ART. III. *Remarks on the Geology of the valley of Mackenzie River, with figures and descriptions of Fossils from that region, in the Museum of the Smithsonian Institution, chiefly collected by the late* ROBERT KENNICOTT, Esq. By F. B. MEEK.

For what is known of the geology of Mackenzie river valley, we are mainly indebted to the distinguished arctic explorer and naturalist, Sir JOHN RICHARDSON, and Mr. A. K. ISBISTER. The first of these gentlemen, while acting as Surgeon and Naturalist of Sir JOHN FRANKLIN'S overland expedition to the Polar Seas, during the years 1825–6–7, collected much interesting information in regard to the geological formations at various localities along Mackenzie river and its tributaries, all of which is published in the form of an appendix to Sir JOHN FRANKLIN'S narrative of his expedition. Again, in 1848, he descended Athabasca, Slave and Mackenzie rivers, in command of an expedition sent out by the British Government in search of the lamented Sir JOHN FRANKLIN and his unfortunate companions. During this expedition he had an opportunity to examine various localities not previously visited, and the additional information thus obtained is published in his interesting "Journal of a Boat Voyage through Prince Rupert's Land." Subsequently Mr. ISBISTER spent some time in these distant northern regions, during which he visited the Rocky Mountains, and other portions of the country bordering on Mackenzie river; and in Volume XI of the Quarterly Journal of the Geological Society of London, he published, in 1855, an interesting paper giving the results of his own observations, and a map on which he colored all that was then known, from the examinations of Sir JOHN RICHARDSON and others, of the geology of the Hudson's Bay Company's territories, Russian America, &c.

As might be expected, however, investigations of this nature, in so vast a country, the whole surface of which is locked in ice and snow for seven or eight months of the year, when made incidentally by parties traveling hastily in pursuit of other objects, must afford us but meagre and isolated

information. Many years must elapse before much can be known respecting the details of the geology of this immense area, so seldom visited by scientific observers. Hence any additional information of this kind, especially when derived from an examination of fossil remains, can scarcely fail to be acceptable to those interested in the progress of geological science.

The specimens upon which this paper is based, were mainly obtained at some seven or eight localities along Mackenzie river and its tributaries, between Clear Water river (lat. 56 deg. 30 min. north, and long. 111 deg. west), and the Arctic Ocean. They were collected by the late Major ROBERT KENNICOTT, who visited this northern country under the auspices of the Smithsonian Institution, and by Messrs. R. W. McFARLANE and B. R. Ross, of the Hudson's Bay Fur Company. To the zeal of these gentlemen, and the liberality of the Smithsonian Institution, I am indebted for the privilege of examining this interesting collection. I am also under obligations to Mr. KENNICOTT, and the other gentlemen mentioned, for interesting information respecting the general geological and topographical features of this remote country, that could not have been derived from an examination of the specimens without the aid of their notes and observations.

The most southern locality from which any of these specimens were obtained, is near the mouth of Clear Water river, a small stream not more than sixty or seventy miles in length, flowing westward into the Athabasca, one of the principal tributaries of Mackenzie river. According to Sir JOHN RICHARDSON, this little stream is elevated about 900 feet above the sea. Immediately east of its source, the dividing ridge between it and Methy lake rises abruptly to an elevation of about 800 feet above the Clear Water valley, and some 188 feet above Methy lake. This ridge, elevated near 1,700 feet above the sea, trends in a north-easterly and south-westerly direction, and forms the divide between the waters flowing eastward into Hudson's Bay and those flowing westward into the Athabasca, and thence through Slave and Mackenzie rivers, and the intervening lakes, to the Arctic Sea. It forms one of the most formidable obstacles in the way of trade and

travel between Lake Superior and Hudson's Bay and the valley of Mackenzie river; all the supplies for the Fur Company's numerous trading establishments along Mackenzie river and its tributaries, and their returning furs, having to be here transported twelve miles across by land between Methy lake and the Clear Water. The eight hundred feet of space between the summit of this ridge and Clear Water valley, judging from Sir JOHN RICHARDSON'S observations, is occupied by a heavy arenaceous deposit, reposing upon a dark bituminous shale, beneath which occur, along the Clear Water and Athabasca rivers, beds of yellowish gray limestone of a more or less laminated structure. The arenaceous deposit appears to be more than six hundred feet in thickness. Salt and sulphur springs may be seen at several places issuing from the limestone; and the overlying shales and sandstones, particularly the former, as well as the limestone, are highly charged with asphaltum or mineral pitch, at various places along the Athabasca and Mackenzie rivers.

At the mouth of Clear Water river, and some miles above, high bluffs are seen along its north shore, composed at the base of a concretionary, and at places compact limestone, surmounted by 150 or more feet of dark bituminous shale, above which the hills are composed of sand or sandstone. This dark shale Sir JOHN RICHARDSON and Mr. ISBISTER refer to the horizon of the Marcellus shale of the New York geologists. The beds of impure argillaceous limestone seen beneath it, form the banks of Athabasca river for more than thirty miles below the mouth of the Clear Water, and are at places considerably stained with bituminous matter. At one place, near the water's edge, Sir JOHN RICHARDSON collected from one of the layers the following fossils, viz. "*Producti*, *Spirifers*, an *Orthis* resembling *O. resupinata*, *Terebratula reticularis* and a *Pleurotomaria*," which were referred by Mr. WOODWARD to the Devonian System.

The fossils now before me, collected from this limestone by Mr. KENNICOTT, at the mouth of the Clear Water, are a small turbinate coral, apparently a *Cysteophyllum*, *Productus dissimilis* HALL, *Strophodonta demissa* CONRAD (sp.), *Orthis iowensis* HALL? (large variety), *Atrypa reticularis* LIN. (sp.), *Cyrtina*

Billingsi MEEK, an *Aviculopecten?* and a cast of a univalve, apparently a depressed *Pleurotomaria.*

The fine *Orthis* I have here referred with some doubt to *O. iowensis*, is the same mentioned by Sir JOHN RICHARDSON, as it resembles *O. resupinata* closely, though clearly distinct. It agrees exactly with *O. iowensis* from the Hamilton group in Iowa, excepting that it attains a larger size, and the larger specimens have, in the front margin, a much deeper and narrower sinus, though there are in the collection individuals showing various gradations between these and others agreeing in all respects with *O. iowensis.* The specimens of *Atrypa reticularis* are numerous and belong to the large dilated variety so common in the Hamilton group of New York; while those of *Strophodonta* agree exactly with specimens from that horizon in New York and localities further west. The specimens I have referred to *Productus dissimilis* are not in a very good state of preservation, but so far as their characters can be made out, they seem to be in all respects identical with *P. dissimilis*, from the Hamilton group in Iowa.

From this assemblage of fossils, particularly when viewed in connection with others yet to be mentioned from the same rock at localities further north, I can have no hesitation in referring this limestone on Clear Water, and near there on the Athabasca river, to the horizon of the Hamilton group proper. If we regard this as a settled point, the next question that naturally suggests itself, is, to what particular horizon do the dark bituminous shales and superincumbent arenaceous deposits of this vicinity belong? Sir JOHN RICHARDSON and Mr. ISBISTER, as already mentioned, referred the former to the Marcellus shale. They were led to adopt this conclusion because some fossils collected from these beds on the shores of Great Bear Lake, by the former of these gentlemen, were referred doubtfully by Mr. Woodward, to "*Tentaculites fissurella* HALL, and *Strophomena mucronata*, *S. setigera* and *Orthis limitaris* of the same author." As *Strophomena setigera* (a true *Chonetes*) and *Tentaculites fissurella* are also said to occur in the Genesee slate, above the Hamilton group, as well as in the Marcellus shale below, while it would be impossible to distinguish the other two small fossils mentioned by the aid

of rough wood cuts and more unsatisfactory descriptions, from allied species of any age, this palæontological evidence would be far from conclusive, even if not conflicting with other facts. When we bear in mind, however, that the Marcellus shale of the New York series, holds a position immediately beneath the Hamilton beds proper, while the bituminous shales under consideration clearly occupy a position above that horizon, it must be manifest that they cannot represent the Marcellus beds if this formation and the Hamilton strata are developed as separate rocks in this region. From all the facts, it is far more probable that this Clear Water and Athabasca bituminous shale represents the Genesee slate, which everywhere holds a position above the horizon of the Hamilton beds.[1]

In regard to the age of the heavy deposits of sandstone and less coherent arenaceous material overlying the dark shales and limestone in the region of Clear Water river, and at various places farther north on the Athabasca and Mackenzie rivers, we unfortunately have no satisfactory information, none of the fossils in the collection having been obtained from these beds. From their constant association, however, with the bituminous shales and limestones, and the fact that similar layers of sandstone were at a few places seen alternating with the bituminous strata, while these overlying sandy beds are themselves often highly charged with bituminous matter, it is probable that at least a portion of this arenaceous series may also belong to the Devonian epoch, or more properly represent the Chemung group of the New York series. Still I suspect that in the vicinity of Methy portage, as well as at some other places north of there, the upper less coherent part

[1] It may be proper to mention, in this connection, that the dark bituminous shale or slate, known as the "Black Slate" of the Western States, which is rather extensively developed in Southern Indiana, and portions of Illinois, Kentucky, Tennessee, and some other Western and Southern States, holds exactly the same position with relation to the Hamilton beds as the Clear Water and Athabasca shales, which it also resembles in being often connected with sulphur, brine, and oil springs. Formerly this black slate was supposed to represent the Marcellus shale (see 13th An. Report Regents University, New York, p. 96, Jan. 1861), but it was shown by Mr. Worthen and the writer to hold a position above the Hamilton strata, and consequently to be more probably the equivalent of the Genesee slate (Am. Jour. Sci., Vol. xxxii, p. 167, Sept. 1861), as has also since been suggested by others. (See a supplementary note to the 15th An. Report Regents University of N. Y., p. 81. dated Sept. 1861).

of these arenaceous deposits may be much more recent, or even belong to the Cretaceous or Tertiary epoch, or possibly to both. Future explorations must settle these questions.

As already stated, these sandy strata continue for some distance below the mouth of Clear Water river, on the Athabasca, surmounting the older deposits, and are at various places impregnated with bituminous matter. At one locality below an old trading post, named *Pierre au Calmut*, Sir JOHN RICHARDSON says they are so saturated with this mineral that fragments become soft and plastic when held in the hand. He also states, in regard to this locality, that "the whole country, for many miles around, is so full of bitumen that it flows readily into a pit dug a few feet below the surface." Other exposures of this sandstone are seen at several places between this and Athabasca lake.

Around the western extremity of Lake Athabasca, granite rocks occur along the shore, and form small islands at several places between the mouth of Athabasca river and the outlet of the lake. Between Athabasca and Great Slave lakes the connecting stream takes the name of Slave river, and flows in a northwesterly direction. The same granitic rocks occur along its shores for some distance down, but at places some forty miles below Lake Athabasca, dark, impure limestones occur, containing mineral pitch. From one of these beds Sir JOHN FRANKLIN collected, in 1825, some fossils referred to "*Spirifer acutus*, and several *Terebratulae*, resembling *T. resupinata*." Associated with these he also found a "*Cirrus* and some crinoidal remains." *Spirifer acutus*, however, being a carboniferous species, and *Terebratula resupinata* a Liassic form, it is evident there is some error in these indentifications, since all the other known facts indicate that these are the same Devonian rocks already mentioned.

None of the specimens before me being from localities on Slave river, I can add nothing in regard to the geological formations along its course to what has already been published by Sir JOHN RICHARDSON. He mentions several rocky rapids and falls along its upper half and the occurrence of limestone cliffs, granite, sienite, crystalline limestone, etc., forming picturesque scenery. On Salt river, a small stream

coming in on the west side, about seventy miles below Slave lake, copious brine springs, and a few outcrops of gypsum are known to occur.

The formations in this region Sir JOHN RICHARDSON supposed to be Silurian, and as he conjectured, of the Onondaga salt group, though he mentions no fossils, and seems to have based his opinion mainly on the presence of brine springs. Below the mouth of Salt river, he says the banks are alluvial all the way down to Slave lake. Near the mouth of the eastern branch of Slave river, he saw an island fifty feet in height, composed of granite; and adds, "beyond that to the eastward the banks of the lake are wholly primitive." That is to say they belong to the vast azoic area extending along the eastern margin of the great Palæozoic basins of Mackenzie river and Lake Winnipeg, to Lake Superior.

The south shore of Slave lake, from near the mouth of Slave river westward to the outlet, seems to be composed mainly of dark limestone and bituminous shale, referred by Sir JOHN RICHARDSON to the Erie division of the New York series. At one locality, thirty-five miles west of Fort Resolution, he collected from the shales the fossils already mentioned as having been referred, doubtfully, by Mr. WOODWARD, to *Tentaculites fissurella*, *Strophomena setigera*, and *Avicula laevis*, HALL. In the limestones beneath this shale, he collected "a *Strombodes* of HALL (*Cysteophyllum?*) having its cysts filled with bitumen, and a *Favosites* very like *F. polymorpha* of the Plymouth marbles." After examining these fossils, and the other specimens collected here, Mr. WOODWARD adds, "I have not identified any of the *Terebratulae* from Great Slave lake, but they are certainly Devonian or Carboniferous."

Mr. ISBISTER, in speaking of the limestones along the banks of Slave river, near its mouth, remarks that they are "like those on Elk (Athabasca) river, highly bituminous," and adds, "but they are chiefly remarkable from their association with extensive beds of compact gypsum, in connection with extremely copious and rich salt springs. When they approach the crystalline rocks they are found, like those of Lake Winnipeg, to be highly magnesian," etc. The fossils which he mentions as having been collected "from this district," now

in the British Museum, are "*Spirifer crispus* Dalm.? *Rhynchonella phoca* Salter, *Atrypa laevis* Vanuxem, *Atrypa reticularis*, an *Orthis*, two small Spirifers like *S. trapezoidalis* Dalm. and *S. pisum* Sow., and fragments of an encrinital stem." Unfortunately he does not say at what particular locality these fossils were collected, nor whether they came from the dark bituminous limestones and shales of this region, or from beds beneath them. He colors, however, on his map, a patch of Silurian here, extending some sixty or seventy miles along the southern shore of Great Slave lake, immediately west of the mouth of Slave river, which he refers to the horizon of the Onondaga salt group (upper Silurian).

Although I am not prepared to say that there may not be Silurian rocks exposed at some localities within the area colored by Mr. Isbister, I fully concur with Sir John Richardson and Mr. Woodward in referring the dark bituminous limestones and shales here to the Devonian system. This opinion is not based alone upon the fossils mentioned by Sir John Richardson, but in part upon a small collection now before me, obtained from these rocks by Mr. Kennicott, at a locality near Fort Resolution. These fossils are contained in a dark, impure limestone matrix, so highly charged with bituminous matter that it will ignite and blaze for an instant, like bituminous coal, when thrown into a hot fire. They are *Favosites polymorpha*, *Atrypa reticularis*, a small smooth *Spirifer* (*Martinia*), *Cyrtina hamiltonensis?* a *Chonetes* marked with rather coarse radiating striæ, regularly crenated by concentric markings, and a small *Productus*, with regular concentric wrinkles on the dorsal valve, and fine radiating striæ on the ventral. Also a minute *Lingula*, having exactly the outline of *L. spatulata* Hall, but more convex than any specimens of that species I have seen, together with the pygidium of a *Proetus*, and imperfect casts of a *Lucina*-like bivalve.

