rocks, which Heer denominated the Ursa stage, over nearly thirty degrees of latitude.

#### Class BRACHIOPODA.

SPIRIFERA allied to *S. PENNATA*, D. Owen, Geol. Rep. of Wisconsin, Iowa, and Minnesota, p. 585, t. 3. f. 3, 4, 8; Hall, Geol. of Iowa, vol. i. pt. 2, p. 510, t. 5. f. 1. (Pl. XXIX. fig. 1.)

We possess only the ventral valve of this shell; it is certainly closely allied to Dale Owen's species. Owing to the removal of much of the shell, the number and condition of the ribs on either side of the mesial fold and sinus cannot be satisfactorily determined. I am obliged to depend more upon the figure than the description, owing to its generalities. The aspect of this shell, with a few others from the same locality and horizon, strongly impresses me with their Devonian facies. The presence of wings or extensions on either side of the median sulcus allies it to the *convoluta*-group in the Carboniferous Limestone; indeed many forms of *Spirifera convoluta* closely resemble the shell I have referred to *Spirifera pennata*; nevertheless I cannot refer it to *Spirifera convoluta*. All the forms which

\* Heer, "Carb. Flora of Bear Island," Quart. Journ. Geol. Soc. vol. xxviii, pp. 161-169 (1872).

I refer to the Devonian rock very closely resemble Tasmanian species, and certainly have that facies. Dale Owen's specimens were obtained from the Devonian of the Hamilton group, Iowa and Rock Island, Illinois, lat. 41° and 42° N. Our specimens are from Ravine, Dana Bay, lat. 82° 42', south of Cape Joseph Henry, and below the Carboniferous Limestone of Feilden Isthmus.

SPIRIFERA ALDRICHI, Eth. (Pl. XXIX. fig. 2.)

I cannot find any American or British *Spirifera* that will agree with this single specimen, the nearest form I know being *Sp. cultrijugata*, Röm.\*, a common species in the Devonian of South Cornwall, but usually found in a distorted and flattened condition.

*Sp. char.* Shell transversely semicircular, hinge-line as wide as the shell, acute at extremities; dorsal valve slightly convex, no mesial fold or large central rib, seven or eight strong simple ribs on either side of the central pair or on the lateral portions of the valve; ventral valve not seen, a cast of the mould indistinctly shows an intermediate or intercalated slender rib (between the larger ones), extending from the umbonal region to about halfway down the valve. This character is not seen in Römer's species (*Sp. cultrijugata*) or in Davidson's figure; but this last distinguished Brachiopodist states that he has a "specimen from the falls of Ohio (Louisville) with small ribs, and in some places bifurcated." Our specimen is only a cast, so that the intercostal or intercalated rib may be one of many on a more perfect shell. *Spirifera undifera*, Röm., and its var. *undulata*, also much resembles *S. Aldrichi*; but the mesial fold is more pronounced, and the intercostal or tuberculated rib is present at the ventral instead of the dorsal portion of the shell. Concentric ridges are not seen over our cast. I regret we have no better evidence to go upon than our one shell. Something, however, must be done with it. I name this shell after Lieut. Aldrich, to whose labours and researches during the sledge-journey round the northern coast of Grant Land we owe so much intimate knowledge of land and ice. The privation and labour undergone in bringing home such evidence, under such adverse circumstances, deserves to be honourably recorded.

*Loc.* Ravine, Dana Bay, lat. 82° 42'.

SPIRIFERA, sp., allied to *S. GRANULIFERA*, Hall.

*Delthyris granulifera*, Hall, Geol. Rep. Fourth District New York, pp. 206, 207, f. 1.

*Sp. arcta*, Hall, 10th Rep. State Cabinet, p. 161.

*Sp. granulifera*, Hall, Pal. New York, pt. 4, vol. iv. p. 223, t. 36 & 37.

