GEOLOGICAL
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DEPARTMENT OF MINES
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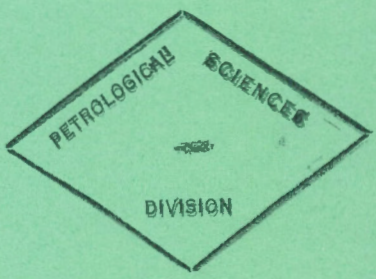
BULLETIN 65



A LATE SILURIAN FAUNA FROM THE SUTHERLAND RIVER FORMATION, DEVON ISLAND, CANADIAN ARCTIC ARCHIPELAGO

Arthur J. Boucot, and others

Price, $1.25

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A LATE SILURIAN FAUNA FROM THE SUTHERLAND RIVER FORMATION, DEVON ISLAND, CANADIAN ARCTIC ARCHIPELAGO

By

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DEPARTMENT OF
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PREFACE

The fossils that are the subject of this Bulletin were collected from the Sutherland River formation by R. Thorsteinsson in 1955 when on a helicopter survey in the Canadian Arctic Archipelago led by Y. O. Fortier. The formation lies within a thick conformable succession of Ordovician, Silurian, and Devonian sediments. Preliminary examination of the fauna failed to establish whether it was of Silurian or Devonian age; further examination by a group of specialists showed that it was late Silurian and this Bulletin comprises their individual reports, together with illustrations of the fauna.

J. M. Harrison,
Director, Geological Survey of Canada

OTTAWA, December 15, 1959

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Illustrations

A LATE SILURIAN FAUNA FROM THE SUTHERLAND RIVER FORMATION, DEVON ISLAND, CANADIAN ARCTIC ARCHIPELAGO

Abstract

A silicified fauna from the Sutherland River formation, Devon Island, Canadian Arctic Archipelago, found in the course of a helicopter survey by the Geological Survey of Canada, is of considerable interest because (1) its age places it near the Siluro-Devonian boundary and (2) it comes from the large Arctic region where palæontologic data are still meagre. The fauna includes brachiopods, ostracods, conodonts, scolecodonts, trilobites, gastropods, and a fish plate, descriptions of which are provided. The age of the fauna is concluded to be Ludlovian, possibly upper Ludlovian.

Résumé

Une faune silicifiée découverte au sein de la formation Sutherland River, sur l'île Devon, dans l'Archipel arctique canadien, au cours d'un levé effectué à l'aide d'un hélicoptère par la Commission géologique du Canada, présente un intérêt considérable du fait que (1) son âge la situe à proximité de la frontière siluro-dévonienne, et (2) elle provient de l'immense région arctique où les données paléontologiques sont encore restreintes. Cette faune comprend des brachiopodes, des ostracodes, des conodontes, des scolécodontes, des trilobites, des gastropodes ainsi qu'une plaque de poisson; l'ouvrage décrit tous ces fossiles. L'auteur en conclut que cette faune remonte au Ludlovien, peut-être au Ludlovien supérieur.

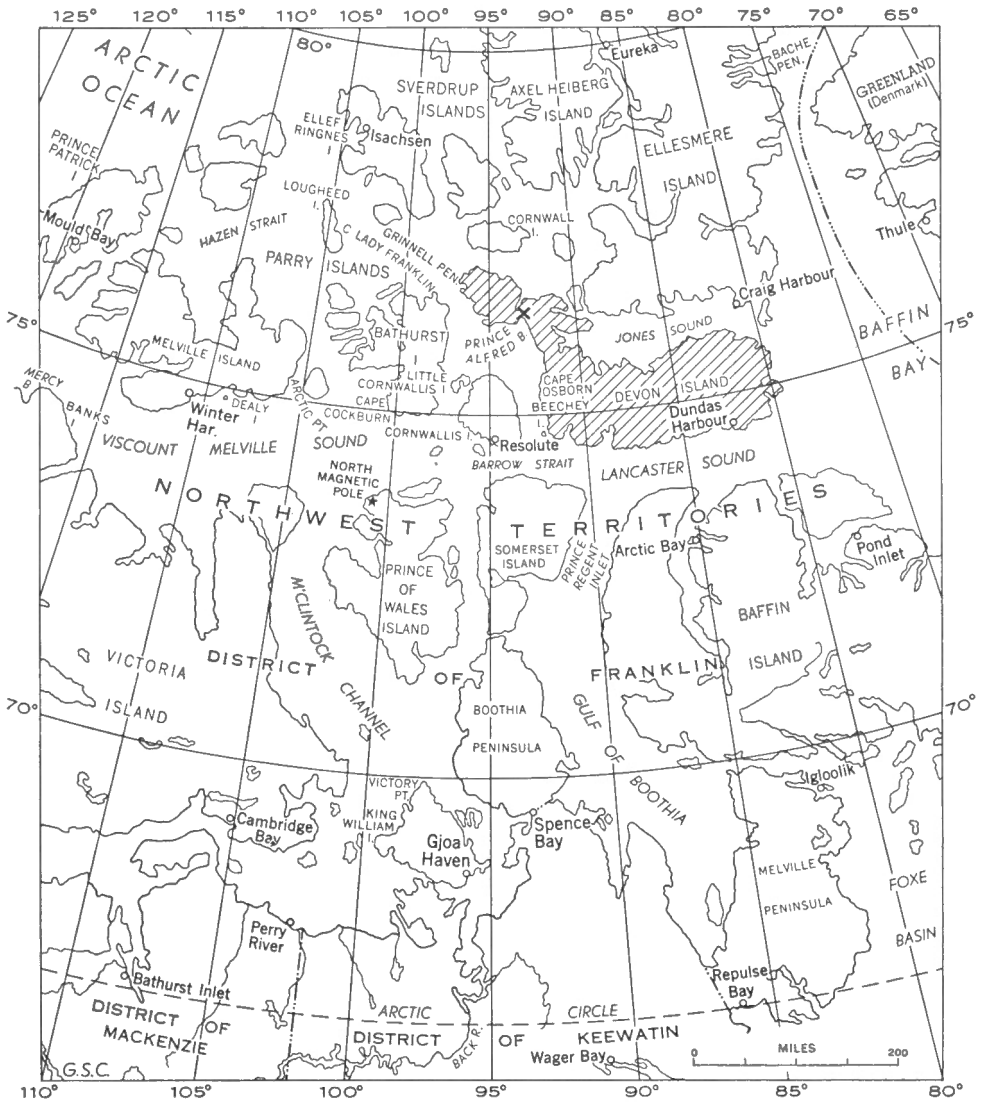

Figure 1. Index map showing location of Devon Island and fauna described in this report.

LOCATION AND GEOLOGIC SETTING

R. Thorsteinsson

Devon Island, comprising an area of about 25,800 square miles, is one of the major islands within the Canadian Arctic Archipelago. This report describes an Upper Silurian fauna from the Sutherland River formation, found by the writer at a locality (GSC loc. Nos. 26428 and 26415) on Devon Island immediately to the north of Prince Alfred Bay in Wellington Channel (*see* Fig. 1).

During six days in July 1955 the writer conducted a geological survey in the region of Prince Alfred Bay, where he mapped an area of some 60 square miles and studied a conformable sequence of Ordovician, Silurian, and Devonian sediments with an aggregate thickness of about 9,000 feet. The Sutherland River formation is a mainly uniform sequence of medium-bedded, aphanitic, grey dolomite about 500 feet thick. The formation has yielded one fauna only, the description of which is the subject of the present report. This fauna was collected near the base of the formation from one stratigraphic horizon in a locally developed biostrome. The Sutherland River formation rests abruptly on the Devon Island formation, which is composed of graptolitic shale of lower and middle Ludlovian age (based on *Monograptus tumescens minor* M'Coy and *Monograptus ultimus* Perner). The Prince Alfred Bay formation, a series of soft, friable, yellowish grey and white sandstone beds about 500 feet thick, overlies the Sutherland River formation gradationally. No fossils were found in the Prince Alfred Bay beds. A limestone formation bearing Middle Devonian fossils rests on the Prince Alfred Bay sandstone, the contact being one of apparent disconformity.

BRACHIOPODS

Arthur J. Boucot[1]

The following brachiopods have been recognized in the Sutherland River formation at GSC localities 26428 and 26415 in the collection made by Thorsteinsson in 1955 from the Douro Range:

Salopina ? sp.
Isorthis orbicularis (Sowerby, 1839)
"Camarotoechia" sp.
Howellella sp.
Cyrtina ? sp.
Protathyris sp.
Coelospira sp.
Shaleria sp.
"Schuchertella" sp.

None of these forms has a sufficiently restricted stratigraphic range to date the fauna more closely than Ludlovian or lower Gedinnian. *Salopina* n. gen. is known from rocks of Wenlockian to lower Gedinnian age, *Isorthis* Kozlowski from rocks of upper Llandoverian to Middle Devonian age, *"Camarotoechia"* Hall and Clarke from rocks of Wenlockian to Gedinnian age, *Howellella* Kozlowski of the small type present in this collection from rocks of upper Llandoverian to lower Gedinnian age, *Cyrtina* Davidson from rocks of upper Llandoverian to Devonian and younger age, *Protathyris* Kozlowski of the smooth, unfolded type present in this collection from rocks of Ludlovian to lower Gedinnian age, *Coelospira* Hall from rocks of upper Llandoverian to Emsian age, *Shaleria* Caster from rocks of Llandoverian to Gedinnian age, and *"Schuchertella"* Girty from rocks of Wenlockian to Middle or Upper Devonian age. The absence of any typically Gedinnian and younger elements like *Nanothyris* Cloud, *Podolella* Kozlowski, *Mutationella* Kozlowski, *Fascicostella* Schuchert and Cooper, *Platyorthis* Schuchert and Cooper, or *Skenidium* Hall is negative evidence for a pre-Gedinnian age, but far from conclusive. Using New York terminology, the writer considers the lower Gedinnian to be approximately equivalent to the Manlius and Coeymans limestones of New York, with the position of the New Scotland formation in doubt between the lower and upper Gedinnian but more probably belonging to the lower Gedinnian.

Geographic Affinities of the Brachiopods from the Sutherland River Formation

The brachiopods from the Sutherland River formation are all forms known in both the Ludlovian and early Gedinnian brachiopod faunas of western Europe and eastern North America. *Salopina* thus far is known only from easternmost America along the Maine and New Brunswick coastal district and from western Europe, but the other genera are widely distributed.

[1] Massachusetts Institute of Technology, Cambridge, Mass.

Systematic Palaeontology

Suborder DALMANELLOIDEA Moore, 1952

Superfamily DALMANELLACEA Schuchert and Cooper, 1931

Family SCHIZOPHORIIDAE Schuchert and LeVene, 1929[1]

Subfamily SCHIZOPHORIINAE Schuchert and LeVene, 1929

Genus *Salopina* n. gen.

Plate I, numbers 1 to 12

Type species: *Orthis lunata* Sowerby, 1839, Silurian System, p. 611, Pl. 5, fig. 15. The specimen figured by Salter (op. cit.) is here designated the holotype of *Orthis lunata.*

Diagnosis. Relatively small schizophoriinids possessing a gently convex, sulcate brachial valve in association with a highly convex pedicle valve.

Comparison. Schizophoria King has a gently convex pedicle valve with a well-developed median ridge separating the diductor impressions, and a highly convex brachial valve. Both valves of *Pionodema* Foerste are subequally convex, and in the pedicle valve a well-developed median ridge divides the diductor field. *Salopina* has a gently convex brachial valve with prominent sulcus and a highly convex pedicle valve, and lacks a median ridge dividing the diductor field.

Exterior of brachial valve. The relatively small brachial valve is subcircular in outline, the straight hinge line being about two-thirds to three-quarters as wide as the maximum width, which is located near the midlength. The lateral and anterior margins are evenly rounded, and the anterior commissure is unisulcate, crenulate, and uniplicate. The brachial valve bears a broad median sulcus whose width is about one-third the maximum width. The interarea is anacline, the length slightly less than half that of the pedicle valve. The valve is multicostellate, the costellae increasing by bifurcation. The costellae are of the 'hollow' type cited by Schuchert and Cooper (1932, p. 139). The 'hollow' costellae characteristic of the Schizophoriinae manifest themselves as numerous, irregularly spaced, cylindrical pits, situated on the crest of the individual costellae, and inclined at a low angle to the exterior of the shell and directed towards the posterior end of the valve. The presence of hollow costellae is indicated on impressions of the exterior by small, elongate fillings with a relief less than half that of the associated costella. The exact function of these pits is unknown. The costellae are rounded in cross-section and are separated by rounded interspaces. A few prominent growth lines are present on most specimens. The open, unmodified notothyrium includes an angle of about 60 degrees. The surface of the interarea is smooth except for growth lines, which parallel the hinge line.

[1] The definition of the family given by Schuchert and Cooper (1932, pp. 139-140) must be modified to include genera that lack a median ridge in the pedicle valve. Such a ridge is present in all the genera at present assigned to the family except *Salopina.*

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Exterior of pedicle valve. The highly convex pedicle valve is subcircular in outline and has its greatest width near the midlength. The lateral and anterior margins are evenly rounded. The interarea is gently concave posteriorly and apsacline. The margins of the interarea are unmodified and include an angle of about 45 degrees.

Interior of brachial valve. The cardinalia consist of divergent, terminally pointed brachiophores basally supported by brachiophore plates. The brachiophore plates diverge from the midline at an angle of about 30 degrees. The dental sockets are floored by short fulcral plates. The cardinal process consists of a short, laterally compressed blade extending from the posterior margin to a point in line with the anterior parts of the fulcral plates. The posterior sides of the cardinal process in large specimens may be faintly striate. The adductor field consists of a pair of small, elongate, antero-laterally diverging impressions medially separated by a low, broad rise which is the internal manifestation of the sulcus. The adductor impressions in large specimens may be longitudinally divided into several parts by low myophragms. Vascular trunks have not been observed. The muscle field is about one-third the maximum width of the valve and extends anteriorly to a point short of the midlength. The interior is deeply impressed peripherally by the costellae.

Interior of pedicle valve. The small hinge teeth are situated on the lateral margins of the hinge line and basally supported by thin dental lamellae. The dental lamellae are short, not extending more than one-fifth the distance to the anterior margin, and are medially concave. Anteriorly the dental lamellae merge with a pair of anterior ridges which laterally bound the muscle field. The muscle field is cordate in outline and bisected medially by a low, inconspicuous myophragm. The internal periphery of the valve is deeply impressed by the costellae of the exterior.

Species assigned. *Orthis lunata* Sowerby, 1839, op. cit.

Distribution

Great Britain: Salopina lunata (Sowerby, 1839) is abundant in the Ludlovian rocks of Great Britain. It is often confused with *Isorthis orbicularis* (Sowerby, 1839).

Belgium: Rocks of Gedinnian age from the Gdoumont region contain *Salopina* aff. *lunata* (Boucot, *in press*).

New Brunswick: The Jones Creek formation (MacKenzie, 1951a, b) contains *S. lunata* and underlies the Long Reach formation, which the writer considers to be of Wenlockian age.

Maine: S. lunata has been reported by Williams (1913, p. 337) from the Pembroke formation, which the writer considers to be of Wenlockian or possibly Ludlovian age. Williams (op. cit.) assumed that Sowerby's

Orthis orbicularis was a synonym of *S. lunata,* but after inspection of Williams' specimens the writer could find none that belongs to *Isorthis orbicularis* rather than *Salopina lunata.*

Devon Island: The Devon Island collection from the Sutherland River formation of Ludlovian age contains a single complete specimen of a small dalmanellid possessing the external form of *Salopina.* Unfortunately, the internal characters of this specimen could not be ascertained, and the presence of 'hollow' costellae could not be determined. Therefore, the generic identity of this specimen remains in doubt.

Derivation. Salopina was probably derived from a form close to *Pionodema,* from which it differs only in the form of the gently convex, sulcate brachial valve and the absence of a median ridge dividing the muscle field in the pedicle valve. The appearance of *Salopina* in a Wenlockian age unit in New Brunswick makes its derivation from *Schizophoria* less likely, as the latter appears only in Upper Llandovery (=Clinton) equivalents.

Subfamily ISORTHIINAE Schuchert and Cooper, 1931

Genus ***Isorthis*** Kozlowski, 1929

Isorthis orbicularis (Sowerby, 1839)

Plate I, numbers 13 to 20; Plate II, numbers 1 to 7

1839. *Orthis orbicularis* Sowerby, Silurian System, p. 611, Pl. 5, fig. 16.

Exterior of brachial valve. The valve is evenly convex, subcircular to elliptical, the width slightly greater than the length in most specimens. The straight hinge line is about half as long as the maximum width, which is located near the midlength. The lateral and anterior margins are evenly rounded. The margins are rectimarginate and crenulate. The interarea is orthocline to anacline and about one-third to one-half as long as the interarea of the pedicle valve. The ornamentation is multicostellate, the costellae increasing by bifurcation. The notothyrium is open and unmodified. The simple cardinal process occupies the apex of the notothyrial cavity but does not extend beyond the notothyrium. The interarea is unornamented except for growth lines paralleling the hinge line. The notothyrium includes an angle of about 60 degrees.

Exterior of pedicle valve. The valve is evenly convex and slightly deeper than the brachial valve. The valve has a subcircular outline, with length and width about equal. The lateral and anterior margins are evenly rounded, crenulate, and rectimarginate. The ornamentation is similar to that of the brachial valve. The hinge line is straight and about half the maximum length, which is near the midlength. The interarea is concave posteriorly and apsacline. The delthyrium is open and

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unmodified, and includes an angle of about 60 degrees. The interarea is unornamented except for growth lines paralleling the hinge line. The umbo extends posterior of the hinge line.

Interior of brachial valve. The cardinalia consist of delicate, pointed brachiophores basally supported by brachiophore plates and a simple cardinal process. The brachiophores border the edges of the notothyrium, are laterally compressed and distally pointed. The brachiophores are basally supported by thin brachiophore plates. The brachiophore plates extend anteriorly about one-third to one-half the length of the valve and diverge from the midline at an angle of about 60 degrees. The cardinal process is simple, short, and may either be laterally compressed into a short blade or be more inflated and knob-like. The dental sockets are narrow, antero-laterally expanding, posteriorly closed over, and floored by fulcral plates. The muscle field is weakly impressed and consists of a pair of flabellate adductor impressions medially separated by a low, poorly developed myophragm. The muscle field extends anteriorly about one-third to one-half the distance to the anterior margin and is laterally bounded by the extensions of the brachiophore plates. The periphery is deeply crenulated by the impress of the external ornamentation and bears crenulae with a rounded cross-section and median grooves.

Interior of pedicle valve. The short, stubby hinge teeth are roughly triangular in cross-section and are basally supported by short dental lamellae. The dental lamellae are medially concave and anteriorly join raised tracks which laterally bound the deeply impressed muscle field. The hinge teeth bound the edges of the delthyrium. The muscle field consists of elongate, paired diductor impressions laterally bounded by low ridges extending anteriorly from the dental lamellae and medially separated by a raised, narrow median ridge. The median ridge probably served for adductor attachment. In a few large specimens the median ridge is deeply grooved. The periphery is grooved like that of the brachial valve.

Comparison. The cardinal process of the similar species *I. fornicatimcurvata* (Fuchs) anteriorly joins a low ridge of secondary material, and this species has a muscle field which is tetralobate, a low sulcus on the brachial valve, a deeply impressed muscle field in the brachial valve, and a relatively wide, raised adductor track in the pedicle valve. None of these characters is present in *I. orbicularis*. *I. orbicularis* deviates somewhat from most species assigned to *Isorthis* in its lack of a relatively broad adductor track in the pedicle valve and a tetralobate, deeply impressed muscle field in the brachial valve medially divided by a low, broad ridge of secondary material.

Distribution. The species is widely distributed in the Ludlovian of Great Britain, but the occurrence in the late Ludlovian Sutherland River formation of Devon Island is the first known from North America. The species has been confused with *I. fornicatimcurvata* by Dahmer (*see* Boucot, *in press*) from strata of lower Gedinnian age in the Ardennes and the Sauerland.

Suborder RHYNCHONELLOIDEA Moore, 1952

Superfamily RHYNCHONELLACEA Schuchert, 1896

Family CAMAROTOECHIIDAE Schuchert and LeVene, 1929

Subfamily CAMAROTOECHIINAE Schuchert and LeVene, 1929

Genus *Camarotoechia* Hall and Clarke, 1893

"Camarotoechia" sp.