From the presence of a *Productus* amongst these fossils, and the affinities of some of the others, particularly when we take into consideration the similar bituminous character of the matrix to the Hamilton group beds on Clear Water and Athabasca rivers already mentioned, I can scarcely doubt that these rocks belong to the Devonian system, and probably

to near the horizon of the Hamilton group. The occurrence here of the numerous brine springs mentioned by Mr. ISBISTER, rather confirms this opinion, since saline springs are very common in districts underlaid by rocks of this age, not only at the various localities already mentioned on the upper tributaries of Mackenzie river, but in the region of Winnipigoos, and south-east of there, at various places, even to North Red River. Hence if the fossils mentioned by Mr. ISBISTER have been correctly identified, I think they must have been obtained from a lower geological horizon than the dark bituminous shales and limestones mentioned.

From the outlet of Great Slave lake commences Mackenzie river proper. Along this stream exposures of dark bituminous shale, containing fragments of *Tentaculites*, are seen at several places between the outlet and Fort Simpson, at the mouth of Liard river. There are no specimens in the collection under consideration from these outcrops of shale, though they doubtless belong, as suggested by Sir JOHN RICHARDSON, to the same Devonian series seen along the north shore of Great Slave lake, and on Clear Water and Athabasca rivers. This suggestion receives some support from a few fossils broken by Mr. KENNICOTT from loose masses of dark bituminous limestone along the shores of Liard river near its mouth. These are an *Orthis* I cannot distinguish from O. *iowensis* of the Hamilton group, a small *Martinia* apparently identical with that mentioned in the rocks near Fort Resolution, and a new *Spirifer* I have described in another part of this paper, under the name of *S. Kennicotti.*

Below Fort Simpson, a few high, precipitous hills, apparently spurs of the Rocky Mountains, are seen on either side back from the river, and nearly horizontal beds of limestone, overlaid by dark shales, occur along the shores. Further down, an island composed of dark gray bituminous limestone, dipping to the southeast, divides the river, and on the right shore below this there is a hill called the "Rock by the river's side," presenting a precipitous front of similar limestone strata, rising abruptly from the water's edge to an elevation of near five hundred feet. The strata composing this hill are highly inclined to the north-west. Unfortunately no

fossils have yet been collected from these rocks at this locality, though Mr. McFarlane saw embedded in some of the strata large shells, which, judging from his description, probably belong to the genus *Nautilus* or *Gyroceras*.

Sir John Richardson saw a thermal saline spring flowing from these rocks, and leaving on their surface an incrustation of sulphate of lime. At some places here he mentions seeing nearly horizontal beds of limestone, overlaid by shale, abutting against the upturned older strata composing these elevated hills and ridges.

Between Fort Norman and the mouth of Bear Lake river, the Mackenzie enters a Lignite Tertiary formation, apparently of the same age as the Great Lignite deposits of the Upper Missouri. Its entire thickness is unknown, but it rises from beneath the water level to an elevation of one hundred and fifty feet or more. Like the Upper Missouri Lignite deposits, this formation is composed of beds of sand, pebbles, pipe and potter's clays, etc., with Lignite strata of various extent; some beds of the latter being at places as much as eight to ten feet in thickness. These Lignites sometimes ignite spontaneously and burn for many years, fusing and consolidating the adjacent clays and sand into masses resembling volcanic products. This formation has been accurately described by Sir John Richardson, who correctly referred it to the Tertiary epoch. In his "Journal of a Boat Voyage through Prince Rupert's Land," he also gives figures and descriptions of several species of fossil plants found in these beds, some of which are very similar to species found in the Lignite deposits of the Upper Missouri.

In the collections now under consideration, there are specimens apparently of a *Taxites*, collected from this formation by Mr. B. R. Ross, of the Hudson's Bay Company, near the mouth of Great Bear river, which, after comparison with specimens brought by Dr. Hayden, from the Lignite formations of the Upper Missouri, I can scarcely believe to be specifically distinct from the latter. If any shells of mollusks occur in these Tertiary beds at this place or further north, it would be highly desirable that a good collection of them

should be obtained for comparison with those of the great Lignite deposits of the Upper Missouri region.

From the statements of Sir ALEXANDER MCKENZIE, Sir JOHN FRANKLIN, Sir JOHN RICHARDSON, Mr. ISBISTER, and other explorers, as well as of various intelligent gentlemen connected with the Hudson's Bay Company, we have every reason to believe that an almost continuous belt of these Lignite Tertiary deposits extends along the eastern flanks of the Rocky Mountains, from the Arctic Ocean southward, so as to connect with the Great Lignite Tertiary basin of the Upper Missouri. It is probable, however, that some of the exposures of Lignite mentioned by these gentlemen may belong to the Cretaceous epoch.

The area occupied by these Lignite formations at the mouth of Bear river must be comparatively narrow where crossed by Mackenzie river, since older rocks occur again immediately below the mouth of the former stream. The Lignite beds, however, are seen at some places farther down, mostly on the west side of the Mackenzie and on Peel's river. They seem not to extend, at least for any considerable distance, across on the north side of Bear river, east of the Mackenzie, several elevated ridges of older strata occupying much of that region. One of these, at the mouth of Bear river, rises abruptly to an elevation of six or seven hundred feet above the water, and seems to be mainly composed of highly inclined, dark, more or less bituminous limestone, apparently of the same age as the "Rock by the river's side," already mentioned. In 1825, Sir JOHN FRANKLIN saw here "some sulphurous springs, and streams of mineral pitch issuing from the lower parts of the limestone strata."

A similar hill, apparently composed of the same formation, occurs near the rapids in Bear river between twenty and thirty miles from its mouth, rising from a narrow base to an elevation of eight or nine hundred feet above the river. This hill seems to be mainly composed of rather thick beds of dark limestone, which at some places dip to the north-west at an angle of 45 degrees.

At the rapids, Bear river passes between nearly perpendicular walls from ninety to one hundred and twenty-five feet

in height, composed below of grayish, undisturbed beds of argillo-arenaceous material containing minute particles of lignite, and, in concretions, impressions of fern leaves. Overlying this are beds of fine sandstone, with, near the summit, a stratum of dolomite, and above all a layer of dark gray laminated limestone. These sandstones and shales, Sir JOHN RICHARDSON says, have much the appearance of the coal measures, but as he found at the base of the exposure, in some loose pieces of brown ferruginous sandstone, specimens of an *Ammonite*, and as two species of that genus have since been described from that neighborhood by the writer, in Prof. HIND'S Report on the Assiniboine and Saskatchewan Expl. Expedition, while there are from near there, in the collection under consideration, fragments of an *Ammonite* and an *Inoceramus*, it is highly probable that these strata belong to the Cretaceous system, though some of the upper portions may be of Tertiary age. The fact that these strata lie in a horizontal position so near hills of highly inclined limestones, probably of Devonian age, evidently shows that they belong to some of the more modern epochs. Undisturbed strata apparently of the same shale and sandstones continue along Bear River to its source in Great Bear lake, and around the shores of the latter.

On Mackenzie river, below the mouth of Bear river, exposures of dark bituminous shale are seen at several places; and at a locality about forty-five miles below Bear river, it forms perpendicular cliffs very similar to the outcrops seen on Clear Water and Athabasca surmounting the limestones containing Hamilton group fossils. Still farther down, walls of gray argillaceous sandstone, in nearly horizontal layers, continue for many miles along the shores. At the rapids farther down, abrupt hills of highly inclined strata of dark grayish limestones similar to those forming the hills and ridges in the vicinity of Bear river occur.

Below the rapids, horizontal beds of sandstone are again seen, and at a locality some forty miles below the rapids, called the "Ramparts," lat. 66 deg., long. 127 deg., the river is walled in on either side between nearly perpendicular precipices, fifty to two hundred feet in height, consisting of highly

inclined strata of limestone very similar to those seen in the hills near Bear lake. These beds are often impregnated with bituminous matter, and generally dip at a high angle in a northwesterly direction. Near the middle of this defile, Sir JOHN RICHARDSON collected from these rocks some fossils referred by Mr. SOWERBY to "*Terebratula sphaeroidalis*, *Producti*, a coral of the genus *Amplexus*, *Terebratula resupinata*, *Spirifer acutus*, a *Cirrus* and some crinoidal remains."

Sir JOHN RICHARDSON expresses no opinion in regard to the age of the rocks at the "Ramparts," further than to say they are very similar to those seen in the other high hills and ridges further up the river. Mr. ISBISTER refers them to the Carboniferous system. That this is an error, however, I can scarcely entertain a doubt, since it is manifest some mistake must have been made in these identifications,—*Terebratula sphaeroidalis* and *T. resupinata* being Jurassic species, and *Spirifer acutus* a Carboniferous species. I suspect, however, that the shell here and elsewhere mentioned by him as *Terebratula resupinata*, is the *Orthis* I have referred to *O. iowensis*, since it nearly resembles *Orthis resupinata* (which it will be remembered was described by SOWERBY as a *Terebratula*), or another similar species I have described from a locality farther down the river under the name *O. McFarlanei*.

I am led to this conclusion from a careful examination of some fossils collected by Mr. KENNICOTT, at the "Ramparts," and others by Mr. MCFARLANE from the same formation, forty miles below. Those from the "Ramparts" consist of a coral having the external appearance of *Amplexus*, but differing in its internal structure, *Favosites polymorpha*, a massive species of *Alveolites*, a *Zaphrentis* (*Z. recta* of this paper), *Atrypa reticularis*, *A. aspera*, a *Rensselaeria? Cyrtina hamiltonensis*, and a small *Spirifer* (*Martinia*). From this assemblage of fossils, I am clearly convinced that these rocks cannot belong to the Carboniferous system, but that they are Devonian, and most probably belong to about the horizon of the Hamilton group.

At numerous places below the "Ramparts," particularly between these and the site of old Fort Good Hope, long, nearly perpendicular bluffs, composed of limestone, sandstone and

bituminous shales occur, sometimes more than one hundred and sixty or seventy feet in height. These beds are usually nearly horizontal, and at some places the bituminous shales alternate with the limestones, while both are overlaid by the sandstones. From the limestones, at one place, thirty miles below the "Ramparts," Sir JOHN FRANKLIN collected specimens which Sir JOHN RICHARDSON says are "full of shells, many of which are identical with those of the flat limestone strata of the Athabasca river." At another locality ten miles below this, Mr. MCFARLANE collected from these limestones some of the same corals obtained by Mr. KENNICOTT at the "Ramparts," also *Atrypa reticularis* (large variety), an undetermined *Rhynchonella*, *Orthis McFarlanei*, described in this paper, a large *Spirifer* (*Martinia*), which I have called *S. Franklinii*, and a large *Gyroceras* I have described under the name of *G. Logani*.

There are, likewise, in the collection from this locality, found in loose masses, casts of a *Rensselaeria* a little under the usual size of the well known *R. ovoides* of the New York Oriskany sandstone, from which it differs specifically. This fossil is quite abundant, and occurs in a different matrix from that of the other species obtained here, being in a rough, very hard, yellowish-gray rock, looking much like a compact silicious sandstone, but when examined under a magnifier, it is seen to be a fine-grained subcrystalline dolomite.

From the other fossils obtained at these outcrops, they would seem to belong to the same rock as that forming the "Ramparts," which, as previously remarked, is probably of about the age of the Hamilton Group. These limestones appear to have also a considerable east and west extension near this latitude, since Mr. ISBISTER, in speaking of the formation at the "Ramparts" above here, says, "it is continued in a westerly direction to the Rocky Mountains, the lower elevations of which are composed of it at that portion of the range through which Peel's river takes its course."

A few fossils in the collections under examination, found by the Rev. Mr. W. W. KIRBY along Porcupine river, west of the Rocky Mountains, also indicate the continuation or reappearance of these rocks on the western slopes of this range, and their

probable extension further westward into Russian America. The fossils here alluded to are *Favosites polymorpha*, apparently two or three species of undetermined turbinate corals, an aggregated *Cyathophyllum*, a *Palaeocyclus*, *Atrypa aspera*, and *Cyrtina hamiltonensis*.

Hamilton group fossils were likewise collected by Mr. McFarlane east of Mackenzie river, at localities on Anderson river,[2] about one hundred and fifty miles in a north-eastward direction from the "Ramparts." These are *Favosites polymorpha*, *Cysteophyllum americanum?* several undetermined turbinate and cylindrical corals, some of which appear to be identical with species found at the "Ramparts," a new species of *Smithia* (*S. Verrilli* of this paper), crinoidal columns, *Orthis McFarlanei*, *Atrypa reticularis* (large dilated variety), *A. aspera*, *Cyrtina hamiltonensis*, or a very closely allied species, *Pentamerus borealis* (of this paper), and a smooth *Rensselaeria?* apparently identical with the casts found forty miles below the "Ramparts."

About one hundred and fifty miles below the "Ramparts," or some sixty miles below the site of old Fort Good Hope, precipitous rocky bluffs, from fifty to one hundred feet in height, occur on both sides of Mackenzie river, forming what is known as the "Narrows." In the collections under examination there are no specimens from this locality, but Sir John Richardson describes the "Narrows" as "a defile similar to that of the 'Ramparts.'" He also states that the cliffs here are mostly sandstone, in nearly horizontal strata, which at some places incline slightly to the south-east. Some of the beds are rather compact and contain much calcareous matter, while others are shaly and strongly impregnated with alum. These alum shale beds extend for some distance up Peel's river, a small stream entering the delta of Mackenzie river on the west, and also around the east and west sides of the delta, as well as along the sea coast at places.

The delta of Mackenzie river, which commences some twenty miles below the "Narrows," is about ninety miles in length, north and south, and widens gradually northward

[2] Anderson, or Begh-ula-tesse river, is a small stream flowing northward into the Arctic sea.

from its head to the shores of the Arctic sea, where it is between forty and fifty miles in breadth. This whole area is occupied by numerous low islands, more or less overgrown with trees, and separated by the several channels of the river. On the west it is bounded by an elevated district connected with spurs of the Rocky Mountains, and on the east by what are known as the "Reindeer hills," from 400 to 800 feet in height, forming, as is supposed, a continuation of the range seen at the "Narrows." At some places, about twenty miles below the head of the delta, outcrops of dark, bluish-gray limestone are seen along the base of these hills, and at other places further down, some high exposures occur, composed of strata of slaty clay above, sandstone in the middle, and bluish-gray alum shale at the base.

In regard to the age of this alum shale formation in the region of the delta of Mackenzie river, we have no reliable information, no organic remains having been found in it, so far as known to the writer. From Sir JOHN RICHARDSON'S descriptions, I infer that it differs in some respects from the very dark bituminous shales found associated with the Devonian rocks on the upper part of Mackenzie river and its tributaries; and as some similar beds occur about the western extremity of Great Bear lake, in the region of Tertiary and possibly Cretaceous rocks, while Lignite deposits are found on some of the islands near the mouth of Mackenzie river, and at other places on the main land, in the region of the delta, I infer that this formation most probably belongs to the Tertiary or Cretaceous system.