This species illustrates a series of forms subject to great variation, both as regards general form and details of the ribs and mesial fold. The curvature or incurvation of the beak I cannot determine, none

\* Rheinisch. Uebergangsg. p. 70, t. 4. f. 1.



being exposed; in other words, we have only a single valve (dorsal), and this partly imbedded in the matrix. It is as variable a shell as *Sp. disjuncta*, Sow., which has received about twenty different names. Hall describes the shell as having a ventricose dorsal valve and prominent rounded mesial fold, rather prominent beak, and area somewhat large, about twenty simple plications on either side of the sinus (our specimen has not so many, twelve to fourteen). No shell being left, we have no means of knowing whether granulose longitudinal striæ existed (as in Hall's shells) or not, these being seen only on well-preserved specimens. The five varieties named by Hall and his descriptions tend to show the variability of these Spiriferidæ. The Hamilton group in Maryland, Virginia, Pennsylvania, New-York State, Erie and Genesee county yield this shell. Our specimens come from Ravine, Dana Bay, lat. 82° 42', from beneath the Carboniferous series of Feilden Isthmus.

ORTHIS?, CHONETES OR STREPTORHYNCHUS. (Pl. XXIX. fig. 4.)

This one specimen may be either a *Chonetes* or *Streptorhynchus*; the hinge-line being hidden, we have no good characters to aid us in determination.

*Loc.* Feilden Isthmus, lat. 82° 43'.

PRODUCTUS, sp., allied to *P. COSTATUS* OR *P. MESOLOBUS*.

This single specimen is evidently of the same species as those I have referred to as *Productus costatus* from the Carboniferous Limestone of Feilden Isthmus; it is, however, associated with those coarsely costated and broadly winged *Spiriferæ* which characterize the Devonian rocks. From Captain Feilden's notes the beds containing these shells must underlie the Carboniferous series, or be at their very base; and this adds strength to the grouping adopted for their reception between the Upper Silurian and Carboniferous series. No *Productus* appears to be known in the Devonian rocks of Canada, and there are only three or four from the Devonian of North America. *Strophalosia* is its representative genus in the British Devonian rocks of North Devon, &c. The genus *Productus* is essentially Carboniferous in specific value; its association with *Spirifer pennata*, *Sp. Aldrichi*, and *Sp. granulifera* is confirmatory of its stratigraphical position.

*Loc.* South of Feilden Isthmus, lat. 82° 43'.

EXPLANATION OF PLATES XXV.-XXIX.

PLATE XXV.

- Fig. 1. *Monograptus convolutus*, His., var. *Coppingeri*, Eth., p. 577.  
Figs. 2, 3. *Pentamerus Coppingeri*, Eth., p. 594.  
Fig. 4. *Strophodonta Feildeni*, Eth., p. 598.  
Fig. 5. *Spiriferæ*, sp., allied to *S. Grimesi*, Hall, p. 628.

PLATE XXVI.

- Fig. 1. *Syringopora parallela*, Eth., p. 583.  
Fig. 2. *Zaphrentis offleyensis*, Eth., p. 588; 2 a, section showing calice.  
Fig. 3. *Amplexus Feildeni*, Eth., p. 589.  
Fig. 4. *Amplexus*, sp., p. 589.

PLATE XXVII.

- Fig. 1. *Murchisonia latifasciata*, Eth., p. 600.  
Fig. 2. *Murchisonia*, sp., p. 601.  
Fig. 3. *Helicotoma Naresii*, Eth., p. 602.  
Fig. 4. *Platyceras naticoides*, Eth.; 4 a, variety, p. 603.

PLATE XXVIII.

- Fig. 1. *Halysites catenulatus*, Linn., var. *Feildeni*, Eth., p. 582.  
Fig. 2. *Halysites catenulatus*, Linn., var. *Harti*, Eth., p. 583.  
Fig. 3. *Chonophyllum*, sp. (allied to *magnificum*, Billings), p. 584.  
Fig. 4. *Polypora biarmica*, Keyserl. p. 622.  
Fig. 5. *Zaphrentis*, sp., p. 588.

PLATE XXIX.

- Fig. 1. *Spirifera*, sp. (allied to *pennata*, D. D. Owen), p. 633.  
Fig. 2. *Spirifera Aldrichi*, Eth., p. 634.  
Fig. 3. *Spirifera*, sp. (allied to *granulifera*, Hall), p. 634.  
Fig. 4. *Streptorhynchus*, sp., p. 635.