Plate II, numbers 8 to 10

Exterior of brachial valve. The fragmentary specimens available suggest that the valve outline is subcircular, with the point of maximum width situated just anterior of the midlength. The valve is evenly convex and bears a broad median fold. The fold is ornamented with four angular plications, separated by angular interspaces, and laterally flanked by four to five angular lateral plications which are also separated by angular interspaces. The interarea is very short and only a fraction of the maximum shell width; it appears to be orthocline. The anterior commissure is uniplicate and crenulate.

Exterior of pedicle valve. The valve is subcircular with a pointed, rhynchonelliform beak. The form of the short interarea is not preserved in the specimens studied. The cardinal margins appear to be megathyrid in form and the delthyrium appears to be unmodified, but the specimens are poorly preserved. The well-developed sulcus contains three angular plications.

Interior of brachial valve. The cardinalia consist of concave, discrete hinge plates basally supported by short crural plates. The crural plates unite medially with a blade-like median septum (which extends anteriorly to about the midlength) to form a short cruralium. The dental sockets are floored by fulcral plates and are laterally directed. The muscle field is not visibly impressed on the poorly preserved specimens studied. The periphery is strongly crenulated by the external ornamentation.

Interior of pedicle valve. The short, stubby hinge teeth are situated on either side of the delthyrium. The hinge teeth are supported by short, thin dental lamellae. The muscle field is not visibly impressed on the specimens studied.

Comparison. The available specimens are too fragmentary for specific identification. However, they are comparable to the group of shells currently assigned to *"Camarotoechia" nucula* (Sowerby). The generic identity of *"C." nucula* and its allies is not yet clear.

Distribution. Shells of the *"C." nucula* type are widely distributed in Ludlovian and Gedinnian equivalents in Europe and North America.

Suborder SPIRIFEROIDEA Allen, 1940

Superfamily SPIRIFERACEA Waagen, 1883

Family SPIRIFERIDAE King, 1846

Subfamily DELTHYRINAE Waagen, 1883

Genus *Howellella* Kozlowski, 1946

Howellella sp.

Plate III, numbers 21 to 30

Exterior of brachial valve. The valve is laterally elongate and elliptical. The hinge line is straight and about half to two-thirds as long as the maximum width, which is about one-third the distance anterior of the beak. The lateral and anterior margins are evenly rounded. The commissure is plicated. The brachial valve bears a broad fold having a rounded cross-section. The fold is laterally flanked by one to three lateral plications, all of which have rounded cross-sections and are separated from each other and the fold by rounded interspaces. The fold is about three to four times as wide as the first lateral plication. The interarea is orthocline to gently anacline and relatively short. It is unornamented except for growth lines paralleling the hinge line. The fine ornamentation consists of concentric growth lines crossed by minute radial striations that project over the anterior edges of the growth lamellae as a fringe of minute spines in well-preserved specimens. The open, unmodified notothyrium includes an angle of about 120 degrees.

Exterior of pedicle valve. The pedicle valve is about twice as deep as the gently convex brachial valve. It has a laterally elongate, elliptical outline, with the maximum width situated slightly posterior of the midlength. The umbo overhangs the hinge line. The apsacline interarea is concave posteriorly and about five times as long as that of the brachial valve. The delthyrium is open in all the specimens studied, and includes an angle of about 50 degrees. The valve is ornamented by a prominent sulcus and lateral plications corresponding to the interspaces of the brachial valve.

Interior of brachial valve. The cardinalia consist of a small striated area in the notothyrium for diductor attachment, flanked laterally by a pair of short crural plates which basally support the short, stubby brachiophores. The brachiophores define the anterior edges of the laterally directed dental sockets, which flare laterally. The poorly defined adductor field is present in the internal impression of the fold and is medially bisected by a low, thread-like myophragm which extends anteriorly to about the midlength. The periphery is crenulated by the impress of the coarse ornamentation.

Interior of pedicle valve. The stubby hinge teeth are subtriangular in cross-section and situated on the lateral margins of the delthyrial cavity. The hinge teeth are basally supported by short dental lamellae which laterally bound the muscle field. The muscle field, medially divided by a low myophragm, is weakly impressed

anteriorly and extends no more than one-third the distance to the anterior margin. The dental lamellae include an angle of about 60 degrees. The periphery is crenulated by the impress of the external plications.

Comparison. Howellella from the Sutherland River formation is characterized by the presence of U-shaped interspaces having a rounded cross-section similar to those present in *H. elegans* Muir-Wood. A number of other described species of *Howellella* also possess this type of ornamentation, however, and until definitive study of these forms has been done, specific assignment of material such as that from the Sutherland River formation seems pointless.

Distribution. Boucot (1957, pp. 316-317) reviewed the distribution of species assigned to *Howellella* and found them in strata of upper Llandoverian to lower Gedinnian age with a world-wide distribution. Forms similar to the Sutherland River specimens have not been found above strata of lower Gedinnian age.

Superfamily PUNCTOSPIRACEA Cooper, 1944

Family CYRTINIDAE Stehli, 1954

Subfamily CYRTININAE Fredericks, 1912

Genus *Cyrtina* Davidson, 1858

Cyrtina ? sp.

Plate III, numbers 31 to 33

Exterior of brachial valve. The valve is transversely elongate in outline, the width being equal to about twice the length. The hinge line is straight and equal to the maximum width. The lateral margins are rounded, and the junction of the hinge line and lateral margins is concave for a short distance. The anterior margin is gently rounded. A prominent fold with high, rounded cross-section is laterally flanked by two well-developed lateral plications separated from each other and the fold by deep, rounded interspaces. The interarea is relatively short and orthocline or gently anacline. The notothyrium appears to be occupied by the cardinalia which, in the specimen available for study, are poorly preserved. The commissure is rectimarginate, crenulate. The fine ornamentation is not preserved.

Exterior of pedicle valve. The single, fragmentary pedicle valve available shows a subpyramidal form, almost catacline interarea, and unplicated apex. The silicification of the valve is too poor for any other conclusions to be made about the exterior. The presence or absence of a deltidial plate could not be determined.

Interior of brachial valve. The cardinalia appear to consist of a bulbous cardinal process fused laterally to a pair of short brachiophores, but the silicification of the available specimen is too poor for any clear description of the interior.

Interior of pedicle valve. The single specimen clearly shows the presence of a median septum, but a tichorhinum is not discernible.

Comparison. The available specimens probably belong to *Cyrtina*, but they are too poorly preserved for specific determination.

Distribution. Similarly plicated forms are known elsewhere in the world in strata of both Silurian and Devonian age.

Superfamily ROSTROSPIRACEA Schuchert and LeVene, 1929

Family ATHYRIDAE Davidson, 1884

Subfamily ATHYRINAE Waagen, 1883

Genus ***Protathyris*** Kozlowski, 1929

Protathyris sp.

Plate III, numbers 9 to 14

Exterior of brachial valve. The valve is subcircular and evenly convex in cross-section. The straight hinge line is about half as long as the maximum width, which is situated near or slightly anterior of the midlength. The interarea is very short and orthocline. The notothyrium is poorly differentiated and is filled by the cardinalia. The surface is smooth except for a series of prominent, concentric growth lines. The anterior and lateral margins are evenly rounded and rectimarginate.

Exterior of pedicle valve. The valve is subcircular, with length slightly in excess of width. The lateral and anterior margins are evenly rounded, and the commissure is rectimarginate. The beak is suberect, and the cardinal margin is terebratulid in form. The large foramen is mesothyrid. The presence of deltidial structures could not be ascertained on the single specimen available for study.

Interior of brachial valve. The cardinalia consist of short, thin brachiophores which laterally bound an apically perforate cardinal plate. The anterior margin of the cardinal plate is straight. The cardinal plate is made up of a lateral pair of plates and a median perforate plate, all expanding radially from the notothyrial cavity. The median plate is broader than the other two and anteriorly is raised more in a direction towards the pedicle valve.

Interior of pedicle valve. No information is available regarding the interior of the pedicle valve.

Comparison. The Sutherland River specimens lack the sulcus on the brachial valves characterizing species like *P. didyma* (Dalman) but strongly resemble *P. praecursor* Kozlowski, 1929, in external form. Ignorance of the spire and jugal apparatus in the Sutherland River form makes specific identification impractical.

Distribution. The genus has a world-wide distribution chiefly in rocks of Wenlockian and Ludlovian age, but lower Gedinnian occurrences are known.

Suborder ATRYPOIDEA Moore, 1952

Superfamily ATRYPACEA Schuchert and LeVene, 1929

Family COELOSPIRIDAE Hall and Clarke, 1895

Genus *Coelospira* Hall, 1863

Coelospira sp.

Plate III, numbers 15 to 20

Exterior of brachial valve. The brachial valve is subcircular, with the straight hinge line equal to slightly less than half the maximum width, which is near the midlength. The lateral and anterior margins are evenly rounded. The valve is gently convex as contrasted with the strongly convex pedicle valve. The median part of the valve bears a broad, anteriorly flaring sulcus. The coarse ornamentation consists of radial plications whose state of preservation in the two available specimens is too poor for their relationships to be worked out. The interarea is very short and appears to be orthocline. The notothyrium is open, very shallow, and does not appear to be modified.

Exterior of pedicle valve. The valve is subcircular, the width being slightly less than the length. It is more highly convex than the gently convex brachial valve. The open, unmodified delthyrium includes an angle of about 90 degrees. The interarea is relatively short and appears to be gently apsacline. The coarse ornamentation consists of radial plications, which are poorly preserved in the two specimens available for study.

Interior of brachial valve. The cardinalia consist of short, discrete hinge plates which are distally recurved to form the lateral margins of the dental sockets. A cardinal process has not been distinguished. The adductor field is poorly preserved in the available material but appears to be medially divided by a myophragm which extends anteriorly almost to the midlength. The interior bears the impress of the external plications.

Interior of pedicle valve. The short, stubby hinge teeth are situated on the lateral margins of the delthyrium. Dental lamellae are absent. The muscle field is medially divided by a low, rounded myophragm which extends about one-third of the distance to the anterior margin; the specimens are too poorly preserved to allow discernment of further characters.

Comparison. The four specimens from the Sutherland River formation are too poorly preserved to be specifically identified.

Distribution. Similar forms are known in the Silurian and Lower Devonian of western Europe and eastern North Amercia.

Suborder STROPHOMENOIDEA Maillieux, 1932

Superfamily STROPHOMENACEA Schuchert, 1896

Family STROPHEODONTIDAE Caster, 1939

Subfamily STROPHEODONTINAE Caster, 1939

Genus *Shaleria* Caster, 1939

Shaleria sp.

Plate II, numbers 23 to 26; Plate III, numbers 1 to 8

Exterior of brachial valve. The valve is subquadrate, the straight hinge line being equal to the maximum width. The lateral extremities are slightly mucronate. The shell is gently concave. The lateral and anterior margins are gently rounded. The interarea is steeply anacline to hypercline, and relatively short. A small, nub-like chilidium is situated on the interarea. The ornamentation consists of both coarse and fine radial costellae, which increase in size anteriorly and in number by implantation. There are about three to five fine costellae between each pair of coarse costellae. Closely spaced concentric growth lines occur between and upon the radial ornamentation. The concentric ornamentation gives rise to a scalloped pattern which is most noticeable along the lateral and anterior margins, where the scallops are concave anteriorly. The commissure is rectimarginate and crenulate. The distal extremities of the cardinal process lobes extend outside the shell.

Exterior of pedicle valve. The valve is gently convex. The interarea is relatively short and orthocline. A small pseudodeltidium fills the apex of the delthyrium. The delthyrium includes an angle of about 70 degrees. Ornamentation and outline are similar to those of the brachial valve.

Interior of brachial valve. The cardinalia consist of disjunct, posteriorly directed cardinal process lobes flanked laterally by linear socket plates. A small chilidium occurs well below the posterior base of the cardinal process lobes. The socket plates form the anterior margins of the shallow, laterally directed dental sockets. The hinge line is semi-denticulate. The muscle field is only partly preserved in the available specimens but can be seen to be medially divided by a low, rounded myophragm, to be longitudinally elongate in form, and to include an angle of about 40 degrees between the low, rounded lateral ridges. The pseudopunctae are evident as numerous small pustules. The impress of the radial ornamentation is visible on the interior.

Interior of pedicle valve. The hinge line is semi-denticulate. The muscle field is flabellate, laterally bounded by low ridges of secondary material, and includes an angle of about 90 degrees. A low, rounded myophragm separates the muscle field into two parts. The muscle field is restricted to the posterior third of the valve.

Comparison. The Sutherland River specimens are too poorly preserved to be specifically identified with any degree of certainty. However, it is worth noting that the flabellate form of the muscle field in the pedicle valve is distinctly different from that present in the Ludlovian species *S. ornatella* (Davidson) and the Gedinnian species *S. rigida* (De Koninck) (in these last two species the low, lateral bounding ridges in the pedicle valve are almost subparallel for much of their length). The muscle field of the Sutherland River specimens is reminiscent of that present in *Leptostrophia* Hall and Clarke, but the latter lacks the crenulated concentric ornamentation characterizing *Shaleria,* and the cardinal process lobes are directed towards the pedicle valve rather than posteriorly.

Distribution. The genus is widespread in Silurian and Lower Devonian rocks in Europe and eastern North America.

Superfamily ORTHOTETACEA Williams, 1953

Family SCHUCHERTELLIDAE Stehli, 1954

Subfamily SCHUCHERTELLINAE Williams, 1953

Genus *Schuchertella* Girty, 1904

"Schuchertella" sp.

Plate II, numbers 11 to 22

Exterior of brachial valve. The valve is gently convex and subquadrate in outline, width exceeding length. The hinge line is straight and slightly shorter than the maximum width, which is located near the midlength. The lateral and anterior margins are gently rounded. A low, broad sulcus occupies the middle third of the valve in small specimens but is poorly developed in large specimens. The interarea is very short and appears to be steeply anacline to hypercline. A ribbon-like, medially conjunct pair of chilidial plates occupy the median part of the hinge line. The chilidial plates cover only the base of the cardinal process. The radial ornamentation consists of radial, angular costellae which increase in size and in number anteriorly. The commissure is rectimarginate, plicate, and weakly unisulcate. Closely spaced concentric growth lines are evident on some specimens.

Exterior of pedicle valve. The valve is subquadrate in outline, width exceeding length. The lateral and anterior margins are gently rounded. The valve is convex and about two to three times as deep as the brachial valve. The interarea is relatively long and apsacline. The delthyrium is closed by a strongly convex pseudodeltidium, and includes an angle of about 70 degrees.

Interior of brachial valve. The cardinalia consist of disjunct cardinal process lobes basally supported by laterally recurved crural plates. The cardinal process lobes are posteriorly directed. The laterally recurved crural plates form the

anterior faces of the laterally directed, open dental sockets, which lie parallel to the hinge line. The weakly impressed adductor field is medially divided by a low, rounded ridge of secondary material and extends anteriorly about one-third of the distance to the anterior margin. The interior is deeply impressed by the costellae. Pseudopunctae could not be distinguished on the material studied.

Interior of pedicle valve. The short, stubby hinge teeth are situated on the lateral margins of the delthyrium. The hinge teeth and their tracks are basally supported by short plates, which can be interpreted either as short dental lamellae or as deposits of secondary material. In the absence of thin sections which might show whether or not these plate-like structures are secondary or primary, it is not possible to decide their nature.

Comparison. The orthotetacids of the Silurian and Lower Devonian are still very poorly known from a generic point of view. It is clear that the Sutherland River material with its large pseudodeltidium and small chilidial plates does not belong to the common and widespread Silurian orthotetacid *Chilidiopsis* Boucot. Pending further study of Silurian and Lower Devonian orthotetacids, it will not be possible to assign the Sutherland River material generically without a query. Specifically the Sutherland River material is too fragmentary to warrant precise identification.

Distribution. *"Schuchertella"* sensu lato is well known in Wenlockian and younger strata in North America and Europe.

OSTRACODS

Anders Martinsson[1]

The etched residue from the Devon Island locality includes five specimens of *Beyrichia* (*Beyrichia*) *arctigena* n. sp. Five specimens of a palaeocope ostracod generally constitute too inadequate material for the description of a species, as the chance of obtaining adult specimens of both dimorphs is very small. This particular sample, however, includes two females and one somewhat fragmentary male, and in the male specimen the anteroventral part of the carapace, showing the dimorphic character, is preserved. The ornamental structures are so distinct and characteristic that there can be no doubt as to the specific homogeneity of the material. The fact that the species shows European affinities and gives a comparatively good indication of the age of the sediment makes a description particularly desirable. In describing this new species, however, the taxonomy of *Beyrichia* and the Beyrichiidae must be treated in some detail.

Remarks on the Type Species of *Beyrichia (Beyrichia)* and the Authorship of the Family Beyrichiidae

The genus *Beyrichia* was founded by M'Coy in 1846, with *B. kloedeni* M'Coy, 1846, as the type species. In his description M'Coy identified the species with *Battus tuberculatus* Klöden, 1834, but in a later paper (M'Coy, 1851) he pointed out that his species "does not exactly accord with any of those figured by Klöden as varieties of his *Battus tuberculatus*".

This statement is still valid. It is clear that *Beyrichia kloedeni* is not identical with any of the eight forms figured by Klöden in his paper of 1834. This is stressed by Straw (1928) in his revision of the species and is further sustained by Henningsmoen's examination of the species (1954). The internal moulds figured by M'Coy and Straw show that the postadductorial syllobium is not dissected into separate lobes, and Henningsmoen states that the syllobium has a faint groove (fissus) on the outer side, visible in external moulds. Straw and Henningsmoen both examined material from the type locality (Boocaun, County Galway, Ireland), and Henningsmoen stated that he had used M'Coy's type material. Henningsmoen (op. cit.) divided the genus *Beyrichia* into subgenera, and consequently *B. kloedeni* should be regarded as the type species of the subgenus *Beyrichia* (*Beyrichia*).

Kesling and Wagner (1956) made a very thorough and well-illustrated study of a species identified with *Beyrichia tuberculata* Klöden. They draw attention to M'Coy's incorrect nomenclatorial procedure of 1846 where, in principle, a new name is given to an earlier described, valid species, but in contrast to M'Coy (1851) and later authors they regard *B. kloedeni* as a junior synonym of *B. tuberculata*. The results of such a synonym would be that the subgenus *Beyrichia* would be based on a species where the postadductorial syllobium is divided into

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three lobes and would be synonymous with the subgenus *Nodibeyrichia* Henningsmoen, 1954, and that a new name should be given to *Beyrichia* (*Beyrichia*) sensu Henningsmoen. However, *B. tuberculata* and *B. kloedeni* are definitely different species, and the limitation of the subgenera, as defined by Henningsmoen (1954, pp. 22-27) remains valid.

Beyrichia tuberculata as described by Kesling and Wagner can only be identical with one of the species included in *B. tuberculata* by Klöden (1834), viz., that in figure 21a and b. To avoid further complication of the terminology this specimen should be designated as the lectotype, but the depository is not known and Klöden's material is regarded as lost.

Beyrichia arctigena n. sp. is the first record of the subgenus *Beyrichia* in North America (cf. Henningsmoen, 1954, p. 24).

Some confusion also surrounds the family name Beyrichiidae. The first to base a family-group name on the genus *Beyrichia* was Matthew (1886), who used the name Beyrichinae. As pointed out by Kesling and Rogers (1957), the name is incorrectly constructed, and Matthew's own material did not belong to *Beyrichia* or even to the ostracoda. Kesling and Rogers propose Jones (1855) as the author of the family name, as Jones used the generic name in the plural and subdivided the genus into sections (groups). However, in accordance with the present rules of zoological nomenclature this does not justify the attribution of the family authorship to Jones.

Beyrichiinae Matthew, 1886, is a subfamily name formed on the generic name *Beyrichia,* with an ending in accordance with the nomenclatorial rules. Matthew included in the subfamily, besides the new taxa described by him, the groups Jugosae and Corrugatae of Jones (1855), whose species are still regarded as species of *Beyrichia* and even include the type species. Even if these groups had not been included, Matthew's subfamily name would have been valid according to the rules of nomenclature. Matthew is regarded as the author by Martinsson (1956, p. 18).

Systematic Palaeontology

The terminology used is considerably modified from that introduced by Henningsmoen (1954 and 1955). The terms are illustrated in Figure 2.

Family BEYRICHIIDAE Matthew, 1886

Subfamily BEYRICHIINAE Matthew, 1886

Genus ***Beyrichia (Beyrichia)*** M'Coy, 1846

Beyrichia (Beyrichia) arctigena n. sp.