From the foregoing remarks, it will be observed that amongst all the collections under examination from various localities along Mackenzie river and its tributaries, between Clear Water river and the Arctic ocean, a distance by the general course of the valleys of more than one thousand miles, there are no Carboniferous or characteristic Silurian forms. It would, however, be rash to conclude from this that no rocks belonging to either of these epochs are anywhere exposed along these streams. Yet the impression left upon the mind of the writer from examining these collections, and from reading Sir JOHN RICHARDSON'S notes, as well as from all he has

been able to learn from Mr. KENNICOTT, is, that no Carboniferous rocks crop out along these streams between Clear Water and the mouth of Mackenzie river. It is, nevertheless, highly probable that they, as well as Silurian strata, exist in the Rocky mountains west of these rivers. It is also probable that Silurian rocks occur at places on Slave lake, east of the mouth of Slave river, and on Great Bear Lake, as represented on Mr. ISBISTER's map, as well as on Slave river, and at other places between the great azoic area on the east and the belt of Devonian rocks extending along the valley of Mackenzie river and its tributaries.

It is an interesting fact, in connection with the Devonian deposits of Mackenzie river, that the same rocks appear again in a belt of country west of Lake Winnipeg, extending thence southward and south-eastward through Dakota, Minnesota and Iowa, to Rock Island, Illinois. By consulting ARROWSMITH's general map of British America, in connection with ISBISTER's and Prof. HIND's geological maps of portions of the same, and Sir WILLIAM LOGAN's recently published beautiful geological map of the Canadas, the Saskatchewan country, and northern portions of the United States, it will be seen that the belt of Hamilton group rocks laid down by the last mentioned authors, as extending from Rock Island, Illinois, in a north-westerly direction to the Saskatchewan, ranges very nearly in the same direction, and almost on a line with the general trend of the great valley of Mackenzie river and its upper tributaries. From all the facts, therefore, now known, it is highly probable that there is a continuous stretch of Devonian rocks, mainly of the age of the Hamilton group, extending from Rock Island, Illinois, in a north-westerly direction to the Arctic ocean, a distance, in a right line, of near two thousand five hundred geographical miles.

It is also worthy of note, that collections of fossils now before me, obtained at about the extreme opposite ends of this long belt of Devonian rocks, and hence at localities separated by nearly thirty degrees of latitude, include a considerable proportion of undoubtedly identical species, and altogether present a degree of general similarity strongly corroborating the generally accepted opinion that climatic conditions, if not

uniform over the whole world, were at least little if at all influenced by difference of latitude during the Palæozoic epochs.

Supplementary Note.

Before commencing the descriptions of the fossils in the collection under investigation, I would call the attention of the intelligent gentlemen connected with the Hudson's Bay Company, as well as of others more directly interested in the establishment of settlements in these remote northern districts, to the numerous indications of extensive deposits of petroleum along the valley of Mackenzie river and several of its tributaries, particularly on the Athabasca river. It is true, these localities are too distant from markets to attract the attention of speculators, but it will be readily understood that an abundant supply of rock oil here would be of great value to the employees of the Fur Company, who, I was informed by Governor McTavish, now transport all they consume of this useful article, by long overland journeys and boat voyages from the south, to their various stations scattered throughout the vast area of their operations. In addition to this, should settlements ever be established in the region of Athabasca river, or Bear lake, we could scarcely overestimate the value and importance that a few flowing oil wells would be to the inhabitants of these districts, since such wells might not only afford a sufficient supply of oil for illuminating purposes, but even be used as a concentrated fuel for cooking, warming houses, and driving steam engines, and thus measurably compensate for the scarcity of wood in this rigorous climate.

That large quantities of oil exist at no very great depths beneath the surface at some of the various localities already mentioned, where the rocks and earth are saturated with pitch, is highly probable;—the pitch being merely the fixed residue left by the evaporation of the volatile portions of petroleum that found its way to the surface during the long ages of the past. The significance of the oil indications alluded to here will be more apparent, when it is remembered that the rocks, where they occur on Athabasca river

and other localities mentioned, belong to about the same geological horizon as that in which the oil of many of the great flowing wells of Pennsylvania is supposed to have its origin. The occurrence of numerous copious brine springs here is also worthy of note.

Descriptions of the Fossils contained in the Collection.

CORALS.[3]

Family CYATHOPHYLLIDAE.

Genus ***Cyathophyllum*** GOLDFUSS, 1826.

Cyathophyllum arcticum MEEK.

Pl. XI, fig. 8.

Corallum compound, aggregated or growing in masses two or three inches in diameter, from a base composed of a single corallite, increasing by lateral and interstitial budding. Corallites very unequal in size, generally crowded together and angular, but apparently sometimes scarcely in contact, and rounded. Epitheca well developed and distinctly wrinkled on the outer or under side of the corallum, and around each corallite, when they are not crowded together. Calices, like the corallites, varying much in size and form, rather deep, with nearly vertical sides. Septal radii eighteen to about twenty-two, thin, and alternating with the same number of very short rudimentary secondary ones, which usually merely form rather prominent striæ on the walls between the others; principal series extending to the middle of the calices, but rarely reaching quite to the middle of the corallites, as seen in the transverse section. Tabulæ very thin, somewhat irregular, and apparently occupying a considerable portion of the middle of each corallite, nearly transverse, but curving up on each side, as seen in longitudinal sections; dissepiments forming very small vesicles, arranged in oblique ascending series, in a thin surrounding zone.

Height of corallum, 1.70 inches; greatest breadth at summit, 2.70 inches. Diameter of calices varying from 0.14 to 0.36 inch; average depth about 0.18 inch.

In its general appearance, this coral resembles *Cyathophyllum quadrigeminum* of GOLDFUSS, as figured on pl. xviii, fig.

[3] I am under obligations to Prof. A. E. VERRILL, of Yale College, who has devoted especial attention to the study of recent fossil corals, for suggestions in regard to the generic relations of several of the corals described in this paper, respecting which I was in doubt.

6, *b*, of his Petrefacta Germaniae, more nearly than any other species with which I am acquainted, but differs materially in apparently always increasing by interstitial and lateral gemmation, as well as in the smaller number and unequal development of its septal radii.

The specimen figured does not show the loose mode of growth and rounded character of the corallites seen in other individuals too large to be conveniently figured.

Locality. Porcupine river, Russian America, lat. 66 deg. 27 min. N., long. 143 deg. W. Also on Grand river, and near Fort Good Hope on Mackenzie river, lat. 66 deg. N., long. 128 deg. W.

Genus ***Cysteophyllum*** LONSDALE, 1839.

Cysteophyllum americanum, var. ***arcticum*** MEEK.

Pl. XI, fig. 6.

Cystiphyllum americanum EDWARDS & HAIME, Monogr. Polyp. Foss. (1851), p. 464, pl. xiii., fig. 4, 4a.

Corallum conical, or possibly becoming cylindrical in large specimens, straight or somewhat curved. Surface with a thin epitheca, and distinct wrinkles, with stronger encircling ridges of growth. Calice circular, or a little oval, conical, and of moderate depth; marked with radiating impressed lines, indicating the position of rudimentary septa, formed by the crowding together of the walls of the vesicles within. Interior, as seen in a longitudinal section, entirely occupied by a dense vesicular tissue, the vesicles being largest and most irregular in the central region, and becoming very small, crowded, and arranged in oblique ascending series on each side; in a transverse section, showing thin radiating false septa, of which about one hundred may be counted in the entire series. Near the middle, these false septa are distinct, but they become gradually more irregular and obscure as they approach the exterior.

Length, 2.10 inches, or more; breadth, 1.25 inches.

It is with considerable doubt that I have ventured to refer this to the New York species described by EDWARDS and HAIME. Yet it agrees so nearly in its internal structure with the figure of that species given by those authors that I am led to think it may possibly be the same. It is shorter, however, in porportion to length, than a specimen of *C. americanum*, with which I have compared it, while the vesi-

cles of its interior are proportionally smaller, more crowded, and hence more numerous than in the New York species. It may be an entirely distinct species, but without more specimens for comparison, it seems scarcely possible to settle this question satisfactorily.

Locality and position. Onion river, lat. 67 deg. N., long. 125 deg. W. Collected by R. W. McFARLANE.

Genus ***Aulophyllum*** EDWARDS & HAIME, 1850.

Aulophyllum? Richardsoni MEEK.

Pl. XI, fig. 3.

Corallum nearly cylindrical, or in immature examples conical, more or less flexuous, and with encircling ridges and wrinkles of growth well defined. Epitheca very thin, usually worn off in weathered specimens. Calice apparently very shallow and circular, or a little oval. Septa very thin, about seventy, of which every alternate one extends to the central region, while the intermediate ones all terminate at a kind of rudimentary wall, about one-third of the way in from the surface to the middle. Space within the inner wall, between the septa, divided into numerous small vesicles; intercostal spaces of the outer zone, between the inner wall and the surface, occupied by much smaller vesicles, ranging obliquely outward and upward.

I know this coral only from fragments less than 0.80 inch in diameter, none of which show the entire length. They are also nearly all considerably compressed, but this seems to be from accidental pressure. The generic characters cannot be made out with much confidence from such materials, and hence I am by no means satisfied that the species should not be called *Cyathophyllum Richardsoni*. As near as its internal structure can be determined, however, from the specimens collected, it would seem to differ from that genus in having an inner wall encircling the central region, and thus more nearly approaching the genus *Aulophyllum*. It also wants the transverse tabulæ generally more or less developed in the central region of *Cyathophyllum*.

In most of the specimens the epitheca has been removed, so as to show the septa very distinctly. Usually about seven of these can be counted in a space of 0.20 inch. Where the

epitheca is not removed, however, there seems to have been moderately distinct septal costæ marking the positions of the septa. The dissepiments are likewise quite distinctly seen between the costæ of weathered specimens.

This is almost certainly the coral referred by Mr. SOWERBY, in Sir JOHN RICHARDSON'S collection, to *Amplexus*, which it much resembles externally, though it differs widely from that genus in internal structure.

Named in honor of Sir JOHN RICHARDSON.

Locality and position. Mackenzie river, at the "Ramparts," lat. 66 deg., long. 127 deg.

Genus *Zaphrentis* RAFINESQUE, 1820.

Zaphrentis recta MEEK.

Pl. XI, fig. 1.

Corallum obconical, straight, or probably sometimes a little curved, rather attenuate at the lower extremity. Epitheca thick, strongly wrinkled, or, at irregular intervals, even constricted by the marks of growth, almost entirely concealing the septa. Calice circular, conical, and rather shallow; septal fossette lateral, very shallow. Septa thin and numbering in the primary series about forty, which alternate with as many imperfectly developed secondary ones; on grinding away the epitheca, about seven of these two sets may be counted in the space of 0.20 inch. Tabulæ forming irregular vesicular cavities, apparently not very distinct from those formed by the dissepiments, excepting that they are larger and more transverse. Vesicles of the outer zone rather small and ranging obliquely outward and upward.

Length, 1.70 inches; breadth, 0.95 inch; depth of calice, 0.33 inch.

The septal fossette is so faintly marked in this species that it might be readily overlooked, and cause the coral to be referred to *Cyathophyllum*. The presence of the fossette, however, is obvious enough, when once the attention is drawn to it, and warrants the reference of the species, when taken in connection with its other characters, to the genus *Zaphrentis*. I am not acquainted with any very closely allied species.

Locality and position. Anderson's river, lat. 67 deg. N., long. 125 deg. W., and on Porcupine river? lat. 67 deg. 27 min. N., long. 143 deg. W. Collected by R. W. MCFARLANE.

Zaphrentis Mcfarlanei Meek.

Pl. XI, fig. 2.

Corallum about medium size, or rather less, conical, and distinctly arched, surface with strong irregular ridges of growth, and, especially where the epitheca is a little worn, showing the septa; calice circular, oblique, and apparently of moderate depth; septal fossette small, but deep and well defined, placed about half way between the middle and the side, in a lateral position with relation to the curve. Septa about forty, every alternate one being stouter and more prominent than the others, and extending to the middle of the calice, where they are considerably contorted. Tabulæ apparently nearly wanting, or only dividing some portions of the centro-lateral region into irregular vesicular cavities; outer interseptal area occupied by numerous small vesicles.

Length, about 2.30 inches; greatest breadth, 1.20 inches.

The only specimens of this coral in the collection are considerably worn, so as to make the surface appear smoother than is natural, and remove the margins of the calice in such a manner as to make it appear shallow. So far as I have been able to make comparisons, it seems to be distinct from the described species.

The specific name is given in honor of Mr. R. W. McFarlane, who discovered and collected the specimens described.

Locality and position, same as last.

Genus *Smithia* Edwards & Haime, 1851.

Smithia Verrilli Meek.

Pl. XI, fig. 7.

Corallum depressed, moderately convex below, where it seems to have been protected by a thin epitheca, and attached by a small central peduncle; upper side nearly flat. Calices nearly as deep as wide, with vertical walls, and subangular, slightly raised margins, showing about fifteen principal septal radii, and as many short intermediate secondary ones; the former rather prominent on the walls, and continued in the bottom of the calices to the center, while the latter assume the appearance of raised striæ between. Mural circles, as seen in sections, not very distinctly defined, being mainly indicated by the sudden thickening of the radii as they pass on; situated regularly at intervals of once to twice their own diameter apart. Radii thirty to thirty-five, rather thin,

and minutely and very obscurely granulose, or striate on the sides; a few of them straighter and more confluent in one direction than the others, and generally meeting those from the adjacent corallites at various angles, as seen in transverse sections; the twelve to fifteen principal ones continued to the center of the mural circles seem to be sometimes a little twisted about the center, while the others coalesce with them, or die out a short distance within the walls. Dissepiments very thin, and arching a little downwards, in crossing the intercostal spaces, arranged closer together than the radii themselves.

Transverse diameter of the corallum, 2.20 inches; height of do., 0.75 inch; breadth of mural circles and calices, 0.13 inch; interspaces from 0.13 to (occasionally) 0.18 inch.

In transverse and longitudinal sections the radii of this species are very distinctly visible, but the dissepiments, which are much thinner, are with difficulty seen in sections, though distinct enough on weathered surfaces. Specifically it seems to be most nearly allied to *P. Verneuili* of EDWARDS & HAIME, but differs in having its mural circles much more regularly and closely arranged, while it is more compact in structure, not being disposed to separate into flattened laminæ.

I take pleasure in dedicating this species to Prof. A. E. VERRILL, of Yale College, New Haven, to whom I am indebted for suggestions in regard to the affinities of the corals described in this paper.

Locality. Anderson river, lat. 67 deg. N., long. 126 deg. W.

Genus *Combophyllum* EDWARDS & HAIME, 1858.

Combophyllum multiradiatum MEEK.

Pl. XI, fig. 4.

Corallum depressed, discoid, circular, flat below; upper side with a broad, very shallow calice, which is flattened within; septal fossette narrow, but well defined, extending from the middle to the margin of the calice. Lateral margins rounded, and as it were duplicated by a distinct furrow, extending entirely around. Radial septa numbering 48 to 50 in the primary series, which alternate with a shorter intermediate series, only extendnig into the inner margin of the very shallow calice.

Height, 0.13 inch; breadth, 0.67 inch.

The only specimen of this interesting coral, in the collection, is much worn, as if it had been transported by running water; consequently it is impossible to determine whether the septal radii were crenate or not, though they appear to be smooth. It differs widely from the only other described species of the genus with which I am acquainted (*C. osismorum* and *C. leonense* E. & H.), in its much more numerous septa aud more depressed form.

Although this genus is usually placed in the subfamily Zaphrentinae, it certainly differs very materially from the other genera of that group.