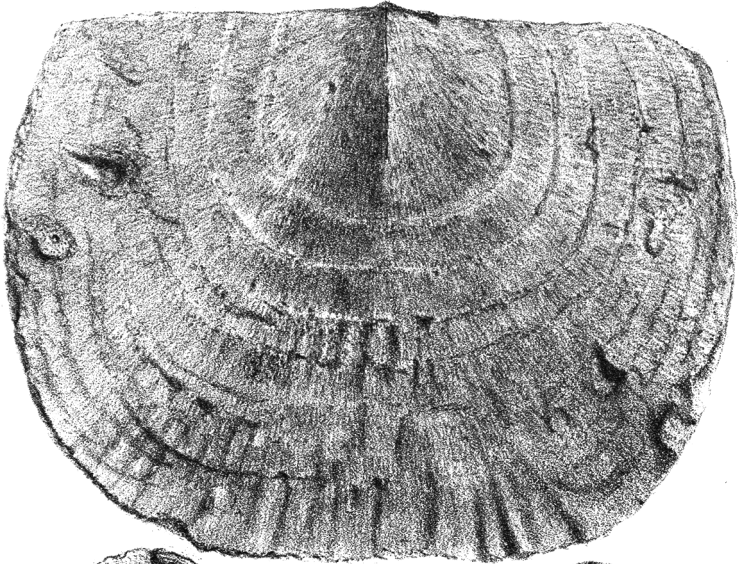
DISCUSSION.

THE DUKE OF ARGYLL expressed the pleasure he felt at having listened to these most interesting papers, and remarked that, taking into account the enormous difficulties in the way of collecting fossils and rock-specimens under the conditions in which the expedition was placed, no apologies were needed for the smallness of the collection. Indeed he thought that we ought rather to be surprised that so much had been brought. The papers raised questions of the highest interest, but it was impossible to discuss them adequately in the brief time at the command of the meeting; for his own part, he should prefer to wait for their publication.

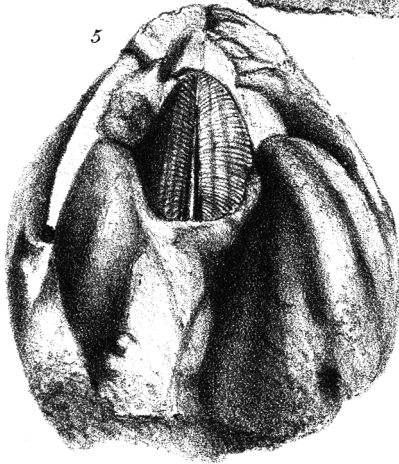
MR. CHARLESWORTH commented on the reported absence of Lamelibranchiate Mollusca, and remarked that all negative evidence of this kind required to be received with great caution.

Prof. T. RUPERT JONES said that these papers were founded on the application of modern ideas to great tracts of which but little was known. It was remarkable, considering how small the amount of materials brought back necessarily was, that it should have furnished such exceedingly important evidence in connecting the strata of various countries and in elucidating preexisting difficulties. He thought that we were greatly indebted to the Expedition, although undoubtedly much still remained to be done; and it was to be hoped that future expeditions would clear up many doubtful points and supply much new and desirable information. He remarked that