Plate IV, numbers 1 to 6

Diagnosis. Species of *Beyrichia* with entire postadductorial syllobium, without a detectable groove. Lobal cusps protrude over the hinge line; the syllobium has two cusps of about equal size. The crumina is large and opens widely towards

the main space of the carapace, reaches very slightly behind the preadductorial node, and is drawn up anteroventrally so that its longitudinal axis forms an angle of about 45 degrees with the hinge line. Carapace sparsely and coarsely tuberculate.

Description. The lateral outline and the major features in the lobation (*see* Fig. 2) correspond exactly to the species of *Beyrichia* (*Beyrichia*) known from Europe. The species is characterized by a marked simplicity of lobation, exhibited in the gradual transition of the cruminal wall into the main space of the carapace and into the anterior lobe, and in the absence of the syllobial groove which is characteristic of most related species.

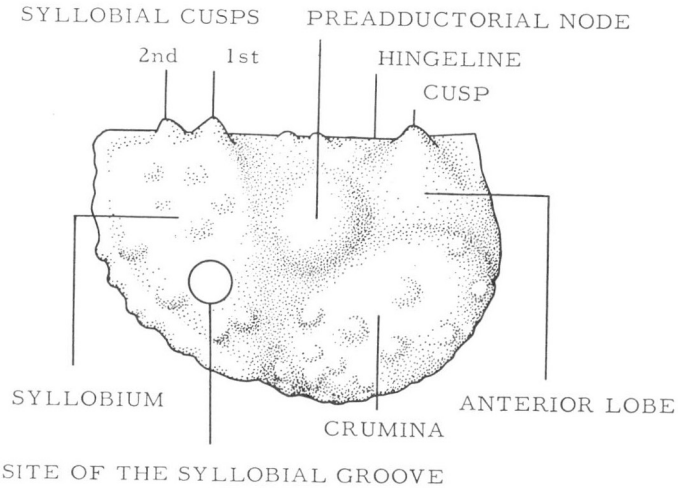

Figure 2. Terms of beyrichiid carapace morphology.

Postadductorial syllobium broadly triangular, gradually merging into the ventral swelling of the male carapace; in the female a slight constriction is visible between the syllobium and the crumina. From the first cusp and downwards the syllobium is well marked off from the adductorial sulcus. The two cusps are of about equal size; the first cusp shows a tendency to be slightly larger than the second. Both cusps protrude considerably over the hinge line.

The anterior lobe merges gradually into the ventral swelling of the male carapace; in the female the transition towards the crumina is very gentle. The cusp of this lobe protrudes over the hinge line to about the same level as the syllobial cusps.

Preadductorial node knob-like, slightly oval, isolated, without any marked lobal connection with the syllobium. Its main axis forms a slightly acute angle with the rear half of the hinge line.

Crumina very voluminous, not constricted proximally, and therefore opening widely towards the main space of the carapace. It extends from a vertical line touching the hindmost part of the preadductorial node to the foremost part of the valve. Its main axis forms an angle of about 45 degrees with the hinge line.

Tuberculation (*see* Fig. 3) very sparse; tubercles very coarse, sometimes developed as very low spines. A lumen is observed in some broken tubercles.

As in many other species, some elements in the pattern of tuberculation can be distinguished: (1) a *velar* row of comparatively closely spaced tubercles along the anteroventral and ventral part of the velar ridge, sparser along the posteroventral part; (2) a *supravelar* row of three or four main tubercles along the posteroventral part of the syllobium; (3) a very marked spine-like tubercle (the calcarine tubercle) just behind the crumina or in the corresponding position on the male carapace; (4) two main tubercles near the hinge line above the preadductorial node; (5) sparsely dispersed tubercles over the crumina, missing in its dorsal part, denser towards its ventral part and arranged in indistinct transverse rows which almost reach the valve margin; (6) two supravelar pairs of main tubercles anteroventrally in the male; (7) accessory tubercles are found on the anterior lobe, on the syllobium, and above the preadductorial node; (8) an indistinct row of *marginal* tubercles is developed along the rear half of the ventral margin.

The hingement consists of a simple groove in the right valve, corresponding to a simple ridge (not observed in this material) in the left valve.

The penultimate moult instar and the adult males (tecnomorphs) resemble each other in all essential features except size.

Dimensions. The dimensions of palaeocope ostracods are best illustrated by the relatively stable hinge length and the height over the adductorial sulcus, immediately behind the preadductorial node. In addition, the total length, total height (including the crumina but not the lobal cusps), and the greatest length of the crumina are given. Measurements are in microns:

Table I

Dimensions of *Beyrichia arctigena* n. sp.

GSC Number	Sex	Hinge Length	Height over Sulcus	Total Length	Total Height	Length of Crumina
15013	♀	1680	1080	1800	1180	1020
15014	♀	1770	1120	1970	1210	1130
15015	♂	(1750)	1120	(1830)	1130	—
15016	Juv.	1480	980	1620	1000	—
15017	Juv.	1420	920	1500	920	—

Remarks. The taxon most closely related to *Beyrichia arctigena* is that recorded by Henningsmoen from Gjeitøy, Ringerike, Norway, as *Beyrichia* (*Beyrichia*) cf. *kloedeni* (Henningsmoen, 1954, p. 41; Pl. 2, figs. 6, 7, 8, 12, 18, etc.). Common features are the more markedly anteroventral position of the

crumina and the almost complete isolation of the preadductorial node. The crumina is very large in both taxa, without very much proximal restriction, and therefore opens widely towards the main space of the carapace.

As pointed out by Henningsmoen (op. cit., p. 40) the material from Ringerike comprises more than one species. *Beyrichia arctigena* differs from them mainly in its well-developed syllobial cusps, the absence of a syllobial groove, and the advanced simplicity in tuberculation. There is a more advanced tendency to fusion of all lobal features in *B. arctigena* than in the Norwegian species, except that the three dorsal cusps are very distinct.

The Norwegian material comes from the upper half of the Wenlockian. The same or closely related species might well occur through the entire Ludlovian, but

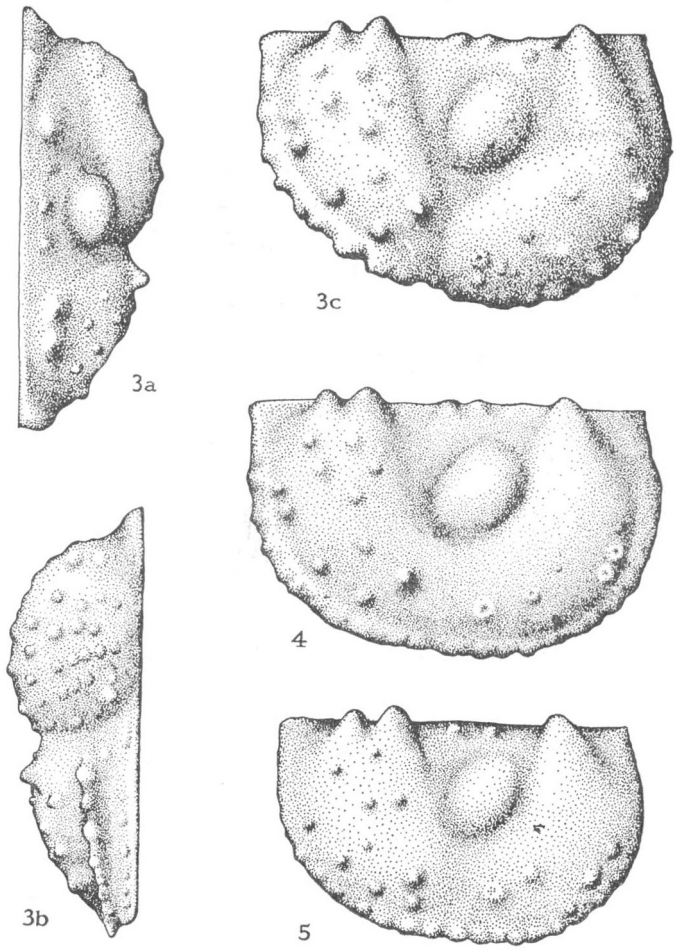

Figure 3. *Beyrichia arctigena* n. sp. 3a-c, dorsal, ventral and lateral views of reconstructed female carapace.

Figure 4. *Beyrichia arctigena* n. sp., reconstruction of male carapace.

Figure 5. *Beyrichia arctigena* n. sp., tecnomorph in the penultimate moult instar.

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hitherto no *Beyrichia* (*Beyrichia*) species has been recorded from the Devonian. In America the subgenus has not been recorded at all. If the occurrence of this ostracod alone is taken into account, it would provide an indication that the beds containing it are Silurian.

The state of preservation of the material can be judged from the figures on Plate IV. The only part of the carapace which is not preserved in any specimen is the preadductorial node, which, however, is a very constant feature in all *Beyrichia* (*Beyrichia*) species. Furthermore, the state of preservation does not show whether the fine subordinate surface granulation and the finger-print striation of the ventral proximal part of the crumina, known from other species, are present in *B. arctigena* (cf. *B. dactyloscopica* in Martinsson, 1956; this characteristic striation has since been found in numerous species from Gotland). The dense tuberculation on the ventral part of the crumina, however, seems to exclude the existence of the striation. Reconstructions of *B. arctigena* are shown in Figures 3, 4, and 5.

The tuberculation pattern has been considered here in some detail. As will be shown in a forthcoming paper on the Beyrichiidae of Gotland, some of the elements in the pattern can be recognized all through the genus, and the calcarine tubercle, which is prominent in the present species, often grows out as a spur-like spine.

Material. Two females, one fragmentary male, and two specimens apparently belonging to the penultimate moult instar, all represented as right valves. All specimens are figured here, and all are from GSC loc. 26428.

SCOLECODONTS, CONODONTS, AND VERTEBRATES

Otto H. Walliser[1]

The fossil collection made by Thorsteinsson from the Sutherland River formation contains fourteen species of scolecodonts (including ten new ones), twenty species of conodonts (including eight new ones), and one scale of an acanthodian fish. The scolecodonts do not provide any information as to the age of the enclosing strata. The conodonts, by comparison with other still partly unpublished faunas, appear to be of high upper Ludlow age, and the stratigraphic range of the genus to which the acanthodian scale is assigned is in accord with this dating.

Scolecodonts

Scolecodonts—parts of the jaw apparatus of fossil polychaete annelids—are mostly found as isolated specimens. Whole jaw apparatus in complete sets ('assemblages') have very rarely been found; in fact, so far only about a dozen species of them are known and described. The forms described here are isolated specimens, and their connections with one another cannot be establishd. Therefore they are described separately and named according to the usual nomenclature. However, specimens which are to be considered as belonging to different species and even to different genera are, with due reserve, united here under one species whenever on the basis of the assemblages published to date they appear to belong to a species.

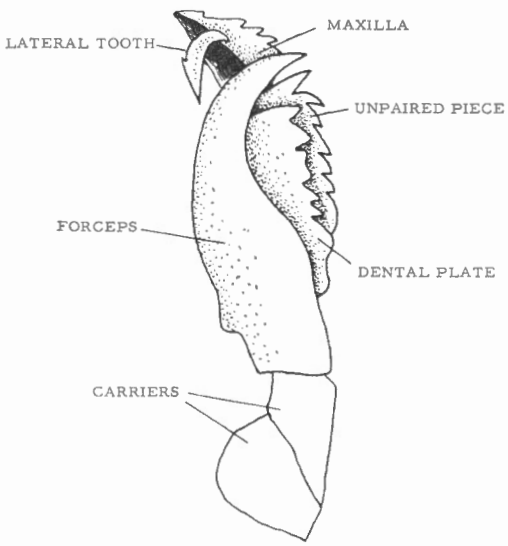

Figure 6. Oral view of the left side of polychaete annelid jaw apparatus, showing terms of scolecodont morphology.

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The terminology used is shown in Figures 6 and 7. The scolecodonts have brilliant coal-black preservation; before photography they were whitened with sublimated ammonium chloride.

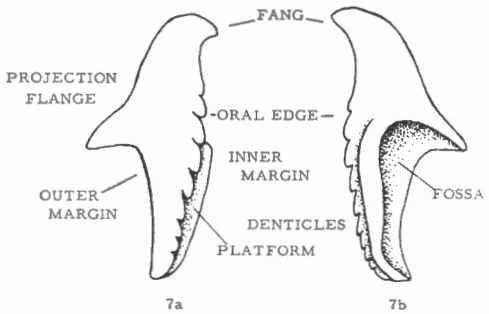

Figure 7. Left forceps of *Ildraites* sp. 7a, oral view; 7b, aboral view.

Genus *Arabellites* Hinde, 1879

Arabellites sinuatus n. sp.

Plate V, numbers 1 a, b

Diagnosis. Left forceps of a species of the genus *Arabellites* with long, hooked fang, a larger number of backward-directed denticles on the oral edge beginning on the front third of the jaw, a small platform on the inner side of the oral edge, and a triangular projection on the outer margin.

Description. The long fang is pointed upward in a wide semicircle and is hooked in the posterior part; externally it shows a longitudinal edge. The posterior edge tapers to the oral edge, which begins in the anterior third of the jaw and is provided with twelve to fourteen small, laterally compressed denticles, which are sharp-edged in the front and rear parts. The outer margin behind the middle of the jaw forms a triangular projection. Posterior of this, the outer margin is very thin and brittle. It moves in a low ridge to the widely truncate posterior end. The inner margin within the posterior half runs parallel to the oral edge and close to it, so that a small platform is formed. The aboral fossa extends from the posterior up to the middle of the jaw. In this area it extends over the whole width.

Comparison. In the literature several similar species have been described, but in comparison with *Arabellites sinuatus* certain differences can be noted. In *A. rectidens* Eller, 1940, the fang is not hooked and is more forwardly directed. The triangular projection of the outer margin is missing in *A. spicatus* var. *contractus* Hinde, 1880, *A. contractus* Hinde, 1882, *Protarabellites hamiltonensis* Stauffer, 1939, and *A. rectidens* Eller, 1940. In *A. spicatus* var. *contractus* Hinde, 1880, and *A. rectidens* Eller, 1940, the oral edge provided with denticles is shorter; it starts farther in the rear and carries fewer denticles. All these species

are closely related. However, since their individual features are constant to a high degree, as shown by other authors and also by the specimens described here, these forms remain as separate species.

Remarks. The specimen shown on Plate V, number 1, is the largest one of this species in the collection. The other specimens are of the size of *Ildraites beckeri* n. sp. (Pl. V, No. 2). This suggests that these two species might refer to the respective left and right sides of the same jaw apparatus of a single species.

Material. Four specimens from GSC loc. 26428.

Genus ***Ildraites*** Eller, 1936

Ildraites beckeri n. sp.

Plate V, numbers 2a-c

Diagnosis. Right forceps of a species of the genus *Ildraites* Eller, 1936, with a strong, hooked fang, a row of strong, backwardly directed denticles, and a wide, rounded, exteriorly extended flange at the outer margin.

Description. The strong, hooked fang is laterally provided with an edge on each side. The inside edge tapers to the oral edge, which bears approximately ten backwardly directed, strong, more or less laterally compressed denticles. The outside edge of the fang tapers to the outer margin. The outer margin forms the margin of a broadly rounded flange, separated from the posterior part by a sickle-shaped notch. The inner margin is thick and round; it borders on the wide fossa extending approximately over the posterior half of the jaw.

Comparison. Ildraites peramplus Eller, 1940, and *I. camurus* Eller, 1945, appear to be closely related to this new species. They differ in several characteristics, however, in particular because they lack an outwardly extending flange. In *I. peramplus* and *I. camurus* the outer margin is parallel to the oral edge and extends to the end of the slightly rounded (in *I. peramplus*) or posteriorly pointed (in *I. camurus*) flange.

Material. Seven specimens from GSC loc. 26428.

This species is named for Professor Carl Becker of the University of Marburg.

Ildraites n. sp.

Plate V, numbers 3a-c

This species differs from known similar forms in its strong oralaboral flattening which, with the equally flattened fang, gives the foremost part the shape of a shovel. Due to this shape of the outer margin, a long, narrow, lateral projection is formed at about the midlength of the jaw. The oral edge is provided with a row of eleven denticles, which decrease in height regularly towards the anterior and posterior ends of the row. The inner margin just behind

the middle turns off towards the inner side and subsequently extends again parallel to the oral edge in the posterior. This produces a narrow interior platform in the posterior half of the jaw. One-half of the aboral side is occupied by a relatively small fossa, whose margins are slightly swollen.

Genus *Leodicites* Eller, 1940

Leodicites sublunatus n. sp.

Plate V, numbers 4a, b

Diagnosis. Dental plate of a species of the genus *Leodicites* Eller, whose oral edge is provided with a row of three to four large denticles followed by another row of smaller denticles.

Description. The jaw is elongated, rounded, wide anteriorly, and tapering to a slender posterior end. Anteriorly a round bow is present on the inner margin. It forms a narrow, arched process with the outer margin. The oral edge is provided with a row of laterally compressed, backwardly directed denticles. Of the first four large denticles, the two in the middle are the largest. These four denticles are followed by a row of about seven smaller denticles that decrease in size towards the anterior and posterior ends. The aboral side of the jaw, including the arched process, is occupied by a deep fossa.

Comparison. The new species shows relationships to *Arabellites lunatus* Hinde, 1879, *Eunicites hebes* Hinde, 1882, *Arabellites excentricus* Stauffer, 1933, *Leodicites biformis* Eller, 1945, *L. clementis* Eller, 1945, *L. convallis* Eller, 1945, and *Polychaetaspis warkae* Kozlowski, 1956. These species, however, are easily distinguished from *Leodicites sublunatus* by differences in the denticles; the first denticle is always the largest, and subsequent denticles decrease regularly in size towards the posterior. In addition, in *Arabellites excentricus* Stauffer the first three denticles show a further divergence in being strongly bent towards the posterior.

Material. Four specimens from GSC loc. 26428.

Leodicites alatus n. sp.

Plate V, numbers 5a, b

Diagnosis. Dental plate of a species of the genus *Leodicites* Eller with strongly conspicuous antero-lateral process. The oral edge following the two large first denticles is provided with a row of smaller denticles.

Description. Jaw subtriangular, anteriorly wide, tapering to the posterior. The outer margin anteriorly describes a sickle-shaped arch towards the exterior and thus with the inner margin forms a narrow, wing-like antero-lateral process. The oral edge is provided with a row of laterally compressed, anteriorly and posteriorly sharp-edged, backwardly directed denticles. The smaller first denticle is followed by the second, considerably larger denticle. Posteriorly follows a row

of six denticles; the first is small and the remaining ones of equal size but considerably smaller than the aforementioned second denticle. The aboral side of the jaw, including the antero-lateral process, is occupied by a deep fossa.

Comparison. Arabellites magnificus Stauffer, 1933, has a similar shape, but its antero-lateral process extends straight down rather than being arched to the posterior, and its denticles are different. *Leodicites scitulus* Eller, 1941, and *L. arquatus* Eller, 1945, also have a similar shape, but behind the largest first denticle their denticles decrease in size regularly towards the posterior.

Material. Three specimens from GSC loc. 26428.

Leodicites sp.

Plate V, numbers 6a, b

The posterior end of the specimen shown is not completely preserved, although apparently originally it was not much longer. The oral edge is provided with a row of laterally compressed denticles, which regularly decrease in size from the first denticle to the posterior. The outer margin in the anterior part bends off at an acute angle towards the posterior, so that it forms a triangular process with the extended margin of the first denticle. The aboral side is occupied by a fossa that is flat in its major part.

Genus *Lumbriconereites* Ehlers, 1868

Lumbriconereites cf. *L. webbi* Stauffer, 1933

Plate VII, numbers 1 to 3

1933. *Lumbriconereites webbi* Stauffer, Bull. Geol. Soc. Amer., vol. 44, p. 1198, Pl. 60, fig. 3.

The present specimens are largely in conformity with the original illustration and description. However, four denticles are missing. In the specimen reproduced on Plate VII, number 1, only a smaller denticle shows between the first and third denticles, whereas in the respective right side (Pl. VII, Nos. 2, 3) two smaller denticles are interpolated.

Some relationship may exist with *Eunicites anchoralis* Eller, 1934, but the incomplete drawings do not allow precise comparison. *Arabellites ausablensis* Stauffer, 1939, appears to be related, but it has more irregularly shaped denticles.

Lumbriconereites n. sp.

Plate VII, numbers 4a-c

This species shows much conformity with *Lumbriconereites* cf. *L. webbi* Stauffer, 1933; however, the first denticle is considerably larger than the next four denticles. This may be an independent form rather than a juvenile form of *L.* cf. *L. webbi,* which is clearly shown by comparing it with a juvenile form of *L.* cf. *L. webbi* of about the same size as this species (Pl. VII, No. 3).