Locality. Onion river, lat. 67 deg., long. 125 deg. Collected by R. W. McFARLANE.

Family FUNGIDAE.

Genus ***Palaeocyclus*** EDWARDS & HAIME, 1849.

Palaeocyclus Kirbyi MEEK.

Pl. XI, fig. 5.

Corallum depressed, discoid, circular. Under side perfectly flat, and protected by a well-developed, concentrically wrinkled epitheca, with some appearance of a small central scar of attachment. Upper side with a very shallow central depression or concavity, surrounded by a broad, low, rounded rim, formed by the slight projection of the septal radii. Columella, if any exists, very short. Septal radii about forty-five, in the principal series, with as many shorter intermediate ones; all with margins apparently nearly smooth.

Height, 0.35 inch; breadth, 1.16 inches.

In the number of its septa, as well as in its general aspect, this species seems to be related to *P. propita* LINN. (sp.), but it is more flattened below, while its septa show none of the distinct crenulations so characteristic of that species.

Named in honor of Rev. W. W. KIRBY, to whom we are indebted for the typical specimen, and other Devonian (Hamilton group) fossils from Russian America.

Locality. Porcupine river, Russian America, lat. 66 deg. 27 min. N., long. 143 deg. W.

Family FAVOSITIDAE.[4]

Genus ***Favosites*** LAMARCK, 1816.

Favosites polymorpha GOLDFUSS. (sp.)

Pl. XI, fig. 10.

The specimens of this species in the collection all belong to the slender, branching variety, with the walls thickened, so as to give the cells or calices a nearly or quite circular form. The branches vary from 0.25 to 0.70 inch in diameter, and although found at various localities, the specimens obtained are mere fragments, generally in a bad state of preservation.

According to EDWARDS & HAIME, this is but a mere variety of *F. cervicornis*, of Blainville, which is not improbable. If so, the latter name will have to be used for the species, as it has priority of date.

Localities. The specimen figured is from Anderson river, lat. 67 deg. N., long. 125 deg. W. Other specimens in the collection are from near Fort Resolution, on Slave lake, and from Mackenzie river, at the "Ramparts;" also, from Porcupine river, Russian America, lat. 66 deg. 27 min. N., long. 145 deg. W.

Genus ***Alveolites*** LAMARCK, 1801.

Alveolites vallorum MEEK.

Pl. XI, fig. 9.

Corallum massive, large, wider than high, apparently lenticular in form, or sometimes concave below, and convex above; laminated structure not always distinct. Calices very small, or rarely more than 0.03 inch wide and half that in height, oblique, generally nearly twice as wide as high, and more or less rhombic in outline. Walls between the calices apparently nearly as thick in worn or weathered specimens, as the diameters of the calices themselves.

Entire size of corallum unknown, apparently sometimes as much as four or five inches broad, and one and a half inches thick or high.

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[4] Prof. AGASSIZ has shown that the animals of the genus *Millepora*, previously considered true Polypi, have the structure of the Hydroid Acalephs; and from analogy he infers that the fossil genera *Favosites*, *Chaetetes*, and indeed all of those extinct corals belonging to the group Tabulata, were probably formed by Hydroid Acalephs.

This is probably an undescribed species, although I cannot clearly satisfy myself that it is distinct from some of those of which I have only seen descriptions without figures.

Locality. "Ramparts," on Mackenzie river, forty miles above old Fort Good Hope.

BRACHIOPODA.

Family LINGULIDAE.

Genus ***Lingula*** BRUGUIERE.

Lingula minuta MEEK.

Pl. XIII, fig. 1.

Shell minute, extremely thin, ovate, rather convex; front rather narrowly rounded; sides most convex in outline slightly in front of the middle, thence narrowing with slight convexity to the beak, which is obtusely pointed. Surface polished, but showing, under a strong magnifier, microscopic lines of growth.

Length, 0.06 inch, breadth, 0.05 inch.

This is the smallest specimen of *Lingula* I have ever seen, and may possibly be a young shell. It resembles closely *Lingula spatula* HALL, from the Genesee slate of New York, but is rather wider in proportion to length, and has a more pointed beak. It is also more convex than any specimens I have seen of that species.

Locality. Near Fort Resolution, on Great Slave lake.

Family STROPHOMENIDAE.

Genus ***Strophomena*** RAFINESQUE.

Strophomena* (*Strophodonta*) *demissa CONRAD.

Pl. XIII, fig. 6.

Strophomena demissa CONRAD, Jour. Acad. Nat. Sci. Philad., Vol. VIII (1842), p. 258, pl. xiv, fig. 14; BILLINGS, Devonian Fossils of Canada West (1861), p. 77.

Strophodonta demissa HALL, Report Regents University, N. Y. (1856), p. 137; Iowa Report, Vol. I (1858), Part 2nd, p. 495, pl. iii, fig. 5, *a—k*.

Numerous fine specimens of this shell in the collection agree exactly in all respects with examples of *S. demissa* from the

Hamilton group in New York, Iowa, and Illinois. Like the latter, they vary considerably in the length of the hinge line, which is in some specimens longer than the breadth of the valves, and in others shorter, while there are various intermediate gradations in this character.

Length, 1.17 inches; breadth, 1.37 inches; convexity, 0.44 inch.

Locality and position. Clear Water river; Devonian system, (Hamilton group.)

Strophomena (Strophodonta) subdemissa Hall.

Pl. XIII, fig. 7.

Strophomena (Strophodonta) subdemissa Hall, 10th Report Regents University, N. Y. (1856), p. 145.

As near as can be determined from a description alone, without a figure, this form agrees well with the above type. I doubt, however, whether it is more than a variety of *S. demissa*, from the typical form of which it differs only in its greater convexity, shorter hinge, and proportionally wider area. If these characters were constant, they would of course be sufficiently distinct to warrant its separation without doubt, but there are so many intermediate gradations as to leave some uncertainty in regard to the propriety of separating these forms as two distinct species.

Length, 1.10 inches; breadth, 1.05 inches; convexity, 0.54 inch.

Locality and position. Same as last.

Genus *Orthis* Dalman, 1828.

Orthis McFarlanei Meek.

Pl. XII, fig. 1.

Shell subcordate, resupinate, very gibbous; length (in adult examples) greater than the breadth; cardinal and umbonal regions very narrow; postero-lateral margins straight, and rapidly diverging forward to the widest part of the valves, which is a little in advance of the middle; hinge line short, or scarcely equaling half the greatest breadth of the valves; cardinal area moderate, nearly twice as high in the ventral valve as in the other, strongly arched in the dorsal valve, and slightly

in the ventral, where it is less than half as high as wide, and ranges nearly at right angles to the plane of the valves; foramen triangular, and about two-thirds as wide as high. Smaller or ventral valve convex in the lateral and umbonal regions, the most gibbous part being near the beak, which is short and a little incurved at the point; provided with a broad rounded mesial sinus, which commences very shallow near the middle of the valve, and widens and deepens rather rapidly towards the front margin to which it imparts a broadly emarginate outline. Larger or dorsal valve extremely gibbous, particularly in the region of the umbo, which, in adult specimens, projects considerably beyond that of the other, and is at all ages strongly incurved. Surface marked with fine radiating striæ, some nine or ten of which may be counted in the space of 0.10 inch.

Breadth of an adult, 1.50 inches; length from the most prominent part of the umbo of the ventral valve to the front, 1.60 inches. Greatest convexity of the two valves, 1.16 inches; length of hinge, 0.77 inch.

This fine *Orthis* will be readily distinguished from all the known species of the genus by its peculiar form alone. Its most marked characters are the shortness of its hinge, the great convexity of its dorsal valve, and the narrowness of the umbonal region of both valves. These peculiarities, together with the remarkable gibbosity and prominence of the umbo of its dorsal valve give it much the general form of *Pentamerus galeatus*. This peculiar form is not abnormal, there being five specimens in the collection, all of which agree exactly in their general outline. The specimens being all more or less worn, do not show very distinctly the surface striæ, though they seem to bifurcate so as to preserve the same size on all parts of the valves. Under a magnifier, the worn and exfoliated surfaces show very distinctly the numerous minute punctures, and occasional larger openings in the striæ so often seen in shells of this genus. The muscular scars of the interior, so far as can be determined from internal casts, seem to be much like those of a variety of *O. iowensis*, and analogous species of this genus from the Devonian and Carboniferous rocks.

I have named this interesting species in honor of Mr. R. W. McFarlane, of the Hudson's Bay Company, to whom we are indebted for the specimens of this and many other species of Devonian fossils from these distant northern regions.

Locality and position. Forty miles below Fort Good Hope,

on Mackenzie river, and on Lockhart river, lat. 67 deg. 15 min. N., long. 126 deg. W., in the Devonian, (Hamilton group.) I have also seen specimens which I believe to belong to this species from the Hamilton group beds of Iowa and Illinois.

Orthis iowensis HALL?

Pl. XII, fig. 2.

Orthis iowensis HALL, Iowa Report, I, Part 2nd (1858), p. 488, pl. xi, fig. 4; BILLINGS in HIND'S Report Expl. Assiniboine, Saskatchewan, etc. (1859), p. 193.

Shell large, robust, resupinate, suborbicular, or in adult examples, a little wider than long, and more or less emarginate in front; rather compressed in young specimens, but becoming gibbous with age. Ventral valve much less convex than the other, its greatest convexity being at the umbo, while its anterior margin in mature specimens is often strongly and abruptly sinuous, or impressed in the middle; cardinal area very small but well-defined and a little arched; foramen generally a little higher than wide; beak small, arched, and projecting little beyond the hinge line, being distinctly less prominent than that of the other valve. Dorsal valve gibbous and regularly arched; beak prominent, strongly incurved; cardinal area rather narrow and distinctly arched; anterior margin in large specimens often emarginated for the reception of the deflected edge of the other valve. Surface ornamented with fine, regular, radiating striæ, which bifurcate and increase by intercalation so as to preserve a nearly uniform size and arrangement on all parts of the shell, those on each side of the beaks curving gracefully outwards to the posterior lateral margins, while distinct subimbricating marks of growth traverse the valves concentrically.

Breadth (of a large adult specimen), 1.88 inches; length, 1.56 inches; convexity, 1.05 inches.

The adult specimens of the above described shell in the collection, are much larger than the typical examples of *O. iowensis*, figured in the Iowa Report, and generally have the mesial sinus of the ventral valve so strongly impressed at the immediate front as to impart a peculiar sharply emarginate outline to the anterior border not seen in any of the Iowa examples I have had an opportunity to examine, though smaller specimens have the sinus much more shallow and the front but faintly sinuous in outline, so as to agree well with examples from Iowa. Internal casts of the dorsal valve agree more nearly with that of a supposed variety of the Iowa species called, in the geological report of that State, *O. iow-*

ensis var. *furnarius* than with those of the typical *O. iowensis*. It may possibly be distinct specifically from the latter, but I am in doubt whether or not in that case it may not have to take the name *furnarius*.

On comparing this shell with *O. McFarlanei* figured on the same plate, the species under consideration will be seen to differ materially in its broader, more rounded, and more compressed form, and less straightened posterior lateral margins. A comparison of a number of fine specimens shows these differences to be constant at all stages of growth.

Locality and position. Mouth of the Clear Water, on Athabasca river. Collected by Maj. R. KENNICOTT.

Family PRODUCTIDAE.

Genus ***Productus*** SOWERBY.

Productus dissimilis HALL?

Pl. XIII, fig. 3.

Productus dissimilis HALL, Iowa Report, Vol. I (1858), Part 2nd, p. 497, pl. iii, fig. 7 *a*, *b*, *c*, *d*, *e*.

So far as the rather imperfect specimens of the little shell figured under the above name afford means of comparison, they agree well with examples of *P. dissimilis* from Iowa, not only in form but in the surface markings of both valves. It should be explained, however, that the specimens figured have had the extremities of the cardinal margin broken away, so as to give an unnatural roundness to the general outline. The little spine bases on figure 3 *a*, are also represented proportionally too large, and too erect.

Length and breadth each about 0.57 inch; convexity, 0.23 inch.

Locality and position. Clear Water river; Devonian, (Hamilton group.)

Productus———?

Pl. XIII, fig. 4.

This shell is evidently related to the last, and yet seems to present specific differences. In the first place, it generally

has its hinge proportionally more extended, and more angular at the lateral extremities; while the striæ on its ventral valve are finer, more crowded, and more waved. It also differs in showing scarcely more than minute traces of spine bases over the disc of the ventral valve. Like the *P. dissimilis*, its dorsal valve is marked by distinct concentric wrinkles not seen on the other valve, but these are more imbricating, and show traces of radiating striæ not seen on that valve of *P. dissimilis*. These radiating striæ, however, are represented too distinct and too continuous on fig. 4 *c*, *d*, while the concentric markings are made to curve too much outwards as they approach the cardinal margin. The specimens are too imperfect to admit of a very satisfactory comparison with foreign species.

Length, 0.61 inch; breadth, 0.65 inch; convexity, 0.24 inch.

Locality and position. In dark bituminous limestone, on the south side of Great Slave lake, near Fort Resolution. Devonian.

Productus ————?

Pl. XIII, fig. 5.

Having but an imperfect cast of a ventral valve of this shell, it is not possible for me to characterize it, or to determine whether or not it is new; especially since several apparently similar forms have been named and imperfectly characterized from equally unsatisfactory material from the Hamilton and Chemung groups of New York. It has been thought desirable, however, to figure it, in order to give as full a representation as possible of the fauna of the Hamilton group beds at these distant northern localities. The reader should understand that the costæ are represented too coarse and too continuous on fig. 5 *a*. They are more properly elongated, more or less confluent nodes, as on fig. 5 *b*, rather than continuous costæ, and probably supported spines.

Locality and position. Lockhart river, lat. 67 deg. 15 min. N. Devonian; (Hamilton group.)

Genus ***Chonetes*** FISCHER.

Chonetes pusilla HALL?

Pl. XIII, fig. 2.

Chonetes pusilla HALL, Tenth Report Regents Univ. New York (1857), p. 109.

It is with considerable doubt that this little shell is here referred to *C. pusilla*, not only in consequence of the fact that only very imperfect specimens were obtained, all imbedded in the matrix, but because it seems to be rather more coarsely striated, while its striæ bifurcate farther from the beak, and are apparently marked by stronger concentric striæ. As I only have a description without figures of *C. pusilla* for comparison, I am not fully satisfied that our shell is distinct, though it probably is.

In the same matrix fragments of another species, with much finer radiating and concentric striæ, are seen.

Length, 0.23 inch; breadth, 0.26 inch; convexity, about 0.08 inch.

Locality and position. Dark bituminous limestone, near Fort Resolution, on the south shore of Great Slave lake.

Family RHYNCHONELLIDAE.

Genus ***Rhynchonella*** FISCHER, 1809.

Rhynchonella castanea MEEK.

Pl. XIII, fig. 9.

Shell longitudinally suboval, or a little longer than wide, moderately ventricose in mature examples; lateral margins subparallel, but broadly convex in outline; front prominent. Ventral valve convex in the umbonal region, and depressed into a broad, flat, rather shallow mesial sinus in the front, where it is produced into a more or less prominent, rounded projection filling a corresponding sinus in the margin of the other valve; beak small and closely incurved over that of the opposite valve; anterior lateral margins on each side of the mesial sinus prominent and sharp. Dorsal valve one-third to one-half more convex than the other, curving strongly down on each side and at the beak, though but slightly in front, where it is a little elevated, so as to form a low, undefined, flattened mesial fold, scarcely traceable to the middle of the valve, and usually marked by a very faint impression along the middle; beak nearly as prominent as that of the other valve, and strongly in-

curved beneath it. Surface apparently nearly smooth, but at the front provided with a few very obscure, rounded plications, from two to four or five of which occupy the mesial fold and sinus, and some two or three the antero-lateral margins on each side. Under a good magnifier there are also to be seen traces of very obscure, fine, radiating and concentric striæ.