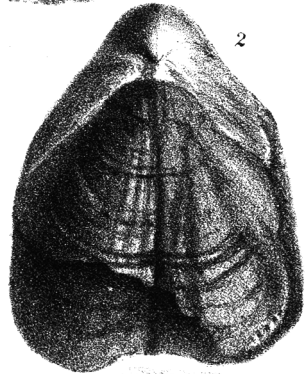
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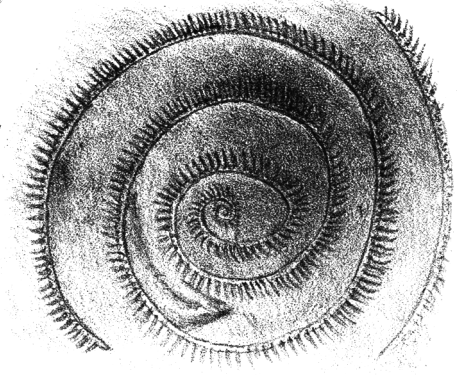
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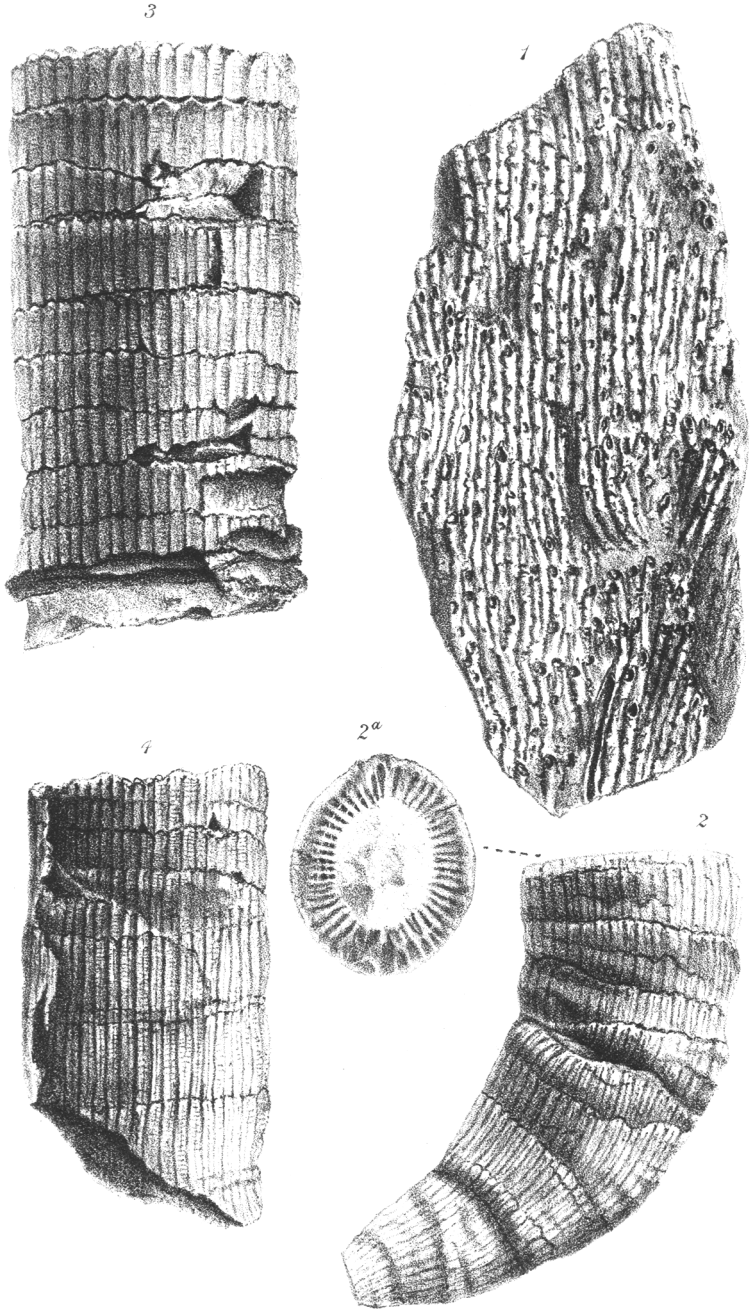


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G. Sharman lith.