Lumbriconereites sp.

Plate VII, numbers 5a-c

The specimen reproduced shows a strong, posteriorly directed fang above a wide, subtriangular fossa. The fang laterally is provided with two rib-shaped edges. A further edge is visible at the posterior part of the fang and tapers to the oral edge, which is provided with a small, equally posteriorly directed denticle.

Eller, in 1938 under the genus *Eunicites* and in 1945 under *Eunicites* and *Ungulites,* described forms which, although principally similar, in detail prove to be considerably different. It would appear that they refer to the same type of form as the previously described species of *Lumbriconereites.*

Genus ***Polychaetaspis*** Kozlowski, 1956

Polychaetaspis ? *kozlowskii* n. sp.

Plate VI, numbers 1 to 3

Diagnosis. Right dental plate of the *Lumbriconereites* type with wide anterior face and strongly pronounced lateral flange. Third denticle very large, fourth denticle very small, followed by a row of denticles of more or less the same size extending to the posterior end.

Material. Three specimens from GSC loc. 26428.

Right Dental Plate

Description. The exterior edge is bordered by the first, blade-like denticle, which is bent almost vertically upward. The second denticle is slightly smaller and of almost the same shape. The third denticle is considerably larger and almost circular in cross-section. Beyond a small gap the dental row, headed by a very small denticle, extends to the posterior end, all the denticles being slightly inclined backward and to the exterior. The oral surface is slightly concave, and the fossa-free aboral surface is convex and bight-like. The aboral surface bends upward to the oral margin at the anterior end. The outer margin extends in a low arch slanting outwardly and, about in the midlength of the jaw, inwardly again, so that a kind of hook-shaped flange is formed that is separated from the posterior part of the jaw by a sickle-shaped bight. On the aboral side a fossa extends over two-thirds of the length. The margin of the fossa is slightly thickened.

Comparison. In most characters the right dental plate of the new species resembles *Polychaetaspis* sp. Kozlowski, 1956, but it differs in the formation of the anterior denticles, which in *Polychaetaspis* sp. Kozlowski have considerably more regular development than in *P.* ? *kozlowskii* n. sp. There is also resemblance to *Kettnerites kosoviensis* Žebera, 1935 (as defined by Šnajdr, 1951), but *K. kosoviensis* has only one smaller denticle before the large denticle, the oral edge has

a sharper bend, and the whole jaw is relatively wider, so that *K. kosoviensis* resembles even more the right dental plate of *Paulinites paranaensis* Lange, 1947.

Left Dental Plate

Description. The anterior point is formed by two large, flattened denticles, of which the second is the larger. Seven very small denticles follow. After two intermediate denticles, a row of nine larger denticles decreasing in height extends to the posterior end. The outer margin in the anterior half is slightly concave and subsequently bends off vertically to the inside, thus forming a triangular shank. From the middle, the outer margin extends obliquely to the posterior end. The inner margin in the posterior half forms a small platform projecting to the interior and extending parallel to the oral edge.

Comparison. The left dental plate of *Polychaetaspis* ? *kozlowskii* n. sp. is similar to *Polychaetaspis* sp. Kozlowski, 1956, but in the latter the anterior two denticles are considerably less extended. *Kettnerites kosoviensis* Žebera, 1935, and *Paulinites paranaensis* Lange, 1947, differ from *Polychaetaspis* ? *kozlowskii* n. sp. solely in that they have developed only one anterior, strongly pronounced, fang-like tooth. This is also true of *Arabellites anglicus* Hinde, 1882, which has other stronger divergencies as well.

Remarks. Although a relation between the two dental plates described here as *Polychaetaspis* ? *kozlowskii* n. sp. cannot be proved, study of the described complete specimens of species of *Kettnerites* Žebera, *Paulinites* Lange, and *Polychaetaspis* Kozlowski suggests that these two dental plates do belong to one species. Definite generic assignment of the two dental plates here assigned to *Polychaetaspis* ? *kozlowskii* n. sp. cannot be made at present.

This species is named for Professor Roman Kozlowski, Warsaw.

Polychaetaspis cf. *P. wyszogrodensis* Kozlowski, 1956

Plate VI, numbers 4 to 10

1956. *Polychaetaspis wyszogrodensis* n. sp. Kozlowski, Acta Paleont. Polonica, I, p. 175, figs. 3-6, 9, 10.

The specimens illustrated correspond to a large extent to the left and right forceps shown by Kozlowski (1956, figs. 9, 10). In the left forceps the concave oral surface is wider anteriorly than those shown by Kozlowski, and the flange, triangular to rounded off in shape, is more pronounced. In the right forceps the outer margin is more sickle-shaped than in Kozlowski's illustrations.

It seems doubtful whether the slender form with the only slightly developed flange (Pl. VI, No. 10) belongs to this species. It is possible that this may be an extremely old specimen.

As Heider (1922) has shown, the polychaete annelids have a second dentition. Thus the illustrated specimens differing greatly in size must be considered as different growth stages, i.e., a kind of ontogenetic sequence. The present study indicates, as Kozlowski also found in his material, that the old stages differ

in their morphologic character at most in number of denticles, and even this varies only from twelve in the smallest specimens (Pl. VI, No. 8) to fifteen in the largest specimens (Pl. VI, No. 9).

Comparison. Left forceps: *Lumbriconereites cooperi* Eller, 1938, shows many characteristics in common with *Polychaetaspis* cf. *P. wyszogrodensis,* but a flange is only slightly developed. *Lumbriconereites obliquus* Eichwald (as illustrated by Hinde, 1882) is very close to *P.* cf. *P. wyszogrodensis,* but the aboral fossa is extended much farther forward; however, further research may reveal their identity.

Right forceps: *Oenonites amplus* Hinde, 1879, is considerably wider; the first denticle is much more strongly developed and is separated from the second denticle by a gap. *Lumbriconereites marlenediesae* Eller, 1942, and *L. johnsoni* Eller, 1945, have wider end parts, and their flanges are more rectangular than triangular. *L. hibbardi* Eller, 1940, is closer to *P.* cf. *P. wyszogrodensis,* but its flange is slightly less pronounced; again, further investigation may indicate their identity. In *L. cooperi* Eller, 1938, the flange is less extended laterally and the first denticle is slightly removed from the other denticles. In *L. affinis* Stauffer, 1933, the inner margin is heavily arched, the whole, very massive jaw is narrower and the first denticle is separated from the remaining dental row.

Undetermined Scolecodonts

Plate VII, numbers 6, 7

Plate VII, number 6. The jaw has the shape of a flat, slender cone with a bent point, and laterally at the posterior end it is provided with a flange-like bight. On the aboral side at the posterior end a flat, transversely oblong fossa is formed extending into the cone.

A remotely similar form has been figured by Eller (1945) as *Eunicites ansatus* n. sp. Our specimen may refer to a lateral tooth, as in Eller's form. These elements in the jaw apparatus are not common, however, and there are very few descriptions of them in the literature.

Plate VII, number 7. This jaw consists of a slender, high tooth placed on a triangular base that is strongly extended posteriorly. The basal anterior margin of the tooth forms a small triangular process, aborally extending obliquely to the posterior. The aboral side is occupied by a deep fossa.

This specimen probably also refers to a lateral tooth. Similar specimens, though not directly comparable to our specimen, have been illustrated by Hinde (1882) as *Arabellites uncinatus* n. sp., by Žebera (1935) as *Ebetallites* n. gen. *ancoraeformis* n. sp., and by Eller (1945) as *Eunicites whiteae* n. sp.

Stratigraphic Position of the Scolecodonts

The scolecodonts in this collection are related to species known from the Ordovician to the Middle Devonian. The differences in form, although clearly discernible, are nevertheless very slight. From this we may conclude that most of

the Palæozoic scolecodont-bearing polychaete annelids developed very slowly. The scolecodonts, therefore, are of very little use for stratigraphic purposes. Better collections and further knowledge of the variation in width and the relationships of the single jaws may in the future make the scolecodonts more valuable as time indicators.

Conodonts

The collections contain only a limited number of conodonts—tooth-shaped parts of fluorapatite from animals of unknown systematic position (Chordata ?). It is regrettable that the specimens are so few as they represent a fauna of considerable phylogenetic, systematic, and stratigraphic interest.

The quoted genera and species, as various assemblages have shown, are in fact form genera and form species, several of which may have been united in one animal. The orientation of the conodonts and the nomenclature of their parts are shown in Figure 8. The specimens were coated with ammonium chloride before photographing.

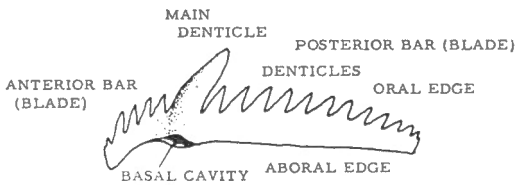

Figure 8. Terms of conodont morphology, as illustrated by *Hindeodella* sp.

Genus *Angulodus* Huddle, 1934

Angulodus n. sp.

Plate VIII, number 19

The present specimen shows the characteristics typical of this genus. The posterior bar is bent downward posteriorly. The anterior bar in its fore-part is bent slightly downward and inward. The main denticle and the denticles of the bars are widely to narrowly elliptical in cross-section, with anterior and posterior edges. The bases of the short, slightly backwardly directed bar denticles are coalesced.

Beneath the main denticle is a basal cavity, heavily bloated laterally and transformed anteriorly and posteriorly into a fossa extending on the aboral edge of the bars to their ends.

Comparison. The new species has similarities with *Angulodus demissus* Huddle, 1934, a Devonian form from the lower New Albany shales, but in the latter the end of the posterior bar is so sharply bent as almost to form a semicircle, and in cross-section the denticles are round, without anterior and posterior edges.

Genus *Hindeodella* Ulrich and Bassler, 1926

Hindeodella cf. *H. equidentata* Rhodes, 1953

Plate VIII, number 15

1953. *Hindeodella equidentata* Rhodes, Phil. Trans. Roy. Soc. London, ser. B., Biological Sciences, No. 647, vol. 237, p. 303, Pl. 3, figs. 248, 252-254.

The present specimen is incomplete and cannot be assigned positively. The discernible characters are clearly in agreement with the named species.

Hindeodella n. sp.

Plate VIII, number 16

The bar is undulated in side elevation as well as viewed from above. The oral edge of the posterior bar is provided with a larger number of denticles of uneven size; between the large denticles are situated two or three smaller, partly developed 'germ denticles'. Both the bar denticles and the main denticle are directed backward. The anterior bar is missing, but the part still remaining shows the arching typical of *Hindeodella*.

Comparison. The denticle formation is similar to that of *H. acuta* Branson and Mehl, 1934, and *H. priscilla* Stauffer, 1938, but neither of these species shows undulation of the bar.

Genus *Ligonodina* Ulrich and Bassler, 1926

Ligonodina sp.

Plate VII, number 13

The posterior bar extends in a straight line from the main denticle to the posterior and is bent downward near its end. It has a few relatively widely spaced, almost round denticles. The oval-shaped main denticle is backwardly inclined. At its anterior side an edge is distinctly formed; the posterior side is rounded. From the main denticle the anterior bar bends in a wide arch to the interior and describes an angle of 90 degrees with the posterior bar. The denticles of the anterior bar are also round, but they are closer to one another. The aboral edge is furrowed by a fossa that widens slightly under the main denticle, forming a barely visible basal cavity.

Comparison. In denticle formation the present specimen resembles *L. acuta* Branson and Mehl, 1934, but in *L. acuta* the anterior bar forms a sharp right angle with the posterior bar. This is even more pronounced in *L. silurica* Branson and Mehl, 1933. *L. diversa* Walliser, 1956, has the same form of bending of the anterior bar, but the denticles stand more closely together and the anterior bar is considerably longer. *L. salopia,* in contrast to the present species, has anteriorly and posteriorly edged denticles.

Genus *Lonchodina* Ulrich and Bassler, 1926

Lonchodina greilingi Walliser, 1956

Plate VIII, numbers 17, 18

1957. *Lonchodina greilingi* Walliser, Notizbl. hess. L.-Amt Bodenforsch., Bd. 85, pp. 38-39, Pl. 3, figs. 20-26.

The specimen reproduced on Plate VIII, numbers 17 and 18, shows the great variation within this species (*see also* Walliser, 1956, p. 38 ff).

Genus *Ozarkodina* Branson and Mehl, 1934

Ozarkodina denckmanni Ziegler, 1956

Plate VIII, numbers 13, 14

1956. *Ozarkodina denckmanni* Ziegler, Notizbl. hess. L.-Amt Bodenforsch., Bd. 84, p. 103, Pl. 6, figs. 30, 31; Pl. 7, figs. 1, 2.

The present specimens are in very close agreement with the original specimens. However, in some places 'germ denticles' are interpolated, these were not observed in Ziegler's specimens. This seems to be dependent on the kind of preservation rather than a feature bearing on the taxonomic evaluation.

Genus *Paltodus* Pander, 1856

Paltodus cf. *P. acostatus* Branson and Branson, 1947

Plate VII, number 10

1947. *Paltodus acostatus* Branson and Branson, J. Paleont., p. 554, Pl. 82, figs. 1-5, 23, 24.

The figured specimen is badly preserved; except that it is more slender than the original figure, our specimen is in agreement with the holotype.

Paltodus cf. *P. recurvatus* Rhodes, 1953

Plate VII, number 8; Figure 9

1953. *Paltodus recurvatus* Rhodes, Phil. Trans. Roy. Soc. London, ser. B., No. 647, vol. 237, p. 297, Pl. 23, figs. 219, 220.

Figure 9. Outline of the cross-section of *Paltodus* cf. *P. recurvatus* Rhodes, figured on Plate VII, No. 8. 9a, near pointed end; 9b, about midlength; 9c, near basal end of cone.

Rhodes (1953) does not illustrate a cross-section of his species, so positive assignment of our specimens to *P. recurvatus* cannot be made. The shape of the cone and the bend of the top correspond exactly with Rhodes' illustrations, but

he makes no mention of longitudinal edges. In the present specimen the anterior face is bordered laterally by more or less distinct edges. In the posterior a further edge extends at the lateral surface, which in the middle has an indistinct keel visible only when the specimen has been coated with ammonium chloride.

Paltodus cf. *P. unicostatus* Branson and Mehl, 1933

Plate VII, number 9; Figure 10

1933. *Paltodus unicostatus* Branson and Mehl, Univ. Missouri Stud., No. 8, p. 42, Pl. 3, fig. 3.

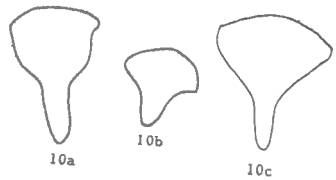

Figure 10. Outline of the cross-section of three specimens of *Paltodus* cf. *P. unicostatus* Branson and Mehl, showing the great variation in width. Specimen 10c is figured on Plate VII, No. 9.

The figured specimen agrees with the original illustration, but again, in the absence of a cross-section, definite assignment under *P. unicostatus* cannot be made. Within certain limits the cross-section varies considerably (*see* Fig. 10). There is always one rib present, although it may be partly indistinct; it limits the anterior plane on one side, whereas on the other side only an edge varying from sharp-edged to rounded is developed. Most of the convex lateral faces diverge towards the posterior, and after a break they extend almost parallel to the posterior end.

Genus ***Plectospathodus*** Branson and Mehl, 1933

Plectospathodus extensus Rhodes, 1953

Plate VIII, number 20

1953. *Plectospathodus extensus* Rhodes, Phil. Trans. Roy. Soc. London, ser. B, No. 647, vol. 237, p. 323, Pl. 23, figs. 236-240.

The Devon Island specimens are in close agreement with the original description and illustrations. The basal cavity, however, does not extend as far up to the posterior edge of the main denticle as it does in the known forms from the lower and middle Ludlow.

Genus ***Prioniodina*** Ulrich and Bassler, 1926

Prioniodina cf. *P. excavata* (Branson and Mehl, 1933)

Plate VIII, number 12

1933. *Prioniodus excavatus* Branson and Mehl, Univ. Missouri Stud., No. 8, p. 45, Pl. 3, figs. 7, 8.

The present specimen appears to be in perfect agreement with the quoted species; however, as most of the posterior bar is missing, a definite assignment to this species cannot be made.

Prioniodina bicurvata pronoides n. subsp.

Plate VIII, numbers 8 to 10

1957. *Prioniodina* n. sp., Walliser, Notizbl. hess. L.-Amt Bodenforsch., Bd. 85, p. 47, Pl. 2, fig. 15.

Diagnosis. A subspecies of *P. bicurvata* that differs from the typical subspecies *P. bicurvata bicurvata* (Branson and Mehl) in having strongly forwardly directed denticles.

Description. A conodont with a long, slightly curved, crooked posterior bar that has a large number of relatively uniform denticles on the oral side. The convex sides of the denticles are flattened and meet in an anterior and posterior edge. The bases of the denticles are coalescent, the tops discrete. The denticles are directed steeply forward, forming an angle of less than 45 degrees with the aboral edge. The aboral edge has a longitudinal fossa on the posterior bar; anteriorly it bends off sharply and broadens to form a basal cavity. The margin of the basal cavity forms an angle of 80 to 100 degrees with the aboral edge of the posterior bar. The main denticle, situated above the basal cavity, is considerably larger than the other denticles; it is equally biconvex, the outer side being slightly flatter than the inner side. The lateral faces meet along sharp edges. Anterior to the main denticle are several denticles (up to six in most specimens); whenever they are present in a large number they form a kind of anterior bar.

Comparison. This new subspecies differs from the typical subspecies by the steep forward inclination of the denticles. In the typical subspecies the angle between the denticles and the aboral edge is more than 45 degrees and usually much more. *P. prona* (Huddle, 1934), in contrast to the new subspecies, has discrete denticles, and the angle between the anterior and posterior bars is smaller (about 45 to 60 degrees). Otherwise, *P. prona* and the new subspecies are similar.

Remarks. It may definitely be assumed that the new subspecies is not an extreme variation of *P. bicurvata bicurvata.* In a fauna of several hundred specimens from the middle Ludlow, the typical subspecies showed relative constancy of form, and there were no specimens transitional between the typical subspecies and the new subspecies (Walliser, 1957, p. 47; in this paper the new subspecies, here named *P. bicurvata pronoides,* was described as *Prioniodina* n. sp.). The new subspecies appears to have been derived from the typical subspecies.

Material. Twelve specimens from GSC loc. 26428.

Prioniodina cf. *P. bicurvata pronoides* n. subsp.

Plate VIII, number 11

The posterior bar of the illustrated specimen is missing. The denticle formation, the form of the basal cavity, and the form of the aboral edge are in complete accord with those of *P. bicurvata pronoides.* The figured specimen does, however, have a relatively long and slightly angled anterior bar with eight denticles.

Genus *Spathognathodus* Branson and Mehl, 1941

Spathognathodus canadensis n. sp.

Plate VIII, numbers 1 to 3

Diagnosis. A species of the genus *Spathognathodus* with a straight to slightly bent blade having a row of denticles of uneven size and in which the margins of the subcentrally situated basal cavity extend laterally, forming tongue-like processes of different length.

Description. The blade extends in a straight line or is only slightly bent. The oral edge has a row of denticles of uneven size, generally ten to twelve but occasionally up to fourteen. A larger denticle is always on top of the basal cavity as well as in the proximity of the anterior end. The latter, by growing together with further denticles, may form a blade-like tooth. The tops of the denticles are always discrete, but the bases are more or less closely grown together. The basal line of the denticles is always slightly sigmoidal. The aboral margin in the anterior part is higher than in the posterior; consequently, the blade in the anterior is less high than in the respective posterior part. The aboral edge is grooved by a narrow fossa. At its transition between the anterior and the posterior aboral edge the fossa abruptly enlarges to form the subcentrally situated basal cavity whose margins are strongly extended laterally into long, unequal, tongue-like formations.

Comparison. The new species is closely related to *S. fundamentatus* Walliser, 1956. In the latter species, however, the equally widely extended basal cavity is entirely situated behind the middle of the conodont, in most cases extending up to its posterior end, and the heights of the blade and its denticles are more regular.

There is also great resemblance between the new species and *S. frankenwaldensis* Bischoff and Sannemann, 1958. The form of the basal cavity and its margin is the same in both, but in *S. frankenwaldensis* the oral and aboral edges show a more pronounced sigmoidal bend, and the much more strongly developed denticles of the anterior end have grown together to form a blade that is much higher than the other denticles. *S. fundamentatus* Walliser seems to be intermediate between *S. canadensis* and *S. frankenwaldensis.*

Material. Twenty-one specimens from GSC loc. 26428.