Length of a medium-sized specimen, 0.96 inch; breadth, 0.79 inch; convexity 0.60 inch.

This shell is not very closely allied to any form with which I am acquainted. The fully developed, more gibbous examples bear some resemblance to *R. subcuboides*, of the N. Y. Tulley limestone; but still they differ so clearly as to render a comparison scarcely necessary. In the first place, this differs in being less ventricose, and never transverse, the length always exceeding the breadth, while its plications are less numerous, and much more obscure. Indeed on most examples they are but feebly defined at the immediate front, while in young specimens they are almost, or entirely wanting. Another marked feature in this species is, that the deflected portion of the anterior margin of the ventral valve, occupying the sinuosity in the front margin of the dorsal, is never so strongly curved as to meet the latter at right angles, but at a more or less acute angle. So that the front of the shell, in looking directly down upon either valve, instead of being sinuous in the middle, is prominent and abruptly rounded, or even subangular in outline. In mature specimens, the margins of the valves in front, on each side of the sinus, are deflected upwards (or more properly downwards, when the shell is placed with the ventral valve down), and meet at an acute angle, so as to form a sharp carina around each antero-lateral margin. The middle plication is usually larger and more distinct in the sinus at the front of the ventral valve than any of the others, and corresponds to an obscure depression along the middle of the mesial fold of the dorsal valve.

There is, in the collection from the same locality, a single specimen of a more gibbous form, with more numerous and more distinct plications, which also has the lateral margins more flattened (laterally) near the beaks, giving the shell a somewhat cuneate outline, as seen in looking directly upon

either valve, (see pl. xiii, fig. 10 *a*, and 10 *b*.) If this specimen has not suffered some accidental distortion by lateral pressure, it must belong to a distinct species.

Locality. Lockhart river, lat. 67 deg. 15 min. N., long. 126 deg. W.

Rhynchonella ———?

Pl. XV, fig. 4.

As I only know this species from the internal cast of a dorsal valve figured on plate xv, and another fragment of the same valve of a smaller individual, I have been unable to identify it with any known species; nor am I willing to describe it as new, without better specimens for study and comparison.

Locality. Mackenzie river, forty miles below Fort Good Hope.

Genus *Pentamerus* Sowerby, 1812.

Pentamerus borealis Meek.

Pl. XIII, fig. 11.

Shell subglobose, about as wide as long. Dorsal valve moderately convex, being most prominent in the central and umbonal regions; beak incurved, and not projecting much beyond the cardinal margin, which is rather straight; front depressed so as to form a shallow, flattened mesial sinus, extending but a short distance back from the margin. Ventral valve more gibbous than the other, particularly in the umbonal region, forming a nearly regular descending arch from the beak to the front, where there is a slight, flattened mesial prominence, causing a moderately distinct sinuosity in the margin, occupied by a corresponding projection of the edge of the other valve; beak prominent, rather ventricose, and closely incurved, so as to bring the point nearly or quite in contact with the umbo of the other valve. Surface with rather small, irregular, distinct radiating costæ, which increase by division, each of the principal ones, particularly on the sides of the valves, giving off one or more smaller ribs on the outer side, which never equal the others in size.

Length from the front to the beak of the dorsal valve, 0.97 inch; do. to the most prominent part of the umbo of the ventral valve, 1.13 inches; greatest breadth, 1.09 inches; convexity of the two valves, 0.91 inch.

A rather remarkable peculiarity of this shell is the appearance of a narrow cardinal area (not a true area), which seems to be common to both valves, and extends out to the extremities of the hinge. Internal casts, however, show two very slightly diverging, or nearly parallel septa, extending about one-third of the length of the dorsal valve, forward from the beak, and one in the ventral valve, exactly as in *Pentamerus*, with which the form of the shell agrees also.

In form, and the size of the costæ, this shell presents much the appearance of the well known *Pentamerus Knightii* of SOWERBY, from which, however, it differs in the possession of a mesial sinus and fold, as well as in having its dorsal valve less ventricose. It also resembles *P. aratus* of CONRAD, but differs in having its mesial sinus in the dorsal valve instead of the ventral. It also differs in not having a smooth space, without costæ, on each side of the beaks. From *P. galeatus*, which presents very nearly the same form, and also has its mesial sinus in the dorsal valve, it will be readily distinguished by its much smaller and more sharply defined costæ.

Locality and position. Anderson river. Devonian, (Hamilton group.)

Genus ***Atrypa*** DALMAN, 1827.

Atrypa aspera SCHLOTHEIM, (sp.)

Pl. XIII, fig. 12.

Terebratula aspera SCHLOT., Petref. (1820), p. 263, t. xviii, fig. 3.

Atrypa aspera DALMAN, Vet. Akad. Handl. (1827), t. iv, fig. 3, etc.

Although none of the specimens of this species in the collection show the interior, I have scarcely a doubt in regard to their identity with the well known *A. aspera*, since they agree exactly in all their external characters, with the Hamilton group specimens from New York, and from various other localities, now before me, as well as with the figures and descriptions of European specimens. It seems to be quite common and well preserved at numerous localities in this distant northern country.

The specimen figured is from Lockhart river, lat. 67 deg. 15 min. N. Other specimens are from the "Ramparts," and Fort

Good Hope, on Mackenzie river, while a few examples of the same shell were found by the Rev. Mr. KIRBY, on Porcupine river, Russian America. Mr. MCFARLANE also found it on Anderson river, lat. 67 deg. N., long. 126 deg. W.

Atrypa reticularis LINN., (sp.)

Pl. XIII, fig. 13.

Anomia reticularis LINN., Syst. Nat., 12th Ed., I (1767), p. 1152.

Terebratulites priscus SCHLOT., Petref. I (1820), p. 262; II, p. 68, 69, t. xvii, f. 2; t. xx, f. 4.

Anomites reticularis WAHLENB., Act. Soc. Upsalensis, VIII (1821), p. 65.

Terebratula affinis SOWERBY, Min. Conch. IV (1823), p. 24, pl. cccxxix, fig. 2.

Atrypa reticularis DALMAN, Vet. Acad. Handl. (1827), p. 127, pl. iv, fig. 2, etc.

Of this widely distributed and well known type (including, as there is reason to think, several closely allied species), there are, in the collections under consideration, a number of well preserved specimens from distantly separated localities. Those figured on plate xiii, were collected by Mr. KENNICOTT, on Clear Water river, near its connection with Athabasca river, lat. 56 deg. 25 min. N., long. 111° W. Most of the specimens from this locality are large, and belong to the dilated variety (or species) so common in the Hamilton group of New York. Some of them are much larger, and even more extended laterally than that represented by figure 13 *a*, of pl. xiii, while others present the form represented by figure 13 *b*. Others of the same types were also found by Mr. MCFARLANE on Anderson river, lat. 67 deg. N., long. 125 deg. W. It is also common on Mackenzie river, at the "Ramparts," and near Fort Good Hope. Smaller specimens were likewise found by Mr. KENNICOTT, near Fort Resolution, on Great Slave lake.

Family SPIRIFERIDAE.

Genus ***Cyrtina*** DAVIDSON, 1858.

Cyrtina Billingsi MEEK.

Pl. XIV, fig. 6.

Shell of medium size; hinge line less than the greatest breath, and obtusely angular, or somewhat rounded at the extremities. Ventral

valve prominent at the umbo, from which it slopes abruptly, with a moderately convex outline, to the anterior and lateral margins; provided with a broad, very shallow, undefined mesial sinus in front; beak obtusely angular, and a little curved backwards; area triangular, somewhat longer on the hinge line than on either of angular lateral margins, slightly arched and inclined backwards over the hinge, and showing more or less distinct transverse marks of growth; foramen very narrow, or less than half as wide as high, closed below the middle by a moderately convex deltidium, which (in the specimen examined), is deeply emarginated above by a large oval aperture with beveled margins. Dorsal valve wider than long, truncato-subelliptical, much compressed or nearly flat, most convex between the middle and the umbo, which is compressed and scarcely distinct from the hinge margin; lateral margins flat, or a little concave; front very slightly raised by the shallow sinus of the opposite valve. Surface ornamented by about forty rounded and faintly defined radiating costæ on each valve, ten or eleven of which occupy the very shallow mesial sinus of the dorsal valve, and about the same number the corresponding slight prominence of the ventral valve. These costæ sometimes bifurcate, or increase by the intercalation of others, which die out before reaching the beaks, particularly on the middle portions of the valves. Faint traces of very fine crowded concentric striæ, and a few stronger lines of growth mark the valves in the opposite direction; while, with a good magnifier, minute granules may be seen on all parts of the surface. Exfoliated surfaces also show, under a magnifier, the minutely punctate structure characteristic of the genus.

Length from the front to the hinge, 0.40 inch; do. from front to point of beak of ventral valve, 0.60 inch; breadth, 0.60 inch. Length of hinge, 0.50 inch; convexity of the two valves, 0.33 inch, about four-fifths of which is occupied by the ventral valve alone.

I have not seen the interior of this species, but as it has the form and general aspect of a *Cyrtia*, or *Cyrtina*, and shows a punctate structure it doubtless belongs to the latter group. As near as can be determined, from a description alone, it would seem to present much the general appearance of *Cyrtina occidentalis* (*Cyrtia occidentalis* of SWALLOW, Trans. St. Louis Acad. Sci., Vol. I, p. 648), from the Hamilton group of Callaway county, Missouri, from which it differs in having plications on the mesial prominence. From *Cyrtina Missouriensis* (*Cyrtia Missouriensis* SWALLOW), which has plications on the mesial elevation, it differs in being much less angular at the extremities of the hinge, and in having much more numerous and smaller plications on each side of

the mesial elevation, which is less prominent and less defined. It will be at once distinguished from *Cyrtina hamiltonensis*, and all the nearly allied species by its much smaller and more numerous costæ, and less prominent and plicated mesial region.

Named in honor of Mr. E. BILLINGS, the able palæontologist of the Canadian Geological Survey.

Locality and position. Clear Water river, a tributary of Athabasca river. Devonian of the age of the Hamilton group.

Cyrtina hamiltonensis HALL.

Pl. XIV, fig. 10; also, figs. 5 and 7?

Cyrtia hamiltonensis HALL, Tenth Report Regents University, New York (1857), p. 126; BILLINGS, Devonian Fossils, Canada West (1861), p. 53, figures 80–82.

Compare *Cyrtina heteroclita*—*Cyrtia heteroclita* of authors.

The form here referred to the above-named Hamilton group species agrees so very closely in all its known characters with New York examples of that shell, that I can see no sufficient reason for regarding it as a distinct species. I know nothing of its internal characters, either from the Arctic specimens under investigation, or from New York examples, but from the general form of these shells, taken in connection with their distinctly punctate shell structure, there is little room for doubting the propriety of referring them to the genus *Cyrtina*.[5]

The specimen represented by figures 5 *a*, *b*, and 7 *a*, *b*, of the same plate, differs from that from which figure 10 was drawn, in having the mesial sinus and fold more angular in the middle, and the foramen unclosed by deltidium, and hence may possibly be a distinct species. As the deltidium, however, may have been broken out in detaching the specimen from the matrix, or otherwise removed, and New York

[5] *Cyrtia umbonata* HALL, Iowa Report, pl. v, fig. 2 *a*, *b*, *c*, has a punctate structure, and as may be seen by the figure of the interior, is a true *Cyrtina*. I have also ascertained that *Cyrtia acutirostris* Shumard, Mo. Report, Part 2nd, p. 204, pl. c, fig. 3 *a*, *b*, *c*, has the internal characters of *Cyrtina*. As *Cyrtia triquetra* HALL, Iowa Report, p. 513, also shows, under a magnifier, a distinctly punctate structure, it must likewise fall into the genus *Cyrtina*. Hence the names of these shells will have to be written *Cyrtina umbonata*, *Cyrtina acutirostris* and *Cyrtina triquetra*.

specimens of *C. hamiltonensis* vary in the roundness or angularity of the sinus and fold, I can with the material at hand for comparison, but regard this as a variety of the same species.

Locality and position. The form represented by figure 10 was collected by the Rev. W. W. KIRBY, on Porcupine river, Russian America, long. 140 deg. W., lat. 67 deg. N. The other example, from which figures 5 *a*, *b*, and 7 *a*, *b*, were drawn, was collected by Major KENNICOTT, at the "Ramparts," on Mackenzie river.

Cyrtina panda MEEK.

Pl. XIV, fig. 8.

Shell pyramidal, wider than long; hinge line less than the greatest breadth of the valves in adult examples; lateral extremities obtusely angular or somewhat rounded. Dorsal valve truncato-subelliptic, nearly flat, or but little convex; beak not prominent; mesial fold rounded, nearly flat, excepting at the front, where it is a little raised, occupying distinctly more than one-third the entire breadth of the valve at the anterior margin, but narrowing very abruptly to the beak. Ventral valve very convex; sides sloping abruptly from the beak to the front and lateral margin; beak high, not incurved, but sometimes twisted to one side; area large, well-defined, triangular, nearly flat, or slightly arched, and finely and regularly striated both ways; deltidium narrow, a little convex, and at the upper extremity perforated; mesial sinus very shallow and rounded, causing a slight projection into a corresponding recess in the margin of the other valve in front. Surface ornamented by 10 to 12 small, regular; simple radiating costæ on each side of the mesial sinus and fold, which latter are without costæ, but marked with very fine, obscure radiating striæ. Fine, obscure lines of growth also mark the entire surface concentrically, in well preserved specimens.

Length, 0.45 inch; breadth, 0.66 inch; convexity, 0.51 inch.

I was at first inclined to regard this as a mere variety of the *C. hamiltonensis*, supposing its smaller and more numerous costæ a difference of scarcely specific importance. On closer examination, however, by the aid of a magnifier, fine, regular radiating striæ (not represented in the figures), were observed on its mesial fold and sinus, a character I believe entirely unknown in that shell. It is possible that both this and the *C. hamiltonensis* may be identical with European forms sometimes referred to *C. heteroclita*, as it is manifest several species

have often been included under that name. As they seem to me, however, to differ specifically from the forms referred by Mr. DAVIDSON to *C. heteroclita*, we do not feel warranted in referring either of these forms to that species.

Locality and position. Onion river, long. 125 deg. W., lat. 67 deg. N.

Genus ***Spirifer*** SOWERBY, 1815.

Spirifer Kennicotti MEEK.

Pl. XIV, fig. 9.