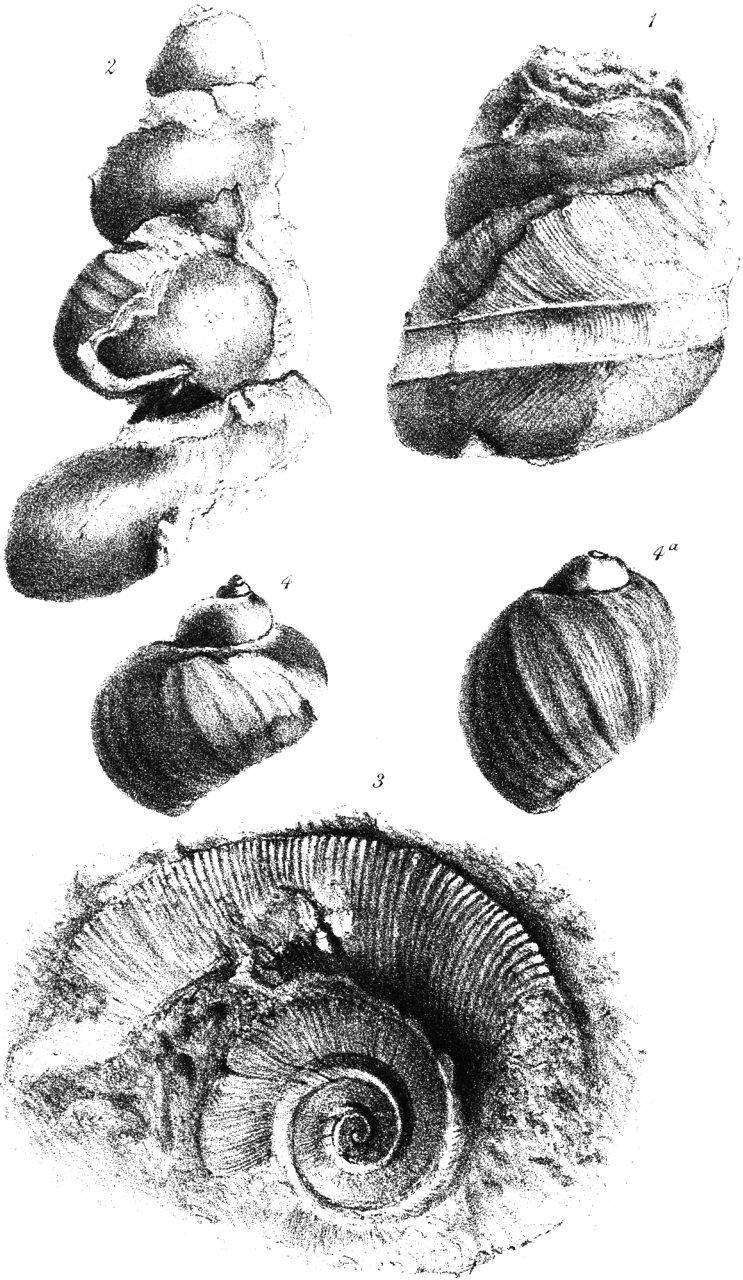
Hanhart imp.