Spathognathodus cf. *S. canadensis* n. sp.

Plate VIII, numbers 4a, b, 5a-c

The specimen shown in Plate VIII, number 5, differs from the holotype in its closely grouped row of denticles. Since the points of about fifteen denticles are broken off, positive assignment to the species cannot be made.

The specimen shown in Plate VIII, number 4, seems to be a juvenile specimen of the new species. The development of variability in denticle size is already discernible, but the basal cavity does not yet have a tongue-like outline.

Spathognathodus sp.

Plate VIII, number 6

The specimen shown corresponds in the form of the blade, the basal cavity, and the oral and aboral edges to *S. canadensis*. The fourteen denticles present, however, are more or less the same size, and there are no denticles of considerably larger size.

Spathognathodus n. sp.

Plate VIII, number 7

The collection contains only one incomplete specimen of this species. The anterior blade (broken off) and the posterior blade (complete) are densely provided with uniform, laterally flattened, slightly backwardly directed denticles touching one another at least at the base. Beneath the only slightly larger main denticle, there is an oblong basal cavity that extends along the blades as a slight groove. Away from the basal cavity the posterior blade is bent downward. The specimen resembles *S. wurmi* Bischoff and Sannemann, 1958, in its denticle formation, the form of the basal cavity, and its crooked posterior blade, but the swollen oral widening of the blade is missing. The specimen seems to be intermediate between *S. inclinatus* (Rhodes, 1953) and *S. wurmi* Bischoff and Sannemann, 1958.

Genus *Trichonodella* Branson and Branson, 1947

Trichonodella inconstans Walliser, 1956

Plate VII, numbers 11, 12

1957. *Trichonodella inconstans* Walliser, Notizbl. hess. L.-Amt Bodenforsch., Bd. 85, pp. 50-51, Pl. 3, figs. 10-17.

Although all the specimens are damaged, they are clearly in agreement with the type material.

Undetermined Conodonts

The collection included one specimen each of the forms described below, all too damaged for generic assignment. They are illustrated in order to put their occurrence on record for possible future taxonomic and stratigraphic use.

Plate VII, number 14. The anterior bar is completely preserved. Laterally it is slightly bent to the interior. The oral edge has a row of denticles not differing greatly in size and with slightly convex lateral faces that meet anteriorly and posteriorly in the edges. Between these denticles 'germ denticles' are discernible. The considerably larger main denticle has the same form as the other denticles. It is inclined relatively sharply to the posterior. Beneath the main denticle a small basal cavity is formed, which extends anteriorly and posteriorly to form a groove on the aboral edge. Presumably this specimen is similar to *Plectospathodus* Branson and Mehl, 1933, traced to a form such as *Plectospathodus extensus* Rhodes, 1953.

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Plate VII, number 15. The posterior bar is missing, but the inwardly bent anterior bar is almost completely preserved. The denticles are of uneven size, and they vary from almost circular to almost elliptical in cross-section. One denticle has an edge developed posteriorly. Beneath the main denticle is a moderately extended basal cavity, which continues as a groove along part of the anterior bar. The specimen may belong to *Plectospathodus* Branson and Mehl, 1933, or *Lonchodina* Ulrich and Bassler, 1926.

Plate VII, number 16. The two bars of this specimen form an obtuse angle. They are provided with a row of oblong, anteriorly and posteriorly edged, backwardly directed denticles, touching one another only at their bases. Beneath the large main denticle is a wide, not very deep basal cavity that extends first as a wide, very shallow groove and then as a wide, slightly convex base to the end of the posterior bar.

Plate VII, number 17. This specimen resembles in some characteristics the *Spathognathodus* n. sp. illustrated on Plate VIII, number 7. The basal cavity, however, extends farther on the bars. In addition, the anterior bar seems to be shorter than the posterior bar, the reverse of the relation seen in Plate VIII, number 7.

Stratigraphic Conclusions from the Conodont Fauna

Conodonts have not previously been described from beds comparable in age with the Sutherland River formation. Middle Ludlow faunas have been described by Branson and Mehl (1933), Rhodes (1953), and Walliser (1956). A fauna of probable Siegenian age has been described by Bischoff and Sannemann (1958), and several faunas of Emsian age have been described by Ziegler (1956). However, the author has had available to him middle Ludlow to Emsian faunas from Central Europe, Bohemia, the Carnic Alps, Spain, Scandinavia, and northern Germany, which have made it possible to date the conodont fauna described in this paper.

The fauna from the Sutherland River formation contains a number of form-species known from the middle Ludlow of England (Aymestry limestone), the Rheinisches Schiefergebirge (Orthoceren-kalk of Giessen), the Frankenwald (Orthoceraten-kalk of Elbersreuth), and the Carnic Alps (*Rhynchonella megaera*-strata). These include *Hindeodella* cf. *H. equidentata, Lonchodina greilingi, Paltodus* cf. *P. recurvatus, Paltodus* cf. *P. unicostatus, Plectospathodus extensus, Prioniodina* cf. *P. excavata, Prioniodina bicurvata pronoides,* and *Trichonodella inconstans.* Of these, *Plectospathodus extensus* and *Prioniodina excavata* are also known to occur in the next youngest described fauna, probably Siegenian age. *Ozarkodina denckmanni* is known from the Emsian.

The remaining conodonts from the Sutherland River formation have thus far not been described, but some of them allow comparison with known species: (1) *Angulodus* n. sp. suggests a relationship with a considerably younger Devonian form; (2) *Spathognathodus canadensis* is very close to the 'Siegenian' form *S. frankenwaldensis,* but has not attained its strongly pronounced denticle

differentiation; (3) *Spathognathodus* n. sp. seems to be intermediate between *S. inclinatus* (middle Ludlow) and *S. wurmi* ('Siegenian').

Hence, our fauna contains a large number of 'old' forms that occur frequently in the middle Ludlow, some of which are also known in the lower Ludlow. Along with these are several species which evidently are intermediate between the older (middle Ludlow) and the younger ('Siegenian') faunas. Except for *Ozarkodina denckmanni*, all the younger elements are missing, especially *Ancyrodelloides* Bischoff and Sannemann, which is known exclusively from the 'Siegenian'. On the basis of the faunas known in the literature, then, we can conclude that our fauna ranges from middle Ludlow to 'Siegenian'.

The Sutherland River conodonts can be dated more precisely by comparing them with some undescribed faunas that were available to the author. These faunas come from the so-called *Beyrichia*-limestone (which occurs in northern Germany as glacial boulders) and from a section in the Carnic Alps extending from the Wenlock to the Lower Devonian.

In the *Beyrichia*-limestone a species of *Spathognathodus* frequently occurs that is much in agreement with our *S. canadensis*. Above an already subcentrally situated basal cavity, the margin of which is not yet as widely extended, a larger denticle has developed. The other denticles are almost alike in form and size. *S. canadensis* thus is intermediate between the new species of *Spathognathodus* from the *Beyrichia*-limestone and *S. frankenwaldensis*. *Ozarkodina denckmanni* is not yet present, but the genus is represented by a form like *O. media* Walliser, 1956. Also present are *Prioniodina bicurvata pronoides* and *Hindeodella* sp. which has an alternating denticle formation similar to our *Hindeodella* n. sp. but without undulation of the bar. From these few forms alone it may be concluded that the Sutherland River fauna is intermediate in age between the fauna of the *Beyrichia*-limestone and the 'Siegenian' fauna.

The conclusions resulting from this comparison with the fauna of the Beyrichian-limestone boulders is best confirmed by the faunal sequence in the continuous section of the Valentintörl-peak in the Carnic Alps. Above the fauna of the *Rhynchonella megaera*-strata (upper middle Ludlovian, not upper Ludlovian; cf. von Gaertner, 1931, 1958, and Walliser, 1956) occur the following faunas, from bottom to top stratigraphically: (a) a fauna with numerous middle Ludlovian forms such as *Ozarkodina media, Prioniodina bicurvata,* and *P. bicurvata pronoides,* and also with *Spathognathodus* n. sp., which in its denticle formation is similar to *S. fundamentatus* Walliser and to the new species of *Spathognathodus* from the *Beyrichia*-limestone but whose basal cavity is formed in the middle of the posterior half of the blade, making it intermediate between *S. fundamentatus* and the new species of *Spathognathodus* from the *Beyrichia*-limestone; (b) a fauna much in accordance with the fauna from the *Beyrichia*-limestone; (c) a fauna like that of the Sutherland River formation; and (d) a fauna with *Ancyrodelloides trigonica* Bischoff and Sannemann, 1958, i.e., like the fauna of 'Siegenian' age. This section again shows the Sutherland River fauna to be intermediate in age between the *Beyrichia*-limestone and the 'Siegenian' fauna.

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The boundary between the Silurian and the Devonian has not yet been established internationally. In England the Downtonian is put in the lowest Devonian and the Ludlow Bone Bed is considered to be the boundary (White, 1956), a view which has recently been supported by Wolfgang Schmidt (1958). Unfortunately, the conodonts of the Ludlow Bone Bed have not yet been described. The *Beyrichia*-limestone was placed in the upper Ludlovian by Gross (1947), who was also of the opinion that the Ludlow Bone Bed eventually may be placed in the upper Ludlovian as a correlative of Stage K4 of the Isle of Oesel. The border between the Silurian and the Devonian in the Carnic Alps has not yet been established. The 'Siegenian' of Bischoff and Sannemann (1958) has not yet been proved by study of the macrofauna; the conodont fauna was placed within the 'Siegenian' only because it is younger than the known middle Ludlovian faunas but older than the Emsian, to which, however, it is closely related.

From this it becomes evident that a positive age for the Sutherland River conodont fauna can be given only after an internationally accepted establishment of the Silurian-Devonian boundary. In determining the boundary the conodonts as well as the macrofauna can be of use, for conodonts can indicate delicate stratigraphic divisions over wide areas and even over entire continents.

For the present purpose, an arbitrary boundary will be drawn between the Silurian and Devonian with the introduction of the 'Devonian elements' *Ancyrodelloides* Bischoff and Sannemann and *Icriodous* Branson and Mehl. Thus, of the above-mentioned faunas from the Carnic Alps, faunas (a) to (c) should be placed in the upper Ludlovian, and fauna (d) in the lowest Devonian. The Sutherland River fauna should thus be placed (with due reservation made for the international establishment of the Silurian-Devonian boundary) in the highest upper Ludlovian.

Acanthodii

Genus *Nostolepis* Pander, 1856

Nostolepis sp.

Plate VIII, numbers 21a-c

Some scales of an acanthodian fish are present in the collection from the Sutherland River formation. The scale figured here consists of an unornamented base part and a ribbed crown separated by a neck part. The base is peripherally a transversely placed rhombus, greatly arched. Anteriorly the neck is only slightly pronounced, but beginning laterally in the posterior between the crown top and the base it is slightly deepened to a hollow-grooved shape. The crown forms a longitudinal rhomboid plate that rises obliquely to the posterior. Its posterior sides vary between straight and slightly concave, and they are longer than the anterior sides. They thus form a posteriorly directed cone that extends slightly beyond the base. The posterior part is bordered on each side by two edges converging towards the point of the cone; anteriorly they become ribs. In addition, seven ribs are situated along the anterior margin of the crown-plate. They begin

to form faintly at the base of the crown, and they are strongest at the turn of the surface to the crown-plate, where they disappear gradually by flattening. A vertical thin-section shows the histologic structures that are characteristic for *Nostolepis,* especially the holes that resemble bone cells in the layers at the base of the scale.

Comparison. The species corresponds very well with *Nostolepis striata* Pander as illustrated by Pander and by Gross. It differs from the specimen shown by Gross (1947, Pl. 26, fig. 7) only by the sharper arching of the base.

Stratigraphic range. The genus *Nostolepis* with its typical species *N. striata* Pander has been described as found within the Upper Silurian of the Isle of Oesel. It has been referred to from time to time by subsequent authors, and Gross made a thorough investigation of it. Gross' material came from the *Beyrichia*-limestone (i.e., from the upper Ludlow), and he mentioned that on the Isle of Oesel, *Nostolepis* appears only in Stage K4 (upper Ludlow; presumably the stratum of Pander's find). Furthermore, one specimen of *Nostolepis* was found by Gross in the Ludlow Bone Bed, the base of the English Downtonian. According to Dr. Tor Ørvig, Riksmuseum, Stockholm, *Nostolepis* extends up to the lowest Devonian (oral communication).

The specimen shown on Plate VIII, numbers 21a-c, is the first of this genus to be found in North America. The known stratigraphic range of *Nostolepis,* in particular one of the group resembling *N. striata* Pander, therefore, is in good agreement with the stratigraphic dating indicated by the conodonts.

TRILOBITES

H. B. Whittington[1]

Trilobite pygidium

Plate IX, numbers 1 to 3

Material. An incomplete silicified pygidium, Sutherland River formation, Douro Range, Devon Island; GSC loc. 26428.

Description. Outline triangular, width greater than sagittal length. Axis strongly convex, tapering evenly backward to rounded, prominent tip; shallow articulating furrow, ring furrows deepest and broadest anteriorly, becoming narrower and shallower backward, dividing the axis into fourteen rings, the last of these rings being faintly defined and close to the tip. Third to tenth ring furrows display best a characteristic sinuosity—medially the furrow has a forwardly convex bend which merges laterally into a faint backwardly convex curve, then into the most distal part which again has a faint forwardly convex curvature. Beyond the tenth ring furrow the furrows become faint and present only in the median region. On steeply sloping tip of axis, just inside border, is a faint convexity suggestive of a post-axial ridge. Inner part of pleural region adjacent to axis horizontal, outer part curved down to slope steeply outward and backward; narrow smooth border, defined by shallow border furrow, extends behind the steeply sloping tip of the axis. Between axis and border furrow pleural regions crossed by pleural furrows which are curved backward distally and are progressively directed more strongly posteriorly. Seven pleural furrows may be distinguished, the ribs between them extremely faintly subdivided by an interpleural groove, this groove best defined adjacent to the axis and close to the border furrow. Doublure narrow, curled under border; border broken on left side and behind axis.

The general form of this pygidium and the sinuosity of the ring furrows lead me to consider that it is probably a phacopoid. Within this group it most resembles pygidia of some dalmanitid genera. As the edge of the pleural regions behind the axis is broken the possibility cannot be excluded that this pygidium bore a small median border spine.

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GASTROPODS

Ellis Yochelson[1]

Collections from two localities, 26415 and 26428, in the Sutherland River formation on Devon Island contain silicified gastropods. Photographs of the gastropods are by N. W. Shupe of the U.S. Geological Survey.

The gastropods are exceedingly difficult to date stratigraphically for several reasons. First, middle Palæozoic gastropods have not been studied either intensively or extensively for more than 60 years. This applies equally to the American and European faunas. Second, although most of the gastropods that have been described from the Silurian and Devonian are relatively large, almost all the silicified specimens in the present collection are fairly small. Third, the preservation of the silicified gastropods is poor in that growth lines cannot be seen on most specimens.

The most probable age of the two collections is Silurian or Devonian. The occurrence of *Gyronema* rules out a Mississippian age, and several characteristic Ordovician genera are absent. Unfortunately, none of the genera identified is restricted to either Silurian or Devonian. In the U.S. National Museum collections, I have been able to find only two groups of specimens that aid with the problem of age determination. One, a single specimen similar to those identified as *Cyclonema* species, is from the Silurian of Pembroke township, Maine. The other, a small collection of high-spired gastropods resembling *Murchisonia* sp. 1, is from the Keyser limestone near Cumberland, Maryland. Identification with the specimens for Canada is only tentative in both cases.

In addition, all Devonian specimens in the Museum collections referred to *Cyclonema* bear comparatively few, coarse, spiral lirae. Species with numerous, fine lirae appear to be restricted to the Ordovician and Silurian. The *Cyclonema* from Devon Island is of the latter type.

In summary, the gastropods are indicative of Silurian or Devonian age. Comparison with specimens from elsewhere is suggestive of a late Silurian age, but this determination is by no means definitive. More precise age determinations must be based on a study of other groups of associated fossils.

From the gastropods alone, it is difficult to make any significant speculations regarding ecology. It may be significant that, with the exception of the specimens identified as subulitaceans, all these gastropods are aspidobranchs. *Murchisonia* and its allies occupy an intermediate position between aspidobranch and pectinibranch gastropods. They possess both a slit and a siphon, primary features of primitive aspidobranchs and pectinibranchs, respectively.

The structure of the gills is one of the essential features of the aspidobranch gastropods. These primitive gills are relatively delicate and ill-adapted to cope

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with sediment. C. M. Yonge, who has investigated the aspidobranch gill in detail (Yonge, 1947), indicates that Recent aspidobranch gastropods live on a firm bottom. Because there has been no detailed study of the ecology of Palæozoic gastropods, any statements are tentative. Nevertheless, the presence of a varied aspidobranch gastropod faunal assemblage suggests that the snails lived on a firm bottom. The water may have been clear for most of the life of these gastropods, or if turbid with sediment, only for intermittent periods.

The gastropod assemblage from each locality is different. The collection from locality 26415 contains only *Gyronema* and *Cyclonema*. The faunule from locality 26428 is more varied but does not contain these two genera. The significance, if any, of the difference between these two collections is not known. Some *Cyclonema* lived on top of crinoid calyces (Bowsher, 1955), but it is not known if all members of the genus had the same life habit. *Gyronema* was a benthonic form that possibly lived on a firm bottom.

Systematic Palaeontology

Class GASTROPODA

Superfamily PLEUROTOMARIACEA

Genus *Mourlonia* Koninck, 1883

Mourlonia sp.

Plate IX, numbers 6 to 8

The specimens assigned to this species are relatively low-spired with wide and rapidly expanding whorls. The whorls are well rounded, the body whorl embracing the penultimate whorl at or just above the periphery; sutures are not impressed. A conspicuous narrow selenizone lies just above the periphery. In some specimens it is depressed slightly, but in others it is raised. This could be in part ontogenetic, the selenizone perhaps lowering with increasing age, but so few specimens show this particular feature that this is only a tentative suggestion. The base is narrowly phaneromphalous. Growth lines and features of the internal lip are unkown.

Although the type species of *Mourlonia* is ornamented by strong growth lines and has a slightly higher spire than this species, some species of *Mourlonia* are known that closely conform to the specimen that is illustrated. The only other genus to which this species might be referred is *Euryzone*. That genus differs in being lower spired, having wider whorls, and a higher, wider selenizone.

Material. Six specimens from GSC loc. 26428.

Figured specimen. GSC No. 15074.

Genus Uncertain

Plate IX, numbers 4, 5

One poorly preserved form has rounded whorls which embrace high on the previous whorl. The individual whorls are relatively narrow. No further details can be gleaned from the available specimens. Possibly this is not a distinct form, but represents incompletely silicified specimens of a pleurotomariacean, perhaps *Mourlonia*.

Material. Five specimens from GSC loc. 26428.

Figured specimen. GSC No. 15073.

Superfamily PLATYCERATACEA

Genus *Gyronema* Ulrich *in* Ulrich and Scofield, 1897

Gyronema sp.

Plate IX, numbers 9 to 14

Although this is one of the more abundant of the species distinguished, nearly all specimens are incomplete or crushed. A reasonably complete description can be given, but the material is inadequate to be formally named.

From the suture outward, the upper whorl surface is flattened and ramp-like to a strong lira. Below this lira the profile is inclined outward and downward at an angle near 45 degrees to another spiral lira of equal strength. Because of crushing, it is impossible to determine the profile of the side in detail, but it proceeds downward in short, straight increments, separated by spiral lirae, the angle of inclination changing at each lira. At least five lirae of equal strength are present on the side, but there may be one or two more. The basal area is moderately well rounded.

The inner lip is straight but slightly reflexed, as is the basal lip. There is a narrow umbilical chink, but it cannot be determined if this is a pseudoumbilicus or if the species is minutely phaneromphalous. The umbilical area is surrounded by a lira or cord.

Growth lines are straight and gently prosocline from the suture and continue straight along the side. They appear to go straight into the umbilical area with no deviation from their course, although they may turn forward slightly when reaching the lowest point of the shell.

A few specimens show several more spiral lirae than do most; none has as many as *Cyclonema* species. The number of lirae is probably a feature of individual variation, but further collecting may show that two species are present at this locality.

Material. Twenty-three specimens from GSC loc. 26415. In addition, four poorly preserved fragments from the same locality probably belong to this species.

Figured specimens. GSC Nos. 15075 to 15080.

Gyronema ? sp.