Shell subsemicircular, rather compressed; valves nearly equally convex; length less than half the breadth; greatest breadth on the hinge line, which is extended apparently into a point at each extremity. Dorsal valve most convex near the middle, thence curving more rapidly to the beak than to the front; sides sloping very gradually and becoming rather flattened near the extremities; beak somewhat compressed, scarcely projecting beyond the hinge line, and with the linear area a little incurved; mesial fold narrow and scarcely distinct from the general convexity of the central region, excepting near the front. Ventral valve very slightly less convex than the other, most prominent between the middle and the beak; lateral slopes a little less flattened than in the dorsal valve; mesial sinus narrow, rather shallow, with rounded margins, continued nearly to the beak, from which it widens and deepens very gradually to the anterior margin, where it produces a moderately distinct, narrow emargination; beak a little incurved and more prominent than that of the other valve, but not produced much beyond the margin of its own area, which is narrow, with nearly parallel margins, and inclined, with a slight curve, back over the hinge; foramen presenting nearly the form of an equilateral triangle. Surface with about twenty-six to thirty simple, regular, well-defined, radiating costæ, on each side of the mesial fold and sinus, separated by depressions of their own breadth. The mesial sinus and depression are also each occupied by six or seven more or less bifurcating costæ. By the aid of a good magnifier, faint traces of numerous minute, closely arranged concentric striæ and granules are also seen on all parts of the surface.

Length, 0.64 inch; breadth, 1.45 inches; convexity, 0.38 inch; height of area in ventral valve, 0.10 inch.

This shell is rather closely allied to *S. acanthotus* HALL from the New York Chemung group. On comparison with good specimens of that species from New York, however, I find it presents the following well-marked differences. In the first place, its mesial fold and sinus are much narrower in

front, while the former is more prominent, less flattened, and not so well defined by the greater depth of the marginal furrow on each side, and the latter has rounded, instead of angular margins. Again, our shell shows only six or seven of the small costæ occupying the mesial fold and sinus at the front, while double that number may be counted upon the fold, or in the sinus of *S. acanthotus*. In addition to these differences, the species under consideration is longer in proportion to its transverse diameter, and has the costæ near each lateral extremity directed much less obliquely outwards, and the pointed extremities less compressed, and more abruptly separated from the outline of the lateral margins than in *S. acanthotus*.

Named in honor of Maj. ROBERT KENNICOTT, its discoverer.

Locality. Liard's river, lat. 60 deg. 15 min. N., long. 123 deg. W. It was found loose, but most probably belongs to rocks of about the age of the Hamilton group in the immediate neighborhood.

Spirifer compactus MEEK.

Pl. XIV, fig. 11.

Shell subglobose, a little wider than long; greatest transverse diameter usually at some point between the middle and the cardinal margin; hinge line equaling about two-thirds the greatest breadth of the valves; lateral margins scarcely ever even obtusely angular at their connections with the hinge, but rounding regularly into the front, which is sometimes very faintly sinuous at the termination of the mesial fold. Dorsal valve rather gibbous, but a little less so than the ventral; mesial fold rounded, depressed or moderately prominent, and without costæ; beak projecting a little beyond the hinge line, and rather distinctly incurved over its narrow cardinal area. Ventral valve most gibbous in the umbonal region; beak prominent and distinctly incurved; mesial sinus moderate, extending to the beak, rounded or very faintly subangular, widening gradually forward without very distinctly defined margins to the front, where it terminates in a semicircular projection, filling a corresponding recess in the margin of the other valve; area moderately high and arching with the beak, rather well defined, but without angular margins, and marked by distinct transverse striæ, crossed by very minute vertical lines; foramen presenting nearly the form of an equilateral triangle, or rather higher than wide. Surface with about nine to ten simple, rounded, rather depressed costæ on each side of the mesial fold and sinus, and numerous fine, very regularly arranged, equal, crowded

concentric striæ, which are regularly arched in crossing the ribs. Under a good magnifier, on protected portions of well preserved specimens, traces of extremely small radiating striæ, apparently produced by regularly disposed granules, may also be seen.

Length of a medium sized specimen, 0.90 inch; breadth, 0.96 inch; convexity, 0.70 inch; breadth of mesial fold and sinus of the front, 0.35 inch. Some specimens are proportionally more gibbous.

This is a neat, rather robust shell, and may be regarded as a representative of *S. fimbriatus* CONRAD, (sp.) Its much more gibbous form, shorter hinge, and smaller, as well as more numerous and more distinctly defined costæ, however, will readily distinguish it from that species. Its concentric markings also differ in being all uniform, closely arranged striæ, without imbricating lamellæ. *S. corticosus* HALL (judging from a description only), seems to be a somewhat analogous shell, but differs in having a longer hinge line and a narrow cardinal area. Our shell, however, is evidently more nearly allied to *S. undiferus* ROEMER, than to any of the American forms mentioned above. Indeed, after comparison with Mr. DAVIDSON'S excellent figures of that variable species, it is with some hesitation that I have concluded to regard the Arctic form as a new species. I am led to do so, however, from the following differences. In the first place, our shell never has the mesial fold flattened along the middle as we most generally see in *S. undiferus*, while it shows no traces of obscure costæ on the sides of the mesial sinus. Again, its concentric striæ are much finer and more crowded than those of *S. undiferus*, and differ in showing, under a magnifier, microscopic crenulations apparently produced by very minute radiating markings.

Locality. Lockhart river, lat. 67 deg. 65 min. N., long. 126 deg. W. Collected by R. W. MCFARLANE.

Subgenus ***Martinia*** McCOY, 1844.

Spirifer* (*Martinia*) *sublineatus MEEK.

Pl. XIV, fig. 1.

Shell small, subcircular, or truncato-orbicular, moderately convex in adult specimens; lateral margins rounding gradually into the more or less regularly rounded front, and more abruptly into the short hinge; cardinal

margin considerably shorter than the greatest breadth of the valves. Dorsal valve subsemicircular, rather compressed and without any traces of a mesial fold; beak small, projecting little beyond the cardinal margin; area small. Ventral valve twice or three times as convex as the other, and without a mesial sinus; area triangular, moderately high, not very sharply defined; foramen triangular, higher than wide, unclosed in all the specimens examined. Surface very nearly smooth, but showing, under a magnifier, faint traces of very fine concentric striæ, and obscure indications of radiating lines. Internal casts of the ventral valve with a faint furrow extending along the middle, on each side of which there is a shallow, flat impression, extending from the umbonal region to each antero-lateral margin.

Breadth of a large individual, 0.62 inch; length, 0.60 inch; convexity, 0.34 inch.

This little shell has the general aspect of young or dwarfed examples of *S. lineatus* MARTIN (sp.), from which it differs in always being without the regular imbricating concentric markings of that species; while it is in all cases without any traces of a mesial fold or sinus. It is also less convex and more inequivalve than *S. lineatus*, and the flattened furrows on internal casts left by corresponding ridges on the interior of the ventral valve, is a feature not mentioned in descriptions or represented by figures, of that species.

It is probably more closely allied to *S. glans-cerasus*, of WHITE, described from rocks of the age of the Hamilton group at Iowa City, Iowa. From the fact, however, that Dr. WHITE'S species is described as being very small and globose, even more globose than the common coal measure form of the west usually referred to *S. lineatus*, I infer that our shell is larger and much less convex; it also always wants the faint mesial sinus, and consequent slight emargination of the front, mentioned in the description of *S. glans-cerasus*.

Locality. Common in the dark bituminous limestone, near Fort Resolution, on the south side of Great Slave lake.

Spirifer* (*Martinia*) *Richardsoni MEEK.

Pl. XIV, fig. 2.

Shell small, wider than long, rather gibbous; hinge line about as long as half the transverse diameter of the valves; lateral margins rounding

somewhat abruptly into the hinge margin, and converging with a slightly convex outline to the front, which is a little truncated, or very faintly sinuous in the middle. Ventral valve about one-third more convex than the other, provided in front with a shallow, subangular, undefined mesial sinus, which dies out before reaching the middle of the valve; beak rather pointed, moderately prominent, and incurved but not projecting more than one-eighth the entire length of the shell beyond that of the other valve, from which it stands a little remote; area broadly triangular, not distinctly defined, arcuate; foramen triangular, unclosed, higher than wide. Dorsal valve moderately convex, and without a mesial fold even at the immediate front; beak small, projecting little beyond the hinge, and not distinctly incurved, provided with a narrow area. Surface (of internal cast) showing faint indications of eighteen to twenty remote linear, radiating ridges on each valve, so indistinct as to leave doubts whether or not they were connected with external costæ.

Length, 0.55 inch; breadth, 0.65 inch; convexity, 0.44 inch.

This species is allied to the last, but differs in being proportionally wider, and although the umbo of its ventral valve is more gibbous, it projects porportionally less beyond that of the opposite valve, from which it is more distant. It also differs in having the anterior margin of the ventral valve provided with a shallow sinus, which imparts a faintly sinuous outline to the front. A more important difference, however, is the indication on the internal cast, of obscure costæ; while the cast of the cavity of the beak of the ventral valve in *S. sublineatus* and its other internal markings, are entirely different.

As near as can be determined from a description alone, without a figure, measurements, or other means of knowing whether that is a very small, or a very large shell, this species would seem to be related to *S. dubius* of HALL. It differs however, from the proportions of that species in being wider than long, instead of longer than wide, or with length and breadth equal, while the beak of its ventral valve projects much less beyond that of the opposite valve, and its dorsal valve is without a mesial fold.

Named in honor of the distinguished Arctic explorer and naturalist, Sir JOHN RICHARDSON.

Locality. Fort Good Hope, on Mackenzie river, lat. 66 deg. N., long. 128 deg. W.

Spirifer (*Martinia*) *meristoides* Meek.

Pl. XIV, fig. 3.

Shell varying from longitudinally suboval to suborbicular, being sometimes longer than wide, and in other examples slightly wider than long, generally rather ventricose in adult specimens; hinge line very short and passing so gradually into the regularly rounded lateral margins as scarcely to appear straight at all; front narrowly, or more or less regularly rounded. Dorsal valve convex, but less so than the other, without a trace of a mesial fold, though the immediate margin at the middle of the front is very slightly raised to give room for an obscure projection of that of the other valve; beak small, but slightly prominent and incurved; area very narrow and curved. Ventral valve gibbous, sometimes rather strongly so, without a mesial sinus; beak prominent, incurved, in ventricose specimens sometimes almost folded down upon the other so as to close and hide the foramen; area very small and obscure, often nearly obsolete; foramen triangular, rather higher than wide, and not closed by a pseudo-deltidium. Surface marked by fine, rather obscure concentric striæ, with a few rather strong concentric ridges of growth, usually passing over the middle of the ventral valve, and between that and the front. Internal cast showing distinct radiating markings. Internal spires rather large, and consisting (in a small specimen) of about six turns. Socket plates of dorsal valve thin, prominent, approximate, and but slightly diverging forward.

Length of a mature specimen, 0.73 inch; breadth of do., 0.65 inch; convexity, 0.47 inch.

This is so remarkable a form, that it was some time before I could come to any conclusion respecting its generic relations. Its longitudinally oval form, extremely short hinge line, passing gradually into the rounded lateral margins, together with the rudimentary condition of its area, gives it much the appearance of a *Merista*. This deceptive appearance is also increased by the beak of the ventral valve being sometimes so closely curved down upon that of the other valve as to completely hide the triangular foramen and obscure area. This latter character, however, it is easy to see, is due to the shell taking, as it were, a second growth after it had attained about half its usual size. In most of the specimens, the growth seems to have been very gradual and regular until they attained a diameter of about 0.50 inch, at which time there seems to have been a period of rest, and the shell was then wider than long, having much the aspect of a form in

our western coal measures, described by Dr. SHUMARD, under the name of *Spirifer plano-convexus*. After this there was a period of rapid, more irregular growth, mainly of the anterior and antero-lateral margins, more particularly of the ventral valve, which changes the form of the whole shell to a longitudinally oval outline, and as it were, spreads open the valves, so as to bring the beak of the ventral valve down upon that of the other.

If the name *Ambocoelia* should be retained, the name of this species would become *Spirifer* (*Ambocoelia*) *meristoides*, since, notwithstanding its extremely short hinge, and obscure cardinal area, it has the peculiar socket plates, and muscular scars of the type of that proposed group. It is very doubtful, however, whether any well defined line of demarkation can be drawn between that type and the group of smooth Spirifers for which McCOY proposed the name *Martinia*.

Locality. Anderson and Lockhart rivers, lat. 67 deg. 15 min. N., long. 126 deg. W.

Spirifer (*Martinia*) *Franklinii* MEEK.

Pl. XIV, fig. 12.

Shell rather large, orbicular, subquadrate in outline, moderately gibbous; hinge equaling about three-fourths the greatest breadth, and rounded at the extremities. Dorsal valve moderately convex, (the most prominent part being in the central and umbonal regions), provided near the front with a low, undefined mesial prominence which scarcely reaches the middle, and is marked by a shallow longitudinal depression; beak extending little beyond the hinge and rather distinctly incurved; area narrow and not extended to the extremities of the hinge, and distinctly arched. Ventral valve more gibbous than the other, its most prominent part being between the middle and the beak, which is produced beyond that of the other valve, and distinctly incurved; mesial sinus very narrow, shallow, and extended nearly to the beak, forming a short semicircular projection in front, fitting into a corresponding sinuosity in the front of the opposite valve; area moderate, continued to the extremities of the hinge; finely striated both ways, and distinctly arched and inclined back over the cardinal line—its lateral margins at first sloping from the beak, then extending out parallel to the hinge margin for a short distance, after which they again slope to the extremities of the hinge; foramen broad at the base and narrowing rapidly to the beak, closed for half the distance down by a rather convex pseudo-deltidium,

which is arched on the lower margin. Surface apparently nearly smooth, excepting a few small marks of growth, but showing, under a magnifier, very fine, obscure, closely arranged concentric striæ, with some appearance of minute radiating striæ.

Length from front to beak of dorsal valve, 1.47 inches; do. to beak of ventral valve, 1.80 inches; greatest breadth, 1.94 inches; convexity of the two valves, 1.24 inches; length of hinge, 1.54 inches.

This species closely resembles some varieties of the well known *Spirifer glaber*, which is said to occur both in the Devonian and Carboniferous rocks. It differs, however, from all Mr. DAVIDSON'S beautiful figures of the various forms assumed by that species in having the lateral margins of the area of the ventral valve extended part of the way out parallel to the hinge margins, instead of sloping regularly from the beak to the extremities of the hinge. This character, however, is not very well represented in our engraving.

It seems also to be related to *S. laevis* HALL, from the Portage group of New York (Geol. 4th Dist. N. Y., p. 245, fig. 1); but differs in the peculiarity of the area already pointed out, as well as in having a much broader foramen, and a much less deeply impressed mesial sinus, particularly at the front margin, while it shows no traces of the few strong folds said sometimes to mark the margin of that shell.

Locality. Mackenzie river, forty miles below the "Ramparts."

Genus *Rensselaeria* HALL, 1859.

Rensselaeria laevis MEEK.

Pl. XIII, fig. 8, and pl. XIV, fig. 4.

Shell rather above medium size, longitudinally ovate or subelliptic in outline, moderately convex in young examples, and very gibbous in adult specimens; front generally rather narrowly rounded; lateral margins forming broad semiovate or semielliptical curves, not inflected. Dorsal valve a little less convex than the other: beak incurved. Ventral valve most convex somewhat behind the middle; beak small, moderately prominent, and closely curved over that of the opposite valve; foramen small. Surface smooth, with a few very obscure traces of ridges of growth. Some of the specimens also show, under a magnifier, very faint indications of radiating striæ, but it is not clear that they are surface markings.

Length of a medium sized adult specimen, 1.77 inches; breadth, 1.13 inches; convexity about 1.10 inches. Smaller specimens proportionally less convex.