G. Sharman lith.

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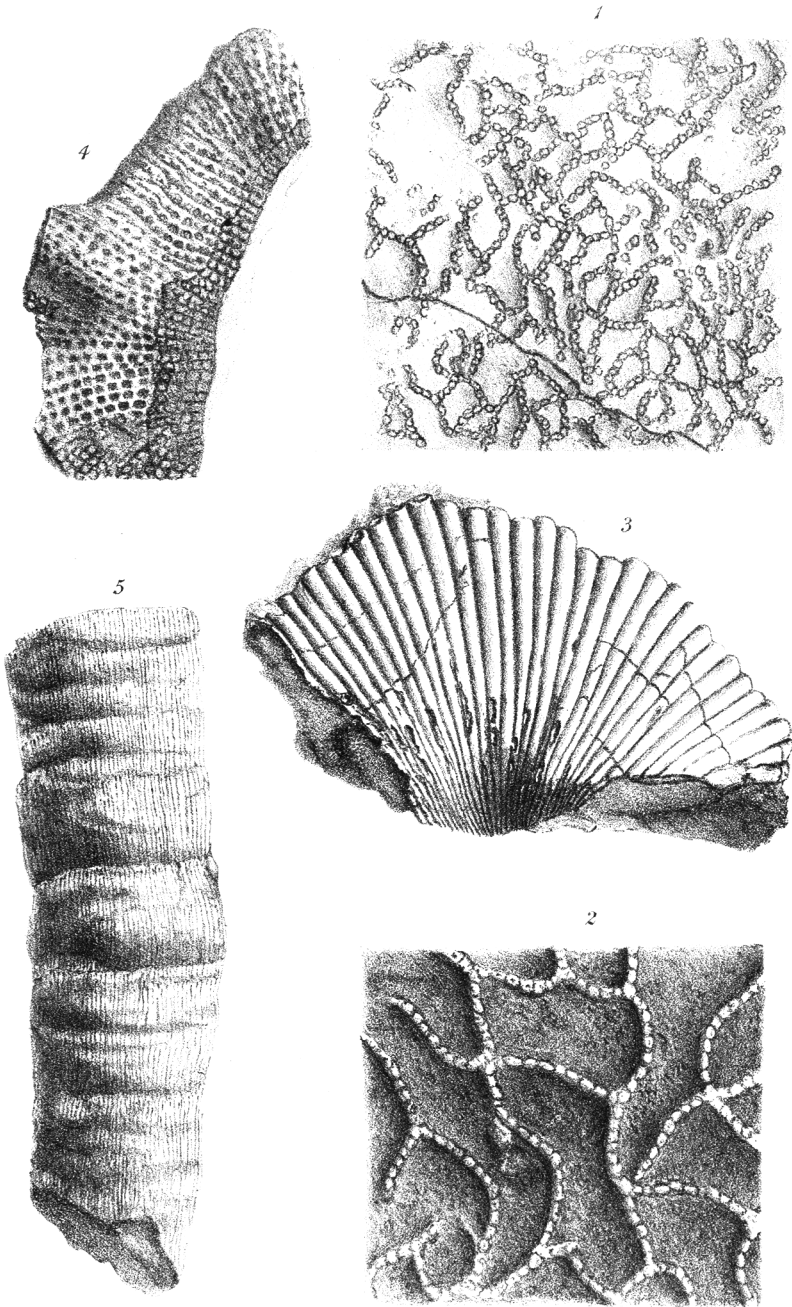




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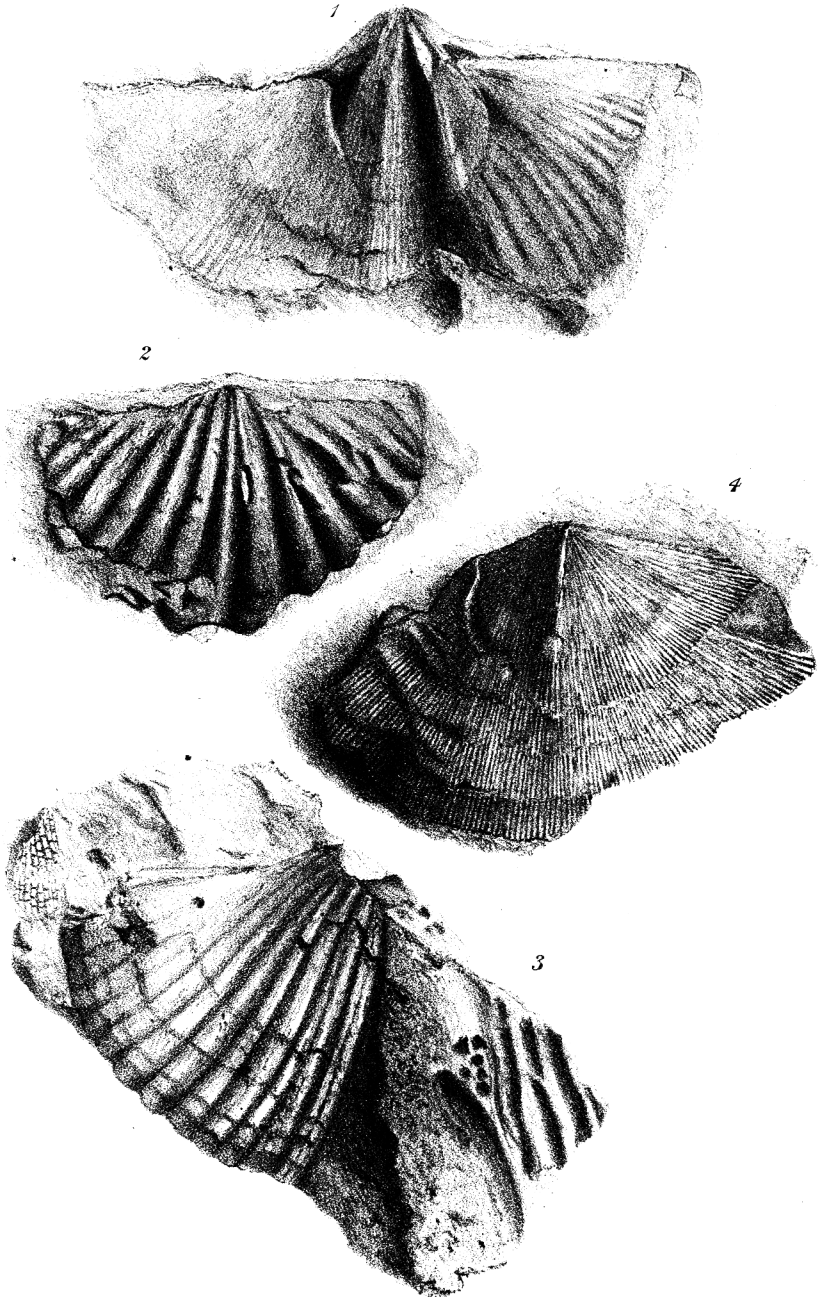
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ARCTIC PALEOZOIC FOSSILS