Plate IX, numbers 15 to 18

It has long been known that many of the Silurian and Devonian species placed in *Gyronema* and *Cyclonema* have nothing in common with the respective genera except the presence of spiral lirae. Probably several undescribed genera are included within this complex. Until a thorough revision of these genera can be made, it is preferable to use the classic generic names in an expanded and loose sense.

In contrast to the preceding species, the specimens placed in *Gyronema* ? are relatively high-spired with only a narrow subsutural shelf. The outer whorl profile is interrupted periodically by spiral lirae as in *Gyronema* species, but there appear to be only four major lirae. The body whorl embraces the penultimate whorl at the lira marking the juncture of the whorl side and base; sutures are correspondingly impressed. The base bears several additional lirae, but their exact number and position is uncertain. The specimens appear to be minutely phaneromphalous. Growth lines are unknown.

An alternative interpretation is that this is a pleurotomariacean with a selenizone on the side of the whorl bordered by two of the lirae. Until specimens with growth lines are available, this interpretation cannot be confirmed or refuted.

Material. Four specimens from GSC loc. 26428.

Figured specimen. GSC No. 15081.

Genus *Cyclonema* Hall, 1852

Cyclonema sp.

Plate IX, numbers 19, 20

In addition to the two preceding species, other specimens in the collections bear spiral lirae. It is possible to confuse poorly preserved fragments of each kind, but the better material shows this form to be distinct. It differs from *Gyronema* sp. in being higher spired, with slightly narrower whorls. The whorls are well rounded throughout their profile and lack a subsutural shelf. The spiral ornament is finer and much more numerous; at least twenty lirae can be counted on the best preserved specimen. Growth lines are prosocline, but there is a faint suggestion of irregularity on the lower part of the whorl. An umbilical chink is present, but without thin sections it is impossible to determine if the species is minutely phaneromphalous.

Material. Eight specimens from GSC loc. 26415.

Figured specimens. GSC Nos. 15082, 15083.

Superfamily Unknown

Indeterminate form 1

Plate X, numbers 1 to 3

In addition to those specimens that can be generally identified, one clearly indeterminate type is present. The fibrous appearance of the silicification, the thinness of the shell, and the generally poor preservation all suggest that these are specimens with only the inner shell layer silicified. The shells are moderately low-spired and expand fairly rapidly. Sutures are impressed and the whorl is moderately well rounded in profile, although this may not be the true shape of the outer shell layer. The base appears narrowly phaneromphalous, but again this may not be a character of the outer shell layer. The outer lip is gently prosocline. Identification is uncertain, but this form may be an anomphalid. Preservation is so poor that it cannot be determined that only one species is present.

Material. Fourteen specimens from GSC loc. 26428.

Figured specimens. GSC Nos. 15084, 15085.

Indeterminate form 2

Plate X, numbers 8, 9

Like the first indeterminate form, these specimens seem to have only the inner shell layer silicified. In general shape, they are similar to silicified neritaceans from the Permian of the southwestern United States. The shells are moderately low-spired, having only two or three whorls preserved. The outer whorl face is flattened and inclined strongly downward and outward, the periphery being low on the whorl. The base is flattened and anomphalous. The shells show straight lines on the surface that are inclined forward and downward. In Permian silicified specimens, these lines are found on the inner shell layer and are approximately at right angles to the growth lines. This is probably a part of the basic fabric of the shell, and the position of the lines is similar in many gastropods similarly preserved.

Neritaceans are unknown before the Middle Devonian. Better specimens that would permit a more positive identification are needed more urgently for this species than for any of the others discussed.

Material. Twelve specimens from GSC loc. 26428.

Figured specimens. GSC Nos. 15089, 15090.

Superfamily MURCHISONIACEA

Genus *Murchisonia* Archiac and Verneuil, 1841

Murchisonia sp. 1

Plate X, numbers 16 to 19

A common species of *Murchisonia* in the collections is characterized by numerous, narrow whorls. The whorls are fairly wide and sutures are shallow.

Most specimens are small. None shows characters of the inner lip; all appear to be anomphalous. Three specimens, somewhat better preserved, show a flattened area on the whorl face. Traces of growth lines, prosocline above and below, indicate that this flattened area is a selenizone. The selenizone, if this interpretation is correct, is flat and inclined slightly inward from vertical, its upper edge forming the periphery of the whorl. It appears to be bordered by a lira above and below. Though details are obscure, the overall character of the shells suggests the typical subgenus *Murchisonia* (*Murchisonia*).

Material. Twenty-one specimens from GSC loc. 26428.

Figured specimens. GSC Nos. 15096 to 15098.

Murchisonia sp. 2

Plate X, numbers 10 to 13

A second species of *Murchisonia* has relatively wider and, accordingly, fewer whorls than the first species. The pleural angle seems to be slightly narrower in this species than in the first, but the few measurements that could be made are inconclusive. Sutures are distinctly impressed and at a larger angle to the horizontal than in the first species. Because of the relatively well rounded whorl profile, this species was at first referred to *Loxonema*. A few specimens, however, show a selenizone forming the periphery of the whorl. This selenizone seems to be slightly wider than that of the first species.

In futher contrast to the first species, most specimens are relatively large. There is enough overlap in size to show conclusively that there are two different whorl profiles and to rule out the possibility that this second species is a later growth stage of the first. This second species may be referable to *Murchisonia* (*Hormotoma*).

Material. Twenty-two specimens from GSC loc. 26428. In addition, there are three other specimens of *Murchisonia* so poorly preserved that they cannot be referred with confidence to either species. Two of these may belong to the first species; the third may either belong to this species or represent an entirely different form.

Figured specimens. GSC Nos. 15091 to 15094.

Superfamily SUBULITACEA

Subulitid gastropod, genus uncertain

Plate X, numbers 4 to 7

These specimens are reasonably well preserved but are unnamed. Our understanding of pectinibranch gastropod relationships in the Palæozoic is in such an incomplete state that one is uncertain of the generic assignment for this form. The specimens do not show any characters that would refer them to a described genus.

Most specimens show four or five whorls. They are fairly high spired with a pleural angle of about 45 degrees. Whorls are globose with the outer whorl face moderately well rounded. Sutures are distinct, but not strongly impressed; whorls embrace just below the periphery, about two-thirds of the total distance down the side of the outer whorl face. The base is well rounded and anomphalous.

One specimen shows a few apertural characters. The columellar lip is reflexed; just inside the aperture a shallow channel occupies the lower one-third of the lip. About the channel and occupying most of the length of the columellar lip is a faint swelling. Just below the parietal wall, there is a second shallow channel.

Material. Seven specimens from GSC loc. 26428.

Figured specimens. GSC Nos. 15086 to 15088.

Class *SCAPHOPODA*

?Scaphopod species indet.

Plate X, numbers 14, 15

Discussion. Although scaphopods are not unknown in the middle Palæozoic they are so uncommon that even questionable material is worth noting. The single specimen is slightly curved in side view. Otherwise, it seems to be a tapering tube, open at both ends and lacking ornament.

Material. One specimen from GSC loc. 26428.

Figured specimen. GSC No. 15095.

SUMMARY AND CONCLUSIONS

Owing to its limited nature the fauna from the Sutherland River formation is difficult to date. The trilobite, the scolecodonts, and the gastropods afford no useful dating information because the stratigraphic ranges and phylogeny of similar Siluro-Devonian forms are not known. The presence of *Beyrichia* (*Beyrichia*) suggests a pre-Gedinnian (pre-Devonian) age, as this subgenus is not known elsewhere above strata of Ludlovian age. The evidence afforded by the brachiopods is inconclusive as all of the genera present in the Sutherland River fauna have been found as high as the lower Gedinnian (Boucot, *in press*), although no characteristically post-Ludlovian genera are present. At best, the brachiopods suggest a Ludlovian to lower Gedinnian range. The conodonts belong to forms which elsewhere are bracketed between the middle Ludlovian and the Siegenian, but most strongly resemble upper Ludlovian forms. The fish plate resembles an upper Ludlovian form.

In view of the above admittedly scanty information, it is concluded that the fauna from the Sutherland River formation is of Ludlovian and possibly upper Ludlovian age.

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PLATES I TO X

Plate I

Numbers 1–5. *Salopina* ? sp. (GSC loc. 26428.) GSC No. 14961; all x6. Number 1, side view of exterior; Number 2, posterior view (pedicle valve above) of exterior; Number 3, anterior view of exterior; Number 4, brachial view of exterior; Number 5, pedicle view of exterior. (Page 3.)

Numbers 6–12. *Salopina lunata* (Sowerby, 1839). Jones Creek formation, road-cut on west side of Jones Creek, about 100 yards south of main highway, Map-sheet Hampstead, New Brunswick. Number 6, impression of interior of brachial valve, x2; note the presence of well-developed fulcral plates and a blade-like cardinal process; GSC No.14962. Number 7, impression of interior of brachial valve, x2; GSC No. 14963. Number 8, impression of interior of pedicle valve, x2; note the short, curved dental lamellae and the cordate form of the muscle field; GSC No. 14964. Number 9, impression of interior of brachial valve, x2; note the broad, shallow sulcus, the blade-like cardinal process, and the slightly divergent brachiophore plates; GSC No. 14965. Number 10, impression of exterior of pedicle valve, x2; note the minute 'hollow spine' fillings in the anterior part of the impression; GSC No. 14966. Number 11, impression of exterior of brachial valve, x2; note the broad, shallow sulcus and the 'hollow spine' fillings; GSC No. 14967. Number 12, impression of exterior of brachial valve, x6; note the 'hollow spine' fillings; GSC No. 14967. (Page 3.)

Numbers 13–20. *Isorthis orbicularis* (Sowerby, 1839). (GSC loc. 26428.) Number 13, exterior of brachial valve, x6; note the development of ornamentation by implantation in this small specimen; GSC No. 14968. Number 14, interior of brachial valve, x6; note the short blade-like cardinal process; GSC No. 14968. Number 15, interior of brachial valve, x3; note the presence of fulcral plates and a short cardinal process; GSC No. 14969. Number 16, exterior of brachial valve, x2; GSC No. 14970. Number 17, interior of brachial valve, x6; note the presence of fulcral plates and a short cardinal process; GSC No. 14971. Number 18, interior of brachial valve, x6; GSC No. 14972. Number 19, interior of brachial valve, x3; note the large angle included by the brachiophore plates; GSC No. 14970. Number 20, interior of brachial valve, x6; note the blade-like brachiophore plates supporting the brachiophores basally; GSC No. 14973. (Page 5.)

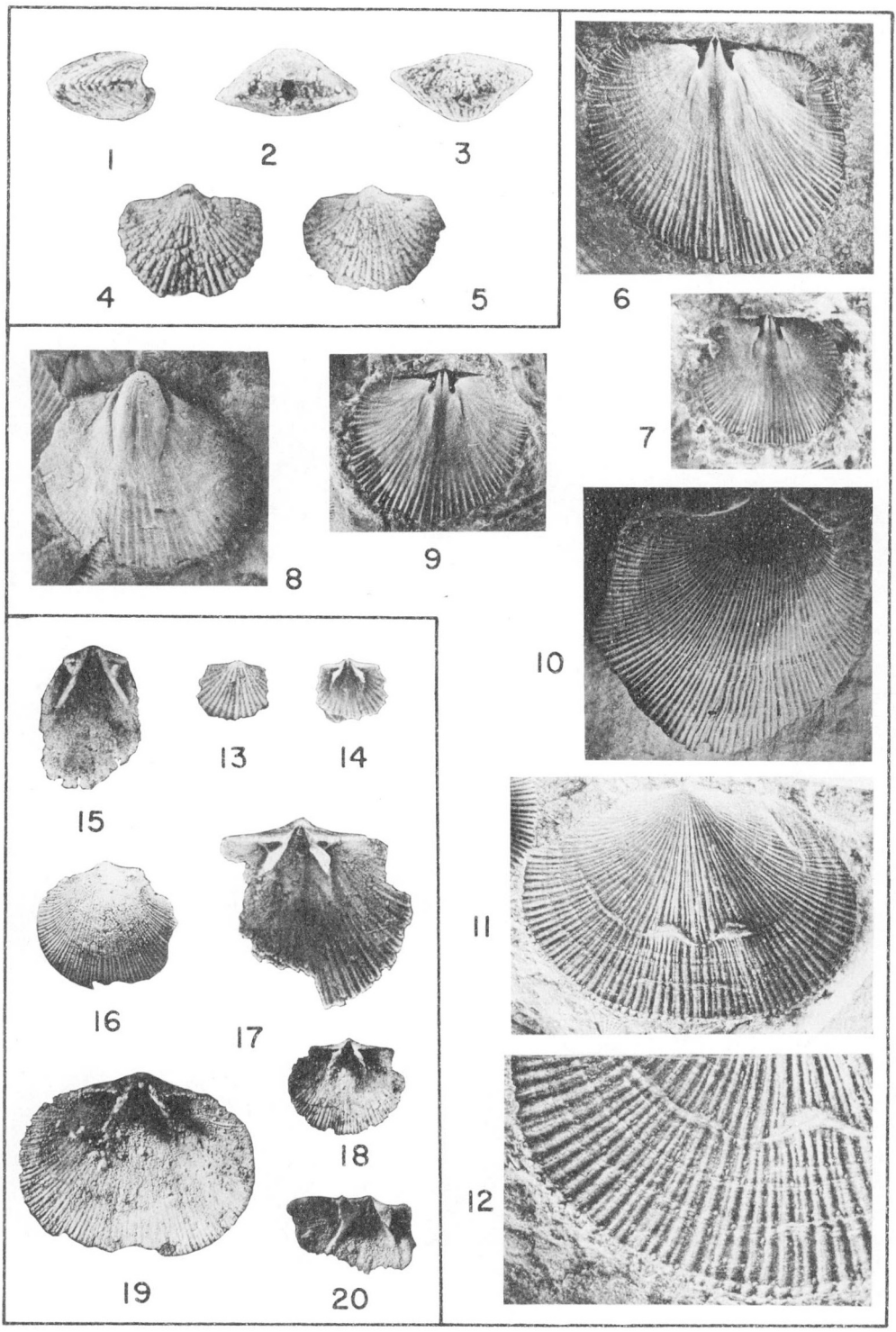
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Plate II

(All x3, except where otherwise stated.)

Numbers 1–7. *Isorthis orbicularis* (Sowerby, 1839). (GSC loc. 26428.) Number 1, interior of pedicle valve; GSC No. 14974. Number 2, interior of pedicle valve; GSC No. 14974. Number 3, interior of pedicle valve; note the raised median adductor track; GSC No. 14975. Number 4, exterior of pedicle valve; GSC No. 14976. Number 5, interior of pedicle valve; GSC No. 14976. Number 6, interior of pedicle valve; note the raised median adductor track; GSC No. 14977. Number 7, interior of pedicle valve; GSC No. 14978. (Page 5.)

Numbers 8–10. "*Camarotoechia*" sp. (GSC loc. 26415.) Number 8, interior of pedicle valve; fragment showing presence of short, blade-like dental lamellae; GSC No. 14979. Number 9, interior of brachial valve; note the discrete hinge plates bordering a short cruralium supported by a long median septum; GSC No. 14980. Number 10, exterior of pedicle valve; GSC No. 14981. (Page 7.)

Numbers 11–22. "*Schuchertella*" sp. (GSC loc. 26428.) Number 11, interior of pedicle valve; note the presence of short, blade-like dental lamellae; GSC No. 14982. Number 12, interior of brachial valve, x6; note the absence of a large, hood-like chilidium; GSC No. 14983. Number 13, interior of brachial valve; note the bilobed cardinal process lobes fused with the margins of the dental sockets; GSC No. 14984. Number 14, exterior of brachial valve; small specimen in which extensive branching of the plications had not taken place; GSC No. 14985. Number 15, interior of pedicle valve; note the relatively large, convex pseudodeltidium and the stout hinge teeth; GSC No. 14986. Number 16, interior of pedicle valve; note the relatively small pseudodeltidium in this small specimen and the presence of stout hinge teeth; GSC No. 14987. Number 17, interior of pedicle valve, x6; note the presence of a large, convex pseudodeltidium and of thin, blade-like dental lamellae; GSC No. 14988. Number 18, exterior of brachial valve; note the small chilidium; GSC No. 14984. Number 19, interior of brachial valve, x6; GSC No. 14985. Number 20, exterior of brachial valve, x6; GSC No. 14983. Number 21, interior of brachial valve; GSC No. 14989. Number 22, exterior of brachial valve, x6; note the presence of chilidial plates and posteriorly grooved cardinal process lobes; GSC No. 14990. (Page 13.)

Numbers 23–26. *Shaleria* sp. (GSC loc. 26428.) Number 23, interior of brachial valve; note the discrete cardinal process lobes and the laterally directed socket plates; GSC No. 14991. Number 24, interior of brachial valve; note the short median septum dividing the poorly impressed adductor field; GSC No. 14992. Number 25, interior of brachial valve, x6; note the discrete cardinal process lobes and the laterally directed fulcral plates; GSC No. 14993. Number 26, exterior of brachial valve; note the tiny chilidium situated between the cardinal process lobe bases; GSC No. 14991. (Page 12.)

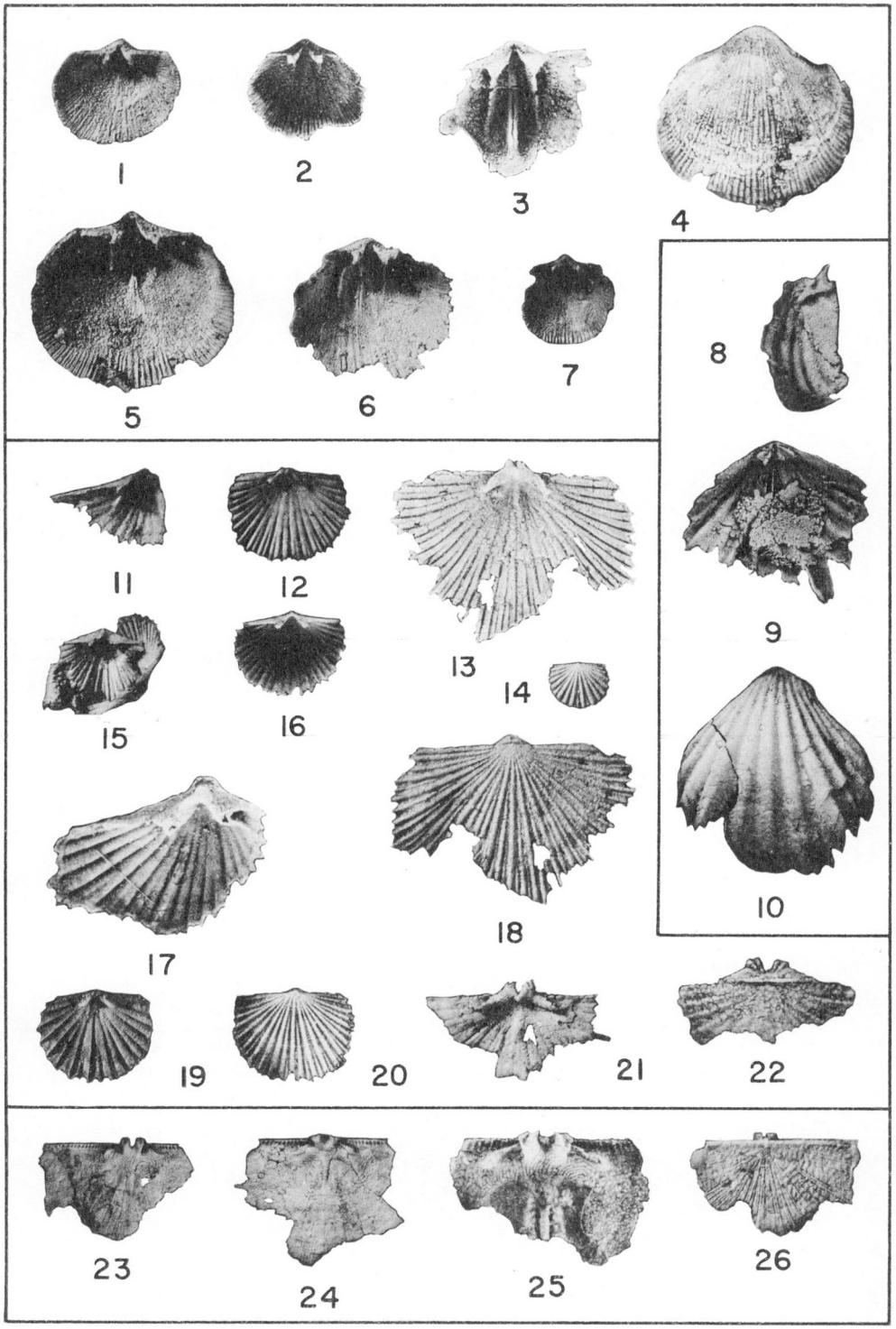
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Plate III

(All from GSC loc. 26428. All x3 except when otherwise stated.)