This shell is so similar in its external characters to *Pentamerus elongatus* of VANUXEM (*Stricklandinia elongata* BILLINGS, *Rensselaeria elongata* HALL), that I should have been left in some doubt in regard to the propriety of considering it distinct, were it not for the fact that Mr. BILLINGS has shown VANUXEM's species to possess the internal characters of his genus *Stricklandinia*, while casts of the interior of the shell under consideration show no traces of the triangular chamber within the beak of the ventral valve as observed in that genus. On the contrary, so far as can be determined from these casts, this arctic species seems to agree with the genus *Rensselaeria*. It differs from the known species of *Rensselaeria*, nearly resembling it in form, such as *R. ovoides*, *R. marylandica*, etc., in its smoother surface, and in never having the lateral margins inflected.

The sections examined by transmitted light, under a high magnifying power, show the shell structure in our species to be finely punctate, the punctures being small and scattering, but regularly disposed.

Locality and position. Onion river, lat. 67 deg. N., long. 124 deg. W., and forty miles below Good Hope, Mackenzie river, lat. 65 deg. 50 min. N., long. 130 W.; also Lockhart river, lat. 67 deg. 15 min. N., long. 126 deg. W. The specimens are all casts, in a hard, gray dolomitic rock, breaking with a rough, irregular fracture, and presenting a harsh granular appearance, that might at a glance, cause it to be mistaken for a sandstone, or at any rate for a silicious rock. As this differs from the matrix of the other fossils from the same locality, I suspect this species to belong to a different rock, possibly older than the Hamilton group. It seems to be abundant at both localities, and is the only recognizable fossil in the masses collected.

GASTEROPODA.

Family PLEUROTOMARIIDAE.

Genus *Pleurotomaria* DEFRANCE, 1826.

Pleurotomaria ————?

Pl. XV, fig. 3.

The only gasteropod in the collections under investigation, is merely an internal cast, with fragments of the shell adhering. It is a depressed form, apparently of *Pleurotomaria*, though I have not been able to see well-defined traces of a spiral band on the cast, which seems to be round, and without any revolving angles or ridges on the periphery or above or below it. The umbilicus was moderately large, and a remaining portion of the shell shows traces of regular oblique lines of growth on the upper side of the body whorl.

Of course it would be improper to attempt to establish a new species upon a single specimen in such a state of preservation. The figures represent two views, natural size.

Locality. Clear Water river, near Athabasca river, lat. 56 deg. 25 min. N., long. 111 deg. W. from Greenwich.

CEPHALOPODA.

Family NAUTILIDAE.

Genus *Gyroceras* KONINCK, 1844.

Gyroceras Logani MEEK.

Shell curved so as to form apparently one entire volution or more, around a free space nearly or quite equaling the dorso-ventral diameter at the larger extremity, increasing so as to about double its diameter in half a volution. Dorsal and ventral sides[6] very broadly rounded, the latter being slightly more compressed than the former; lateral margins narrowly rounded. Section transversely elliptical, the ventro-dorsal diameter being to the transverse as five to seven or eight. Septa deeply and regularly concave, separated by spaces on the dorsal side, about equal to one-eighth the transverse diameter, and on the ventral by spaces equaling only one-eleventh the diameter from the ventral to the dorsal

[6] I use these terms here with relation to the shell only, and not as applied to the animal.

side. Siphon equaling the space separating the septa on the ventral side opposite the point of measurement, and located rather less than half its own diameter within the dorsal side.

Surface (of internal cast) ornamented with obtuse undefined ridges, which originate on the middle of the narrowly rounded sides and extend outwards, but apparently without crossing the dorsum, on each side of which they curve more or less backwards. Between each two of these ridges, immediately on each side of the middle, a small, somewhat elevated, subnodose prominence is seen ranging obliquely outwards and forward. The principal ridges are arranged at intervals of about one to every four or five septa, there being six or seven of them to half of one volution. Finer surface markings, if any existed, unknown.

Greatest diameter of an imperfect specimen measuring seven inches in length around the outer side of the curve, and consisting entirely of the septate part of the shell, 3.83 inches; diameter of the free space within the curve, 1.50 inches. Ventro-dorsal diameter at the larger end, 1.54 inches; transverse diameter of same, 2.30 inches; ventro-dorsal diameter at the smaller end (which is imperfect), 0.80 inch; transverse diameter of do., 1 inch.

The specific name is given in honor of Sir WILLIAM LOGAN, the distinguished director of the Canadian Geological Survey.

Locality. Forty miles below Fort Good Hope, on Mackenzie river, lat. 65 deg. 30 min. N., long. 130 deg. W.

Explanation of the Plates.

Plate XI.

Fig. 1. ***Zaphrentis recta:*** — side view; *a*, view of the calice; *b*, longitudinal section to show the internal structure; *c*, transverse section.

Fig. 2. ***Zaphrentis McFarlanei:*** — side view, looking obliquely into the calice; *a*, longitudinal section; *b*, view of calice.

Fig. 3. ***Aulophyllum? Richardsoni:*** — side view of a specimen a little flattened by pressure, looking obliquely into the calice; *a*, longitudinal section.

Fig. 4. ***Combophyllum multiradiatum:*** — view of upper side, showing the very shallow calice and septal fossette; *a*, side view.

Fig. 5. ***Palaeocyclus Kirbyi:*** — view of under side, showing concentrically wrinkled epitheca; *a*, side view; *b*, view of upper side, showing the very shallow calice and septa.

Fig. 6. ***Cysteophyllum americanum*** var. ***arcticum:***—side view of a somewhat worn specimen; *a*, longitudinal section of same; *b*, transverse section of same.

Fig. 7. ***Smithia Verrilli:***—side view showing the inferior surface protected by the wrinkled epitheca, and the summit with its calices; *a*, upper view of same; *b*, polished transverse section, enlarged about two diameters, to show the confluent septal radii and extremely thin dissepiments.

Fig. 8. ***Cyathophyllum arcticum:***—view of upper side, showing the calices; *a*, a longitudinal section of one of the corallites enlarged so as to show the internal structure, calice, septa, etc.; *b*, a transverse section of one of the corallites a little enlarged.

Fig. 9. ***Alveolites vallorum:***—a fragment showing two sides ground off, and the upper surface with the calices, natural size: *a*, calices enlarged.

Fig. 10. ***Favosites polymorpha:***—a fragment of a bifurcating branch, showing the calices, rounded from the thickening of the walls between; *a*, a transverse section of one of the branches, natural size, showing the more angular character of the cells within.

Plate XII.

Fig. 1. ***Orthis McFarlanei:***—*a*, cardinal view of a small specimen apparently of this species, from Lockhart river; *b*, enlargement of surface striæ of same; *c*, front view of a typical specimen, which is mainly an internal cast, from Fort Good Hope; *d*, ventral view of an internal cast of a smaller individual; *e*, ventral view of the typical specimen; *f*, cardinal view of same; *g*, dorsal view of same.

Fig. 2. ***Orthis iowensis?***—*a*, dorsal view of an internal cast; *b*, ventral view of an internal cast with some portions of the shell remaining; *c*, front view of a larger individual; *d*, side view of same; *e*, cardinal view of a still larger specimen; *f*, dorsal view of same; *g*, ventral view of the same; *h*, front view of a small individual with only a very shallow mesial sinus.

Plate XIII.

Fig. 1. ***Lingula minuta:***—enlarged five diameters.

Fig. 2. ***Chonetes pusilla?***—*a*, ventral view, natural size; *b*, section through the two valves to show their curve and convexity; *c*, enlargement of surface striæ; *d*, ventral view enlarged.

Fig. 3. ***Productus dissimilis?***—*a*, view of ventral valve; *b*, outline profile view; *c*, view of dorsal valve.

Fig. 4. ***Productus,*** (sp. undt.) — *a*, ventral valve; *b*, outline profile; *c*, surface striæ of ventral valve; *d*, dorsal valve (radiating lines represented too distinct).

Fig. 5. ***Productus,*** (sp. undt.) — *a*, ventral view (costæ too coarse and continuous); *b*, side view of same.

Fig. 6. ***Strophomena*** (***Strophodonta***) ***demissa:*** — *a*, dorsal view, showing also the cardinal area; *b*, outline profile view of same specimen; *c*, ventral view of same.

Fig. 7. ***Strophomena*** (***Strophodonta***) ***subdemissa:*** — *a*, dorsal view, showing also the area; *b*, ventral view; *c*, outline side view.

Fig. 8. ***Rensselaeria laevis:*** — *a*, ventral view of a medium sized specimen; *b*, dorsal view of a smaller individual; *c*, front view of same; *d*, ventral view of same; *e*, side view of same.

Fig. 9. ***Rhynchonella castanea:*** — *a*, ventral view; *b*, front view; *c*, side view.

Fig. 10. ***Rhynchonella,*** (sp. undt.) — *a*, dorsal view; *b*, front view.

Fig. 11. ***Pentamerus borealis:*** — *a*, dorsal view; *b*, ventral view; *c*, side view.

Fig. 12. ***Atrypa aspera:*** — ventral view.

Fig. 13. ***Atrypa reticularis:*** — *a*, ventral view of a dilated variety; *b*, ventral view of another specimen with a more rounded cardinal outline.

Plate XIV.

Fig. 1. ***Spirifer*** (***Martinia***) ***sublineatus:*** — *a*, profile view of a small specimen; *b*, dorsal view of same; *c*, internal cast of a larger individual (ventral valve).

Fig. 2. ***Spirifer*** (***Martinia***) ***Richardsoni:*** — *a*, view of ventral valve (mainly an internal cast); *b*, dorsal view of same; *c*, cardinal view of same.

Fig. 3. ***Spirifer*** (***Martinia***) ***meristoides:*** — *a*, dorsal view; *b*, ventral view; *c*, side view: *d*, front view; *e*, side view of a shorter individual; *f*, internal cast, dorsal view; *g*, internal cast, ventral view; *h*, section of a small specimen, showing internal spires.

Fig. 4. ***Rensselaeria laevis:*** — an internal cast of a ventral valve.

Figs. 5 and 7. ***Cyrtina hamiltonensis?*** — *a*, cardinal view; *b*, side view of same. 7 — *a*, view of ventral valve of same; *b*, dorsal view of same.

Fig. 6. ***Cyrtina Billingsi:*** — *a*, lateral view; *b*, dorsal view; *c*, cardinal view; *d*, ventral view.

Fig. 8. ***Cyrtina panda:***—*a*, dorsal view; *b*, cardinal view; *c*, ventral view; *d*, lateral view.

Fig. 9. ***Spirifer Kennicotti:***—*a*, ventral view; *b*, dorsal view; *c*, lateral view.

Fig. 10. ***Cyrtina hamiltonensis:***—*a*, cardinal view; *b*, dorsal view.

Fig. 11. ***Spirifer compactus:***—*a*, ventral view; *b*, lateral view; *c*, front view; *d*, dorsal view.

Fig. 12. ***Spirifer (Martinia) Franklini:***—*a*, ventral view; *b*, lateral view; *c*, front view; *d*, dorsal view.

Plate XV.

Fig. 1. [1] ***Proetus ————?***

Fig. 2. ***Gyroceras Logani:***—*a*, profile view of an imperfect specimen; *b*, view of the concave side of same; *c*, view of the convex side of same.

Fig. 3. ***Pleurotomaria,*** (sp. undt.)—*a*, profile view; *b*, view of upper side.

Fig. 4. ***Rhynchonella,*** (sp. undt.)—view of an internal cast of the dorsal valve.