G. Sharman lith.

Hanhart imp.



G. Sharman lith.

Hanhart imp.

the Vienna 'Transactions' contained a memoir relating to the Austrian expedition, in which, he thought, it was shown that passage-beds existed between the Carboniferous and Permian, in which case we should hardly be justified in drawing between them quite so hard a line as Mr. Etheridge had done.

Sir LEOPOLD M'CLINTOCK said that other expeditions had met with great difficulties in collecting specimens, and that he had himself been obliged to leave behind him a collection of fossils, which was still probably lying as he left it, carefully packed on his sledge. Another collection went to the bottom in the ship; and generally he had been obliged to content himself with bringing the very smallest specimens, in fact such as could be carried in the waistcoat pocket. The same difficulties would affect all Polar expeditions alike, so that there were good excuses for the officers of former expeditions if they did not bring back large collections; and, further, it must be borne in mind that most of them were sent out only for search-purposes, with which the collecting of natural-history specimens was, to a great extent, incompatible.

Dr. RAE said that the coasts he had passed over were unfossiliferous, but that he had been fortunate enough to bring home such geological specimens as he had collected. He inquired whether the officers of the recent expedition had noticed a phenomenon which he had observed at his winter quarters. The tide here rose and fell 8 or 10 feet, and boulders lying even below *low-water mark*, or pebbles from the beach, got frozen early in the winter into the ice formed, and as the mass increased became imbedded in it, until when the thawing of the ice commenced in the spring they made their appearance on the upper surface.

Prof. RAMSAY said that it was difficult to discuss papers covering so many subjects. With regard to Mr. Etheridge's suggestion that there had been deep fjords in Silurian times, he stated that he felt doubtful, as all such fjords now in existence are connected with ice-action and associated with boulders, which do not appear to be present in the deposits. He thought, also, that the presence of Brachiopoda could not be taken to prove deep water.

Dr. GWYN JEFFREYS remarked that the living Brachiopoda had a very wide range in depth—some, such as *Terebratulina*, being found down to great depths; whilst others, such as *Rhynchonella*, were shallow-water forms. Some of the fossils seemed to him to show signs of being southern forms. The Chalk had been mistaken for a deep-water formation, which showed how difficult it was to decide on depth by fossils.

The DUKE OF ARGYLL inquired how deep the ice-cap on the mainland of Greenland was, not in the valleys, but on the hills or tablelands, where it was strictly an ice-cap. If it was no more than some 50 feet it was surely inadequate to produce the phenomena attributed to the action of similar sheets of ice.