Numbers 1–8. *Shaleria* sp. Number 1, posterior view of brachial valve, x6; note the posteriorly grooved cardinal process lobes and the presence of socket plates; GSC No. 14993. Number 2, exterior of brachial valve, x6; note the gently concave form of this valve; GSC No. 14992. Number 3, exterior of pedicle valve, x6; note the presence of fine and medium-sized costellae; GSC No. 14994. Number 4, interior of pedicle valve; note the presence of a convex pseudodeltidium; GSC No. 14995. Number 5, exterior of pedicle valve; note the presence of scalloped concentric growth lines; GSC No. 14996. Number 6, exterior of pedicle valve, x6; GSC No. 14995. Number 7, exterior of pedicle valve; note the gently convex form of the valve; GSC No. 14997. Number 8, interior of pedicle valve; note the flabellate form of the muscle field and the crenulated hinge line; GSC No. 14998. (Page 12.)

Numbers 9–13. *Protathyris* sp. GSC No. 14999. (Page 10.)
Number 9, anterior view of exterior.
Number 10, side view of exterior.
Number 11, posterior view of exterior.
Number 12, pedicle view of exterior.
Number 13, brachial view of exterior.

Number 14. *Protathyris* sp. Interior view of brachial valve; note the perforate cardinal plate; GSC No. 15000. (Page 10.)

Numbers 15–20. *Coelospira* sp. Number 15, interior of brachial valve, x6; note the simple cardinal process laterally flanked by the dental sockets; GSC No. 15001. Number 16, interior of brachial valve; note the impression of the median costae; GSC No. 15002. Number 17, exterior of brachial valve, x6; note the median sulcus with enclosed costae; GSC No. 15001. Number 18, exterior of pedicle valve, x6; GSC No. 15003. Number 19, interior of pedicle valve, x6; note the short hinge teeth; GSC No. 15004. Number 20, interior of pedicle valve, x6; note the low septum dividing the muscle field; GSC No. 15003. (Page 11.)

Numbers 21–30. *Howellella* sp. Number 21, interior of pedicle valve; GSC No. 15005. Number 22, interior of brachial valve; note the discrete hinge plates; GSC No. 15006. Number 23, exterior of brachial valve; GSC No. 15007. Number 24, exterior of brachial valve, x6; note the fine radial ornamentation; GSC No. 15008. Number 25, exterior of pedicle valve, x6; GSC No. 15005. Number 26, interior of brachial valve, x6; note the long, linear myophragm; GSC No. 15007. Number 27, interior of pedicle valve; note the stubby hinge teeth and the low septum dividing the muscle field posteriorly; GSC No. 15009. Number 28, interior of brachial valve, x6; note the short crural plates basally supporting the hinge plates; GSC No. 15007. Number 29, exterior of pedicle valve; GSC No. 15009. Number 30, exterior of brachial valve, x6; note the fine radial ornamentation and the concentric growth lines; GSC No. 15010. (Page 8.)

Numbers 31–33. *Cyrtina* ? sp. Number 31, interior of pedicle valve; note trace of a poorly preserved median septum; GSC No. 15011. Number 32, exterior of pedicle valve; note the pyramidal form of the shell; GSC No. 15011. Number 33, exterior of brachial valve; GSC No. 15012. (Page 9.)

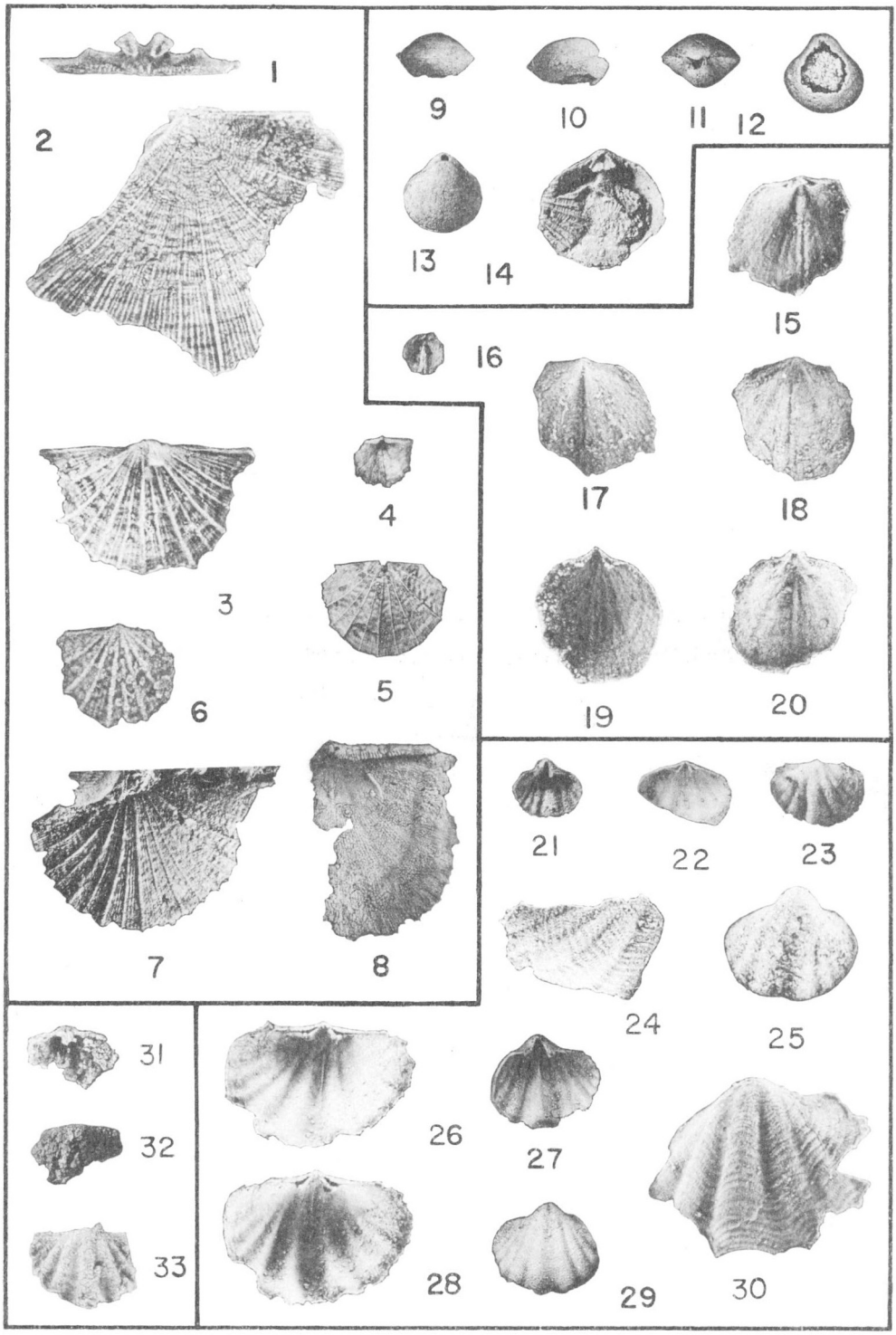
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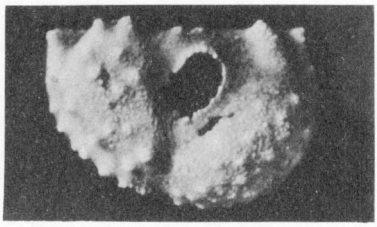
Plate IV

Numbers 1–5. *Beyrichia* (*Beyrichia*) *arctigena* n. sp. (GSC loc. 26428.) All x20. Number 1, right valve of a female specimen; holotype, GSC No. 15013. Number 2, right valve of a female specimen; GSC No. 15014. Number 3, fragmentary right valve of an adult male specimen; GSC No. 15015. Number 4, right valve of a tecnomorph in the penultimate moult instar; GSC No. 15016. Number 5, right valve of a tecnomorph in the penultimate moult instar; GSC No. 15017. (Page 16.)

Number 6. *Beyrichia* (*Beyrichia*) *arctigena* n. sp., showing tuberculation. (Page 16.)



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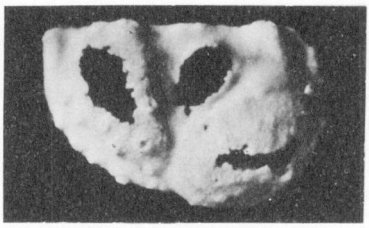

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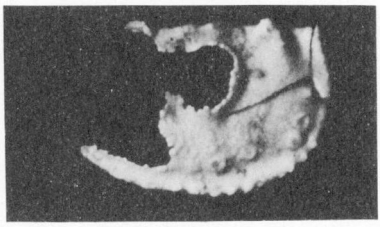

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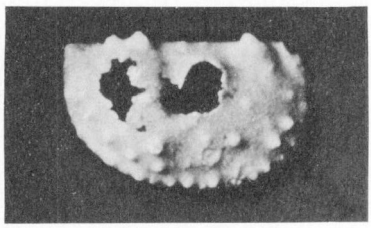

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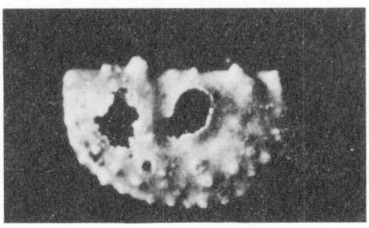

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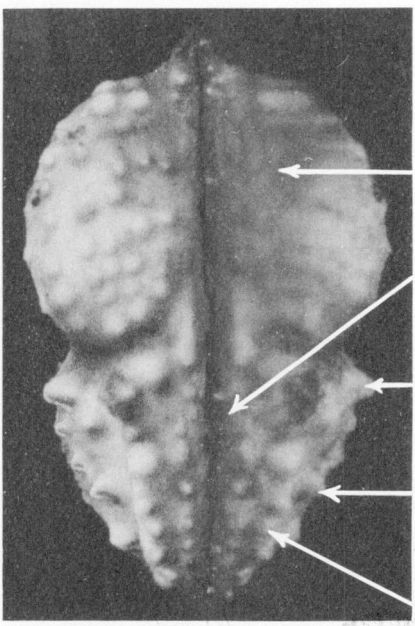
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Plate V

(All from GSC loc. 26428; all about x35.)

Numbers 1a, b. *Arabellites sinuatus* n. sp. Left forceps: 1a, oral view; 1b, aboral view. Holotype, GSC No. 15018. (Page 22.)

Numbers 2a–c. *Ildraites beckeri* n. sp. Right forceps. Holotype, GSC No. 15019. (Page 23.)

Numbers 3a–c. *Ildraites* n. sp. Left forceps. GSC No. 15020. (Page 23.)

Numbers 4a, b. *Leodicites sublunatus* n. sp. Dental plate. Holotype, GSC No. 15021. (Page 24.)

Numbers 5a, b. *Leodicites alatus* n. sp. Dental plate. Holotype, GSC No. 15022. (Page 24.)

Numbers 6a, b. *Leodicites* sp. Dental plate. GSC No. 15023. (Page 25.)

PLATE V

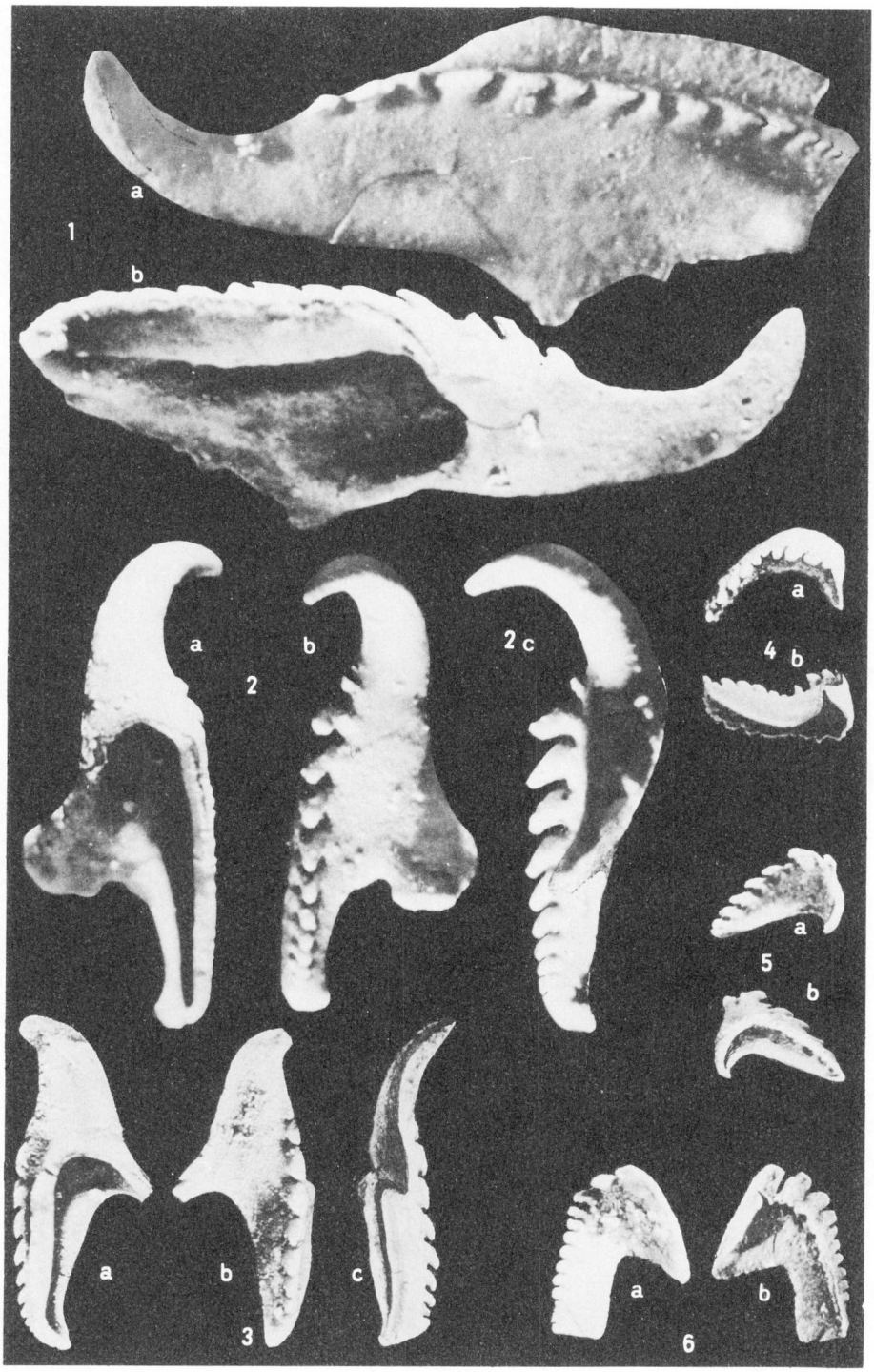

Plate VI

(All from GSC loc. 26428; all about x35.)

Numbers 1–3. *Polychaetaspis ? kozlowskii* n. sp. Numbers 1a-c, right forceps; holotype, GSC No. 15024. Numbers 2a, b, right forceps, small specimen; GSC No. 15025. Numbers 3a-c, left forceps plate; holotype, GSC No. 15026. (Page 26.)

Numbers 4–9. *Polychaetaspis* cf. *P. wyszogrodensis* Kozlowski, 1956. Number 4, left forceps of a large specimen; GSC No. 15027. Number 5, left forceps of a small specimen; GSC No. 15028. Numbers 6a-c, left forceps of a medium-sized specimen; GSC No. 15029. Numbers 7a, b, right forceps of a middle-sized specimen; GSC No. 15030. Number 8, right forceps of a small specimen; GSC No. 15031. Numbers 9a-c, right forceps of a large specimen; GSC No. 15032. (Page 27.)

Number 10. Right forceps, possibly of an extremely old specimen of *Polychaetaspis* cf. *P. wyszogrodensis* Kozlowski, 1956. GSC No. 15033. (Page 27.)

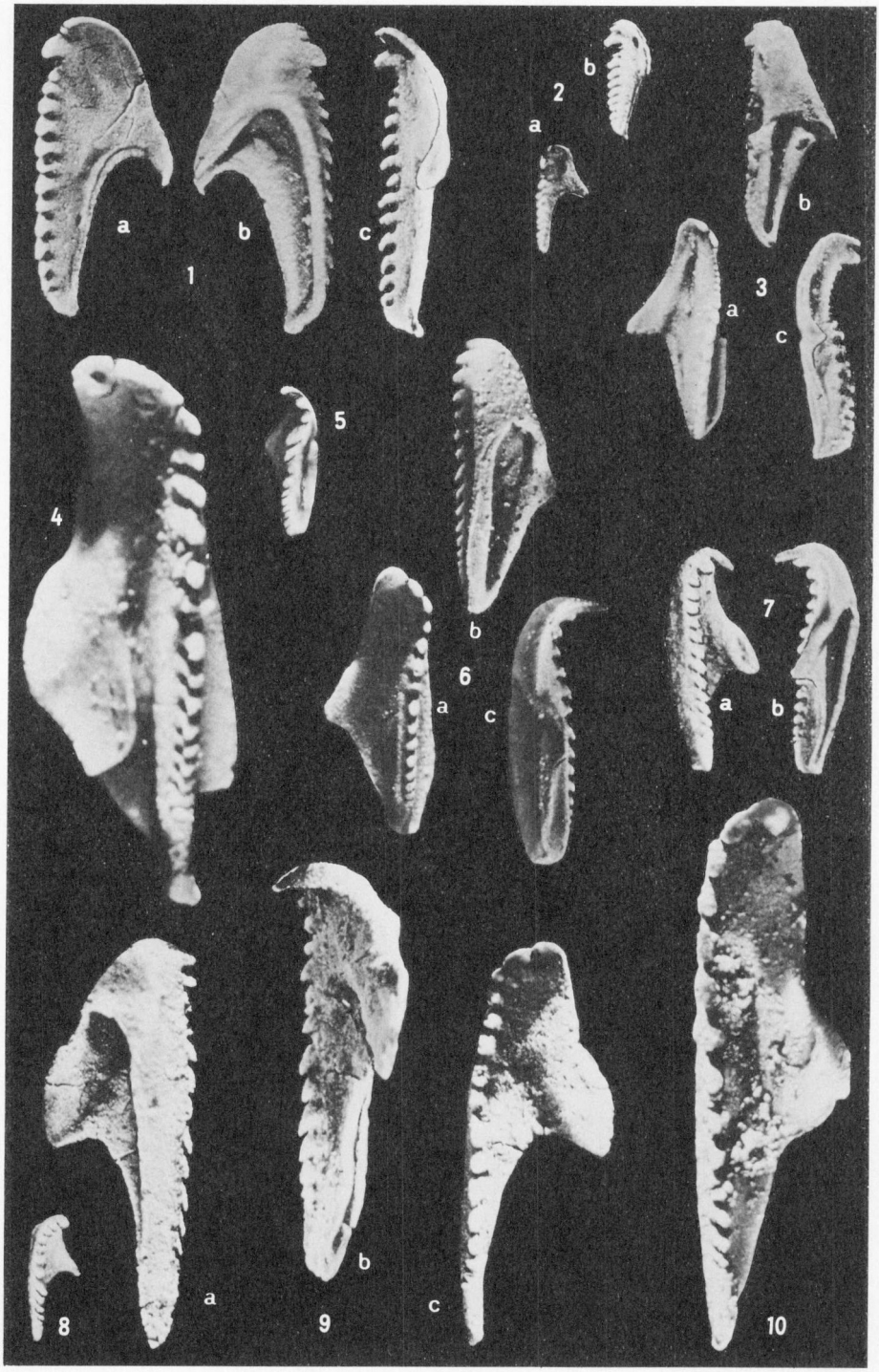
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Plate VII

(All from GSC loc. 26428; all about x35.)

Numbers 1–3. *Lumbriconereites* cf. *L. webbi* Stauffer, 1933. Numbers 1a-c, left dental plate; GSC No. 15034. Numbers 2a-c, right dental plate; GSC No. 15035. Number 3, right dental plate of a small specimen; GSC No. 15036. (Page 25.)

Numbers 4a–c. *Lumbriconereites* n. sp. GSC No. 15037. (Page 25.)

Numbers 5a–c. *Lumbriconereites* sp. GSC No. 15038. (Page 26.)