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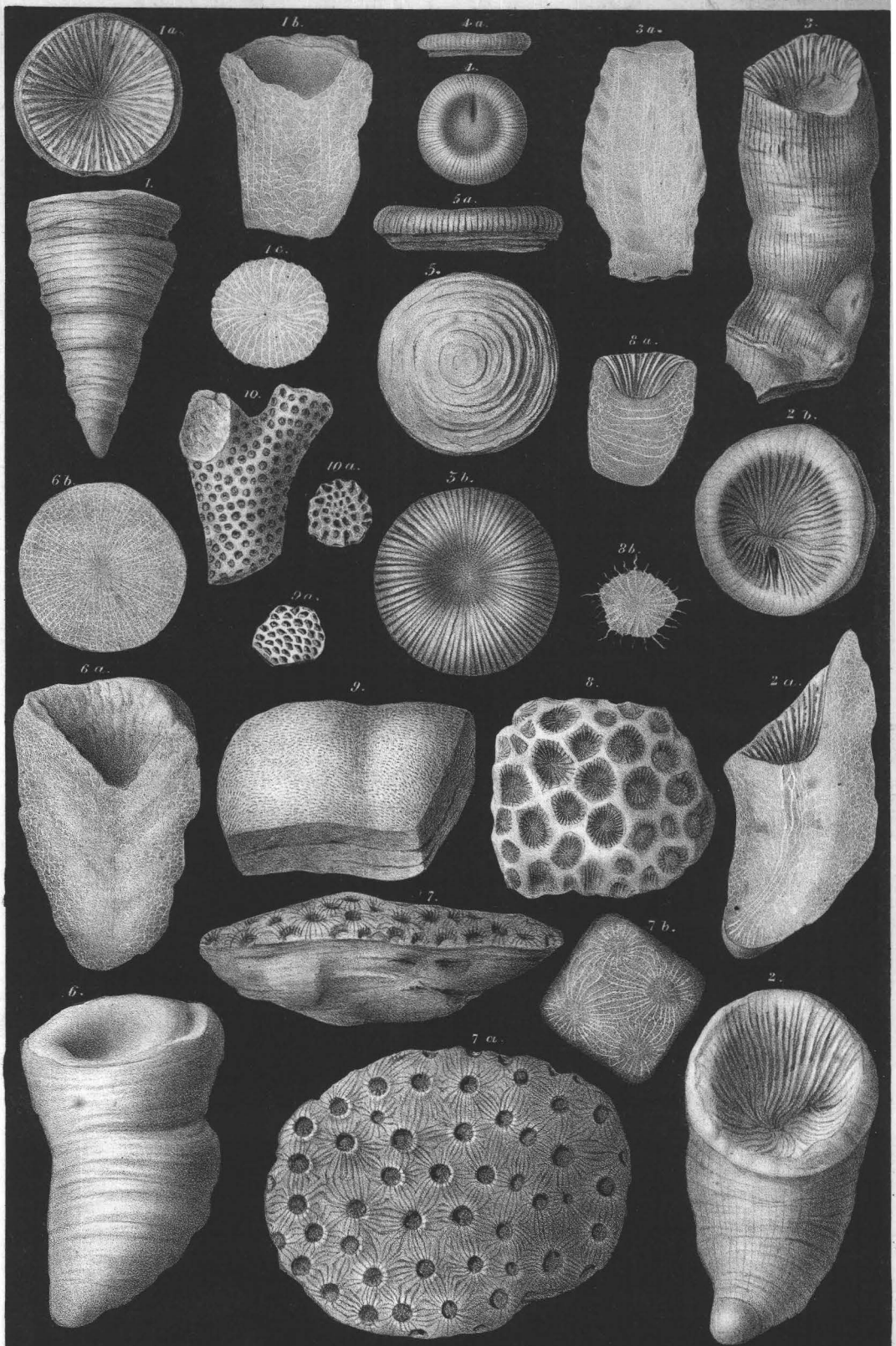
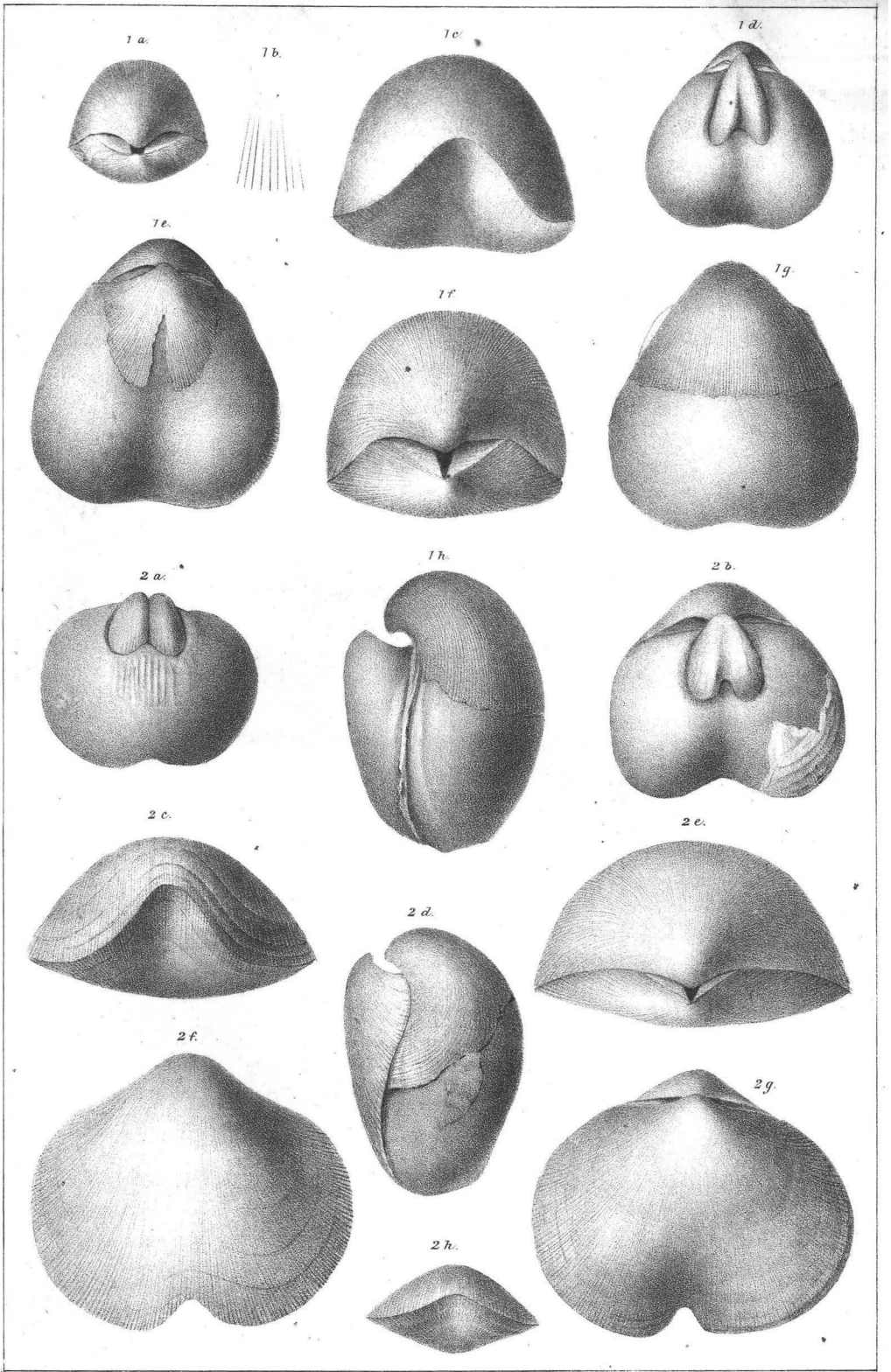
[1] The only specimen of this species contained in the collection was lost during the fire at the Smithsonian Institution; consequently I have not been able to determine whether or not it is identical with any of the known species, and have not attempted to describe it.



F.B Meek, del.

T. Sinclair's lith, Phil^a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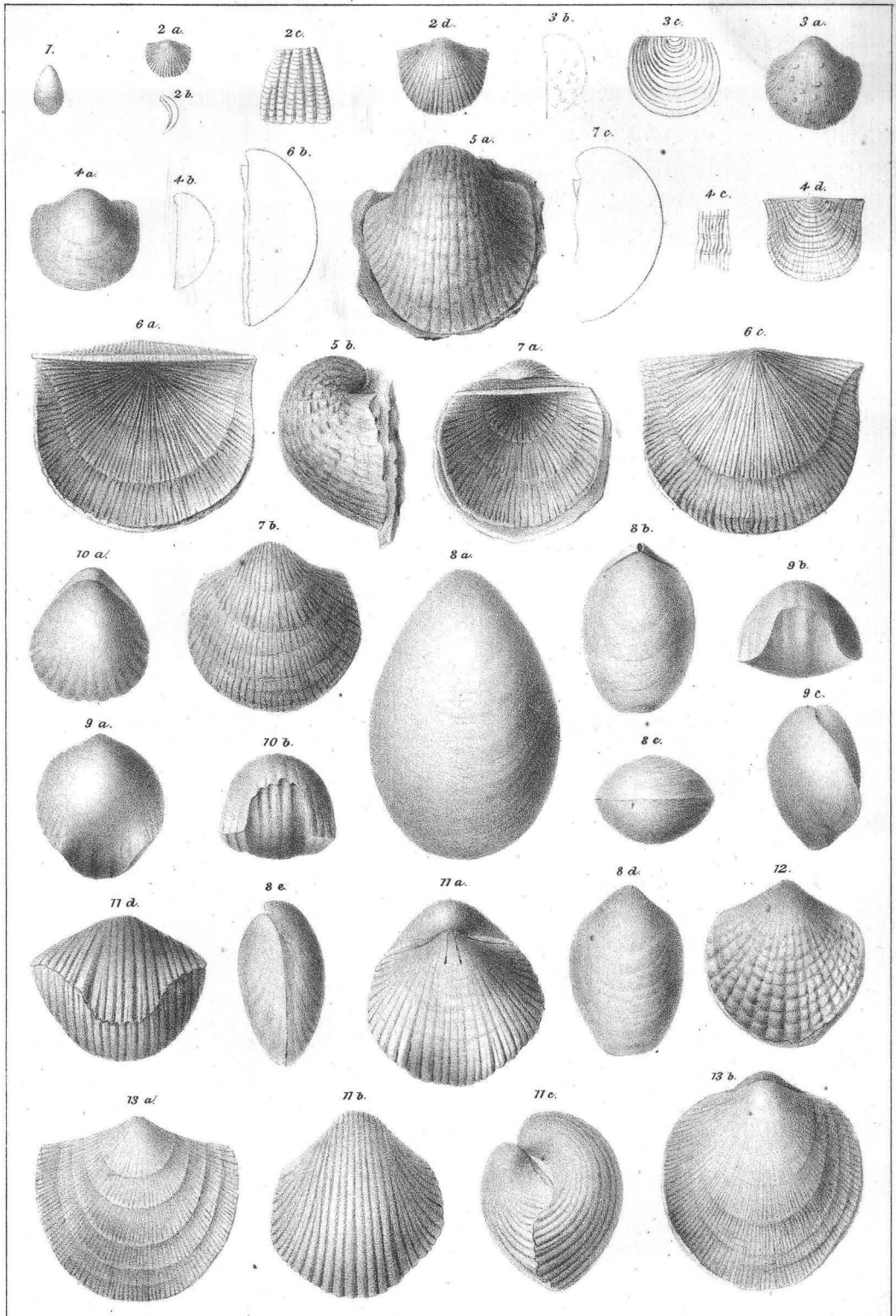
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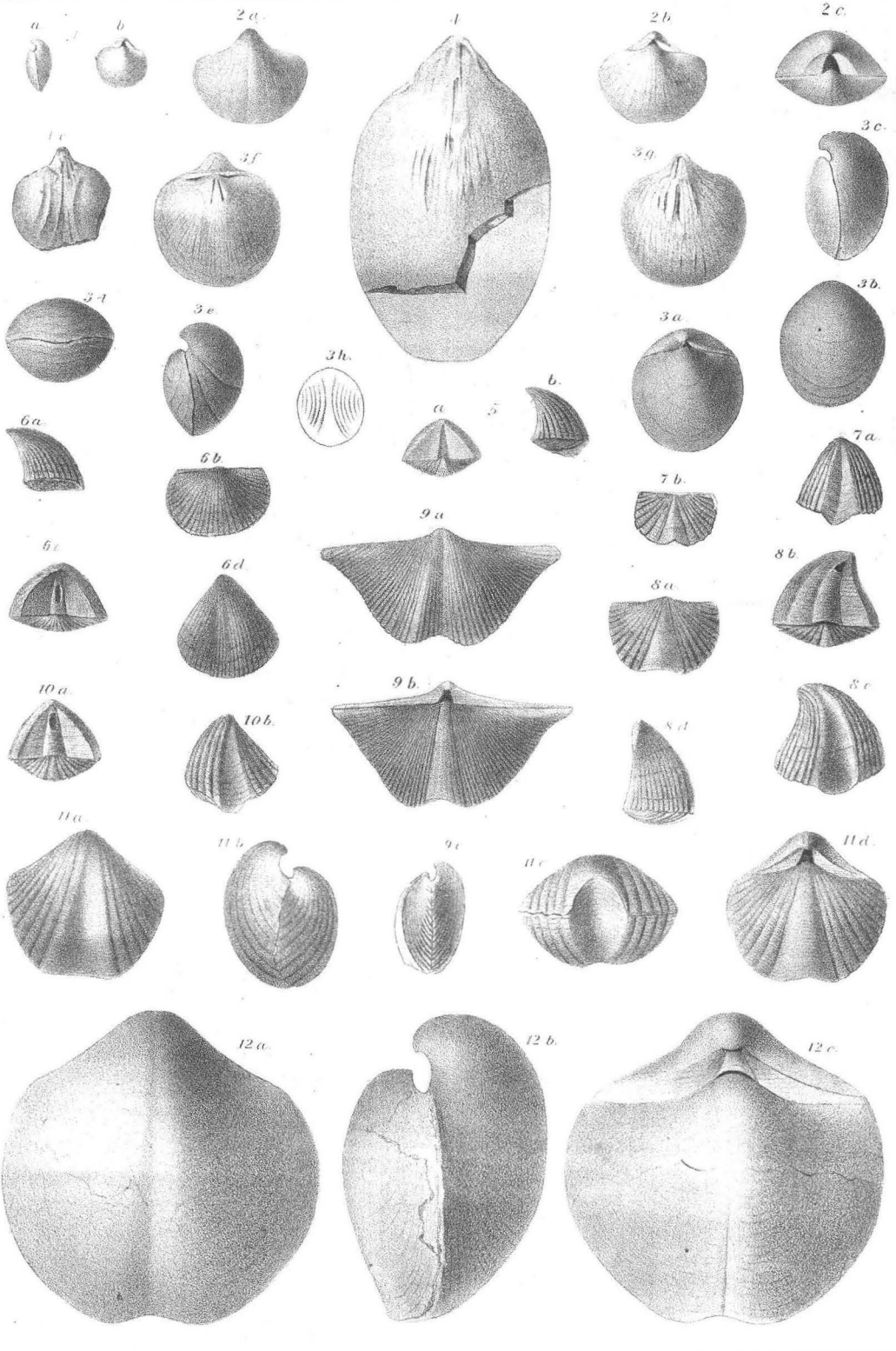

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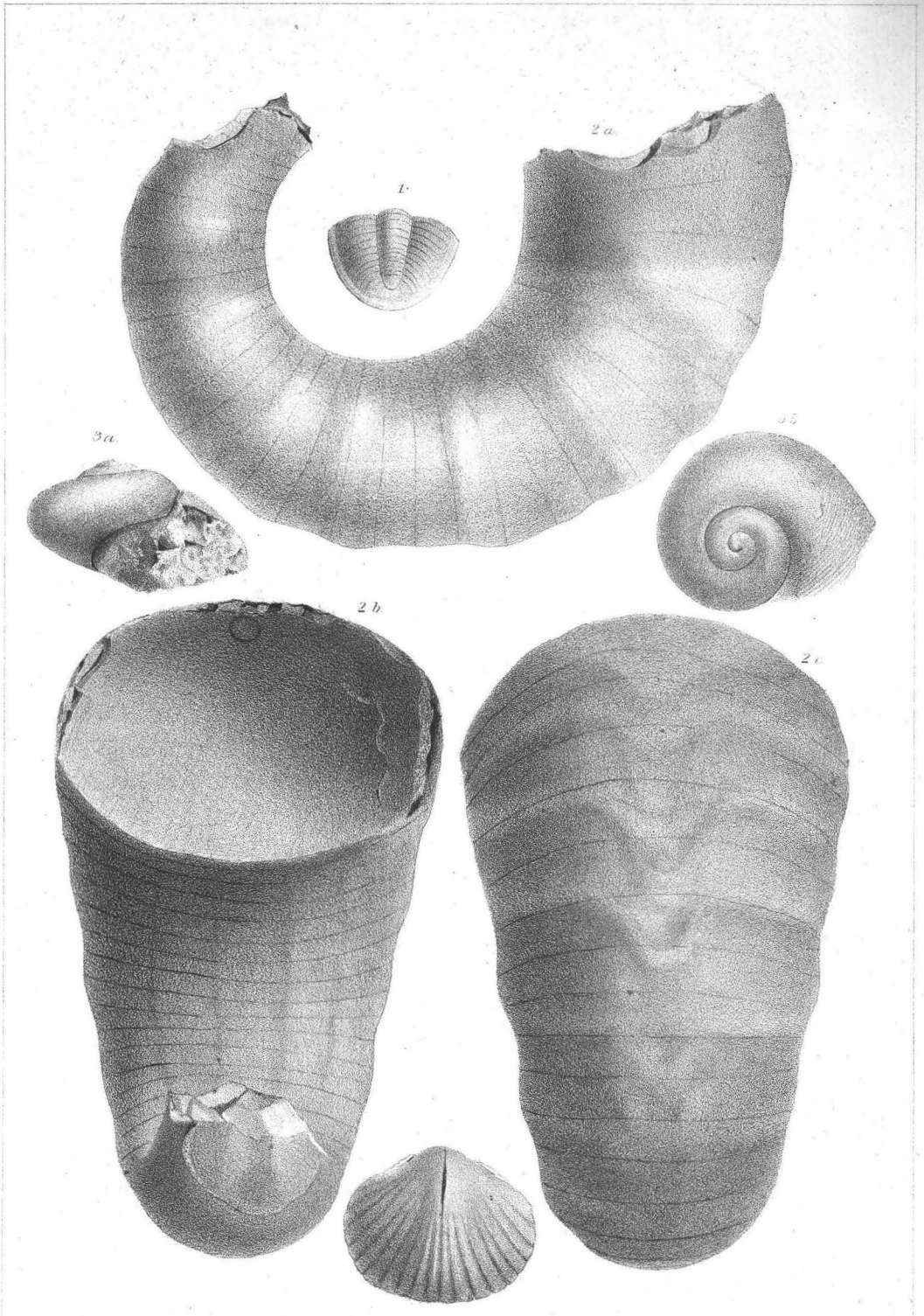

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