Rev. J. F. BLAKE called attention to the way in which certain genera, such as *Bronteus* and *Zaphrentis*, had been said to occur on horizons different from those of which they are usually regarded as

characteristic. Hence it was apparently very difficult to decide as to the age of the rocks. On the whole it appeared to him that the existence of the Lower Silurian was proved, but he doubted whether there was sufficient evidence for the Devonian. He thought the deposits so designated were more likely to represent a marine stage of the *Ursa* series. He called the attention of the Society to these fossils as showing the existence of a temperate climate near the pole, proving that the present condition of the polar regions, rather than the Miocene one, was to be regarded as exceptional.

Dr. HENRY WOODWARD complimented Capt. Feilden on the series of fossils that he had collected, and said that the specimens exhibited formed only a part of them. With regard to Sir Leopold M'Clin-tock's statements, he said that, notwithstanding his having been so unfortunate as to be compelled to leave some behind him, he had nevertheless succeeded in bringing home a valuable collection of fossils, and so also had Sir John Richardson from the Mackenzie River (of Miocene age). With regard to Mr. Blake's remarks, he stated that in England *Bronteus* occurs in the Upper Silurian, so that Mr. Etheridge might fairly attribute to the beds containing that genus an Upper Silurian age. He was unable to offer any opinion as to the other supposed Crustacean remains, as they were excessively indistinct.

Mr. BAUERMAN stated that the gneiss seemed to him to correspond with that of the upper part of the Lower Laurentian, the true upper series, so rich in Labrador, being apparently wholly absent in these Arctic regions. The shales provisionally called Huronian certainly corresponded with some occurring in Canada; but they presented no signs of the hæmatite there found, nor of the galena characteristic of the Lower Silurian of Hudson's Bay. Hence, though there was a general similarity to the Hudson's Bay rocks, there were, nevertheless, some important differences.

Mr. BELT desired to draw attention to a hiatus in the geological record contained in the rocks of the Arctic regions. The authors had noticed the absence of Permian or Triassic deposits; but he did not refer to that, but to a much more remarkable break, namely the presumed absence of strata of Eocene age. In Central Europe in Eocene times tropical plants abounded. Later on the tropical forms disappeared and were replaced by the Miocene flora, containing genera and species that betoken a more temperate climate. It seemed to him, therefore, most likely that the supposed Miocene plants really lived near and around the pole in Eocene times, and migrated southward in the Miocene epoch, when the climate of the Arctic regions became too cold for them. The presence of Miocene species in the Arctic deposits no more proved that they lived there in Miocene times than that of recent species, such as *Pinus abies*, *P. montana*, and *Taxodium distichum*, showed that they lived there in recent times. The absence of an Eocene flora could not be explained by supposing that the Arctic area was then submerged; for no Eocene marine strata had been brought up by the great post-Tertiary elevations that had taken place. He would be glad to learn if the authors

could give any more probable explanation of the supposed absence of Eocene strata than that he had suggested.

Mr. J. S. GARDNER did not believe the beds were Miocene, and called attention to the fact that many Miocene plants are common to the Eocene, as was shown by the American beds.

Capt. FEILDEN, in reply to the Duke of Argyll, said that they had noticed the Petermann ice-cap because it was so different from the ordinary one, and had been fully described in the Blue Book.

Mr. DE RANCE, in reply to Mr. Belt, said that the Austrian geologists had identified Lias and, he believed, Trias in Spitzbergen. He thought that the presence of an Eocene flora followed by a Miocene one was rather opposed to Mr. Belt's idea of the real Eocene age of the supposed Miocenes of the Polar regions.

Mr. ETHERIDGE said that he had been obliged to use negative evidence because it was the best there was. He could not agree with Prof. Ramsay as to the absence of fjords. At present there are plenty of Lamellibranchs near the pole, but now there are plenty of shores on which they can live. They were not here in these early times at any rate; though many fossils had been brought, no Lamellibranchs had been found among them. He would take into consideration Prof. Jones's remarks. He thought he was justified in referring the rocks with *Bronteus flabellifer* to the Silurian, though in Britain it is a Devonian form.