Numbers 6a, b. Sp. indet. GSC No. 15039. (Page 28.)

Numbers 7a, b. Sp. indet. GSC No. 15040. (Page 28.)

Number 8. *Paltodus* cf. *P. recurvatus* Rhodes, 1953. GSC No. 15041. (Page 31.)

Number 9. *Paltodus* cf. *P. unicostatus* Branson and Mehl, 1933. GSC No. 15042. (Page 32.)

Number 10. *Paltodus* cf. *P. acostatus* Branson and Branson, 1947. GSC No. 15043. (Page 31.)

Numbers 11, 12. *Trichonodella inconstans* Walliser, 1956. GSC Nos. 15044, 15045. (Page 35.)

Number 13. *Ligonodina* sp. GSC No. 15046. (Page 30.)

Number 14. Sp. indet. a. GSC No. 15047. (Page 35.)

Numbers 15a, b. Sp. indet. b. GSC No. 15048. (Page 36.)

Number 16. Sp. indet. c. GSC No. 15049. (Page 36.)

Number 17. Sp. indet. d. GSC No. 15050. (Page 36.)

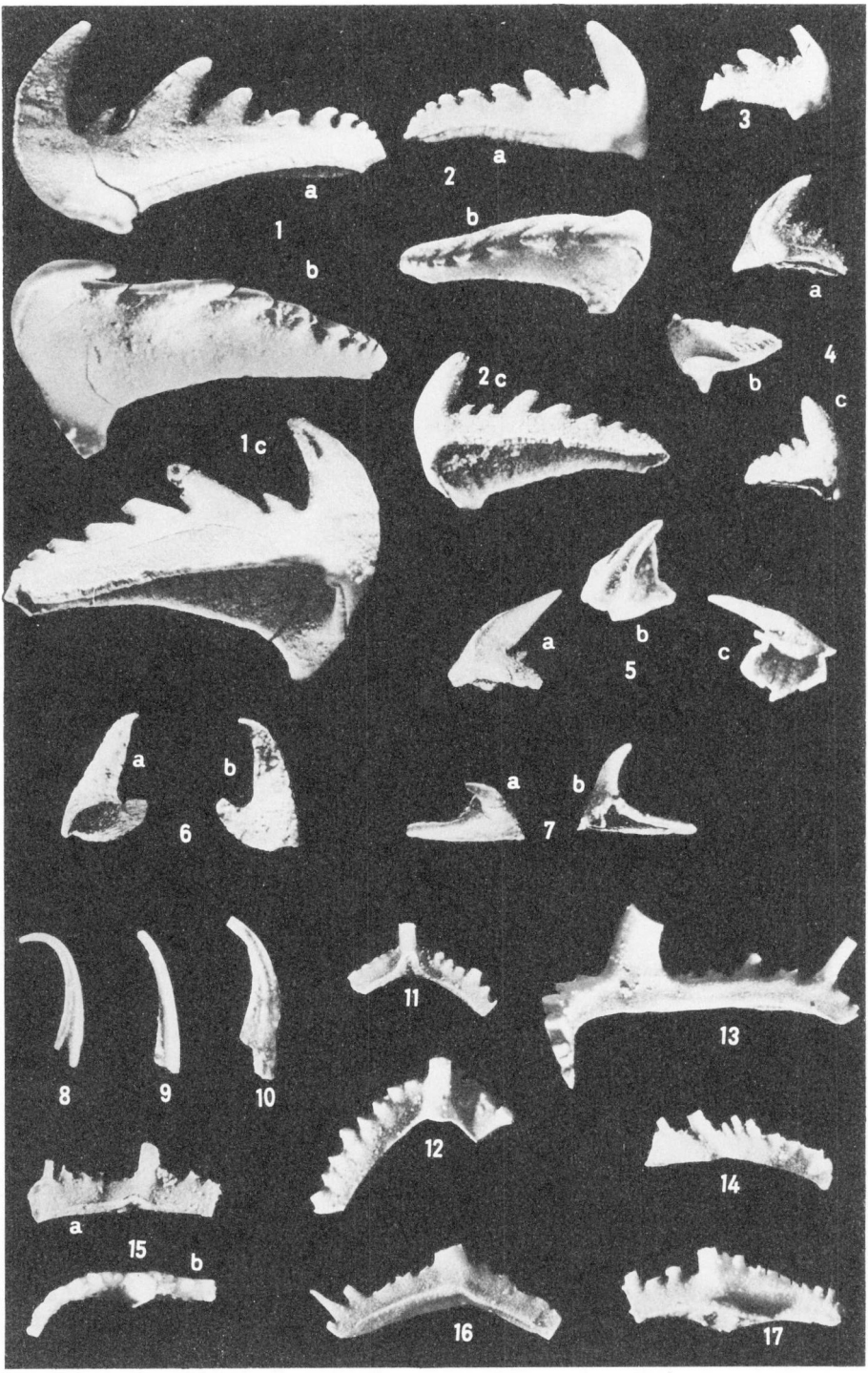
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Plate VIII

(All from GSC loc. 26428; all about x35.)

Numbers 1–3. *Spathognathodus canadensis* n. sp. Numbers 1a, b; holotype, GSC No. 15051. Numbers 2a, b; GSC No. 15052. Number 3; GSC No. 15053. (Page 34.)

Numbers 4, 5. *Spathognathodus* cf. *S. canadensis* n. sp. Numbers 4a, b, juvenile specimen; GSC No. 15054. Numbers 5a-c, specimen with closely grouped row of denticles (number 5a not whitened in order to show the basal line of the denticles); GSC No. 15055. (Page 34.)

Numbers 6a, b. *Spathognathodus* sp. GSC No. 15056. (Page 35.)

Number 7. *Spathognathodus* n. sp. GSC No. 15057. (Page 35.)

Numbers 8–10. *Prioniodina bicurvata pronoides* n. subsp. Number 8, small specimen; GSC No. 15058. Number 9a, view of outer side, and 9b, view of inner side; holotype, GSC No. 15059. Number 10, large specimen; GSC No. 15060. (Page 33.)

Number 11. *Prioniodina* cf. *P. bicurvata pronoides* n. subsp.; GSC No. 15061. (Page 33.)

Number 12. *Prioniodina* cf. *P. excavata* (Branson and Mehl, 1933). GSC No. 15062. (Page 32.)

Numbers 13, 14. *Ozarkodina denckmanni* Ziegler, 1956. Number 13, specimen not whitened in order to show denticle formation; GSC No. 15063. Number 14, specimen whitened; GSC No. 15064. (Page 31.)

Number 15. *Hindeodella* cf. *H. equidentata* Rhodes, 1953. GSC No. 15065. (Page 30.)

Number 16. *Hindeodella* n. sp. GSC No. 15066. (Page 30.)

Numbers 17, 18. *Lonchodina greilingi* Walliser, 1956. GSC Nos. 15067, 15068. (Page 31.)

Number 19. *Angulodus* n. sp. GSC No. 15069. (Page 29.)

Number 20. *Plectospathodus extensus* Rhodes, 1953. GSC No. 15070. (Page 32.)

Numbers 21a–c. *Nostolepis* sp. GSC No. 15071. (Page 38.)

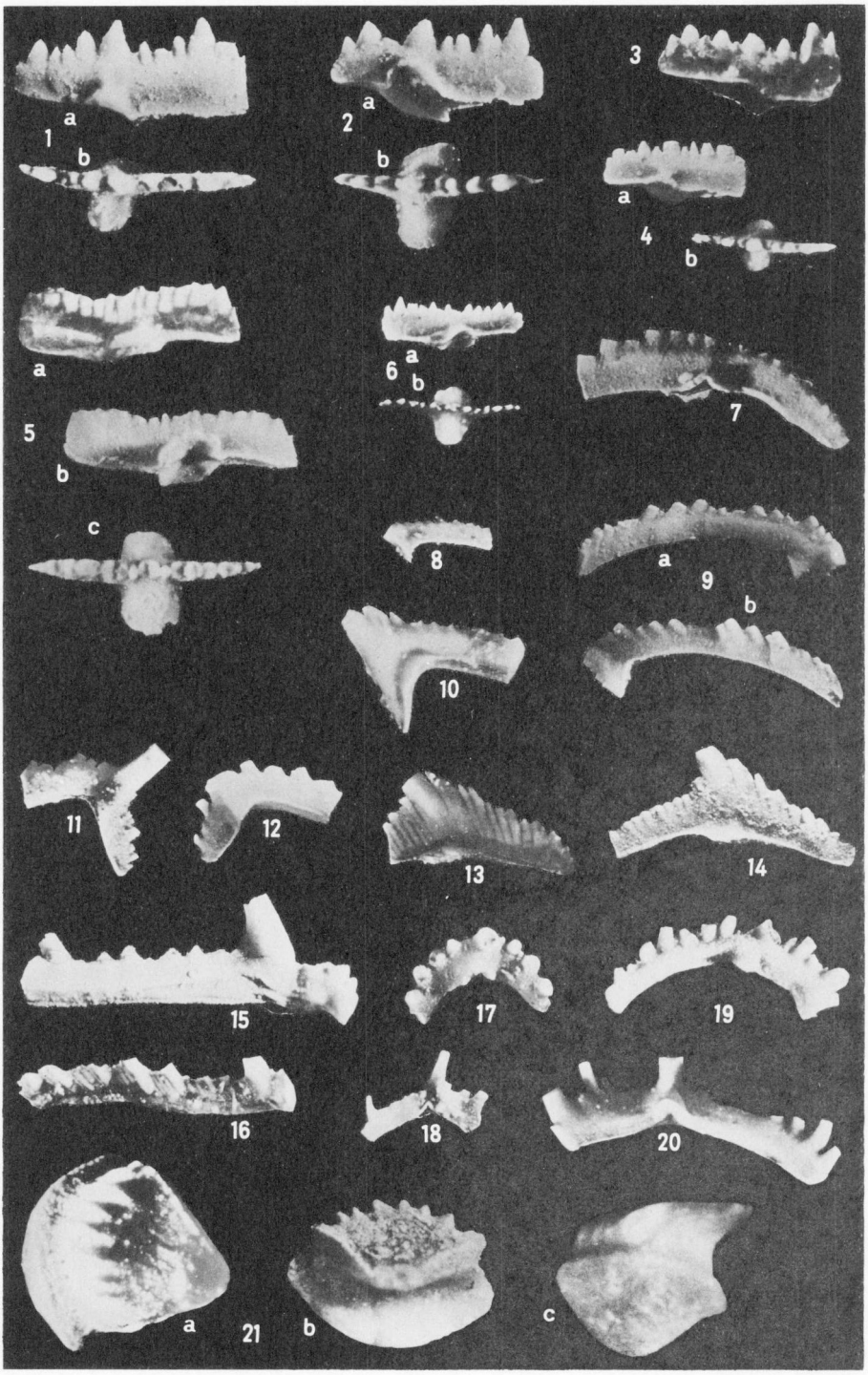
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Plate IX

Numbers 1–3. Trilobite pygidium. Dorsal, right lateral, and posterior view, all x6. (GSC loc. 26428.) GSC No. 15072. (Page 40.)

Numbers 4, 5. Genus uncertain. Oblique top view and side view, both x12. (GSC loc. 26428.) GSC No. 15073. (Page 43.)

Numbers 6–8. *Mourlonia* sp. Oblique basal view, side view, and slightly oblique side view, all x2. (GSC loc. 26428.) GSC No. 15074. (Page 42.)

Numbers 9–14. *Gyronema* sp. Slightly oblique top view, x2; oblique top view, x2; side view of juvenile showing accurate profile, x4; slightly oblique side view, x2; apertural view, x2; and side view of a slightly mashed specimen, x2. (GSC loc. 26415.) GSC Nos. 15075–15080. (Page 43.)

Numbers 15–18. *Gyronema* ? sp. Side view, oblique top view, side view showing aperture, and basal view, all x8. (GSC loc. 26428.) GSC No. 15081. (Page 44.)

Numbers 19, 20. *Cyclonema* sp. Top view, x3; and apertural view, x2. (GSC loc. 26415.) GSC Nos. 15082, 15083. (Page 44.)

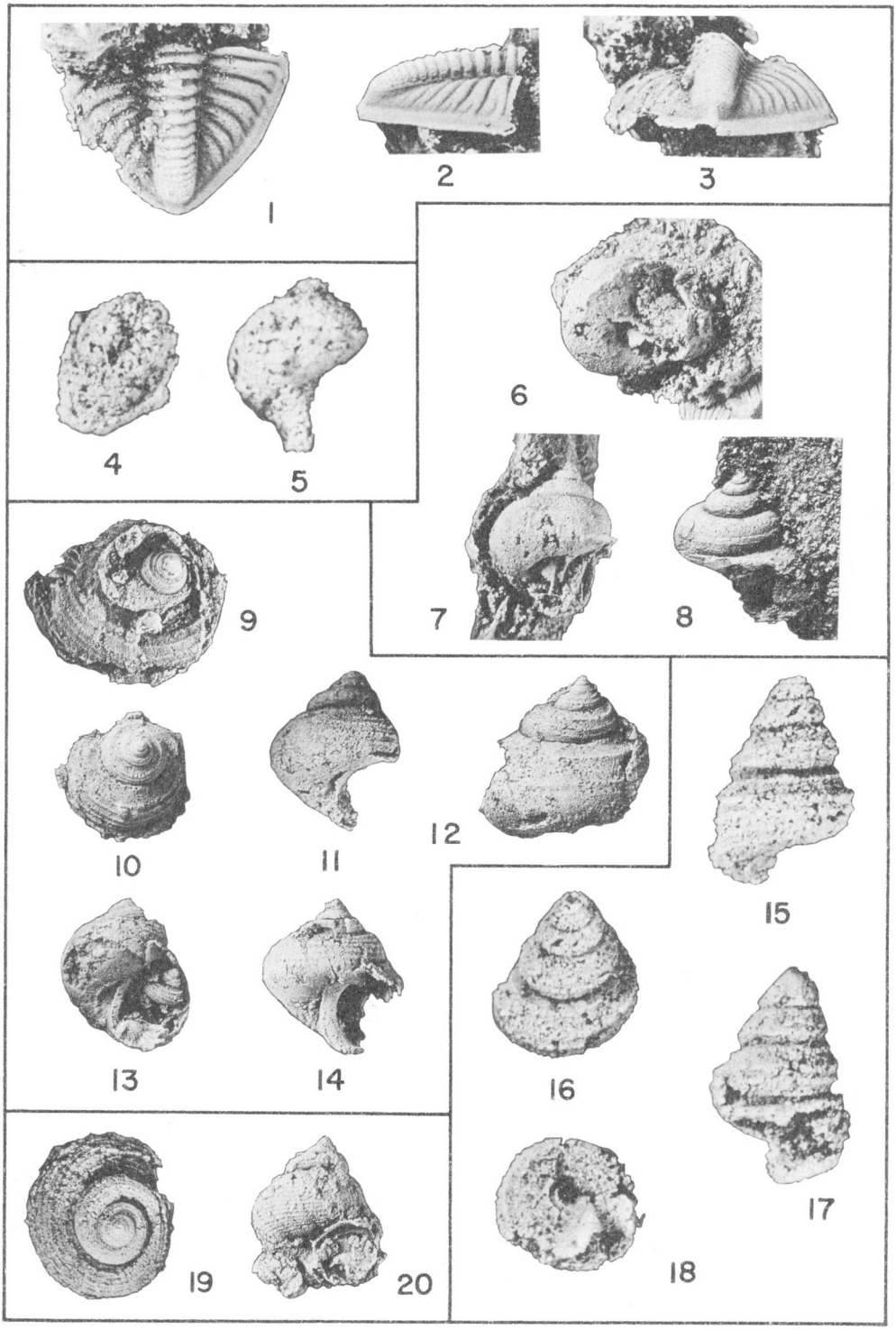
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Plate X

(All from GSC loc. 26428.)

Numbers 1–3. Indeterminate form 1. Side view, oblique basal view, and oblique side view, all x8. GSC Nos. 15084, 15085. (Page 45.)

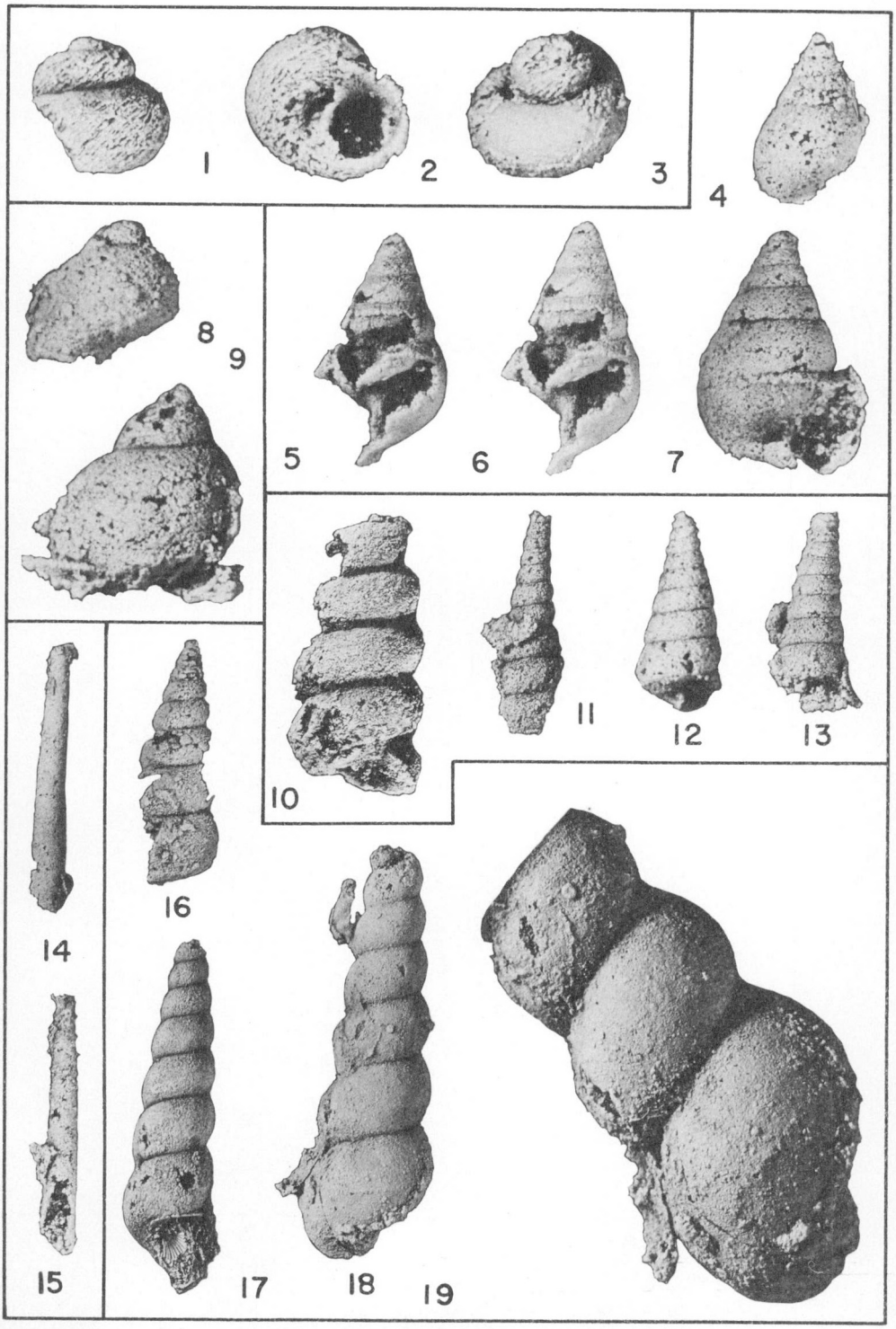
Numbers 4–7. Subulitid gastropod. Side view; side view of broken specimen from two slightly different angles to show inner lip; side view; all x4½. GSC Nos. 15086–15088. (Page 46.)

Numbers 8, 9. Indeterminate form 2. Side views of two specimens; both x8. GSC Nos. 15089, 15090. (Page 45.)

Numbers 10–13. *Murchisonia* sp. 2. Side view showing selenizone, x6; side view of an incomplete specimen, x5; side view, x5; and side view, x5. GSC Nos. 15091–15094. (Page 46.)

Numbers 14, 15. ?Scaphopod species indet. Ventral? and left side view, both x2. GSC No. 15095. (Page 47.)

Numbers 16–19. *Murchisonia* sp. 1. Side view of juvenile, x4; side view, x2; and side views, x2 and x4, showing selenizone. GSC Nos. 15096–15098. (Page 45.)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