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The Eastern Great Basin, Part 4.
Late Llandovery and Wenlock Brachiopods**

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ABSTRACT

Brachiopods from the Late Llandovery and Wenlock dolomites of the eastern Great Basin are described and illustrated. Most of the brachiopods are from the High Lake, Gettel, Portage Canyon, and Jack Valley Members of the Laketown Dolomite. Some species from the Lone Mountain Dolomite and an unnamed formation in southern Nevada are also included. New species are *Protochonetes elyensis*, *Ancillotoechia? perryi*, and *Pentlandella merriami*. New subspecies are *Atrypina hedei* Struve *americensis*, *Spirinella pauciplicata* Waite *eganensis*, and new subspecies A and B of *Brachyprion geniculata* Waite.

INTRODUCTION

This contribution is the fourth part of a series describing the faunas and stratigraphy of Late Ordovician and Silurian dolomites of the eastern Great Basin. Budge and Sheehan (1980 a, b) subdivided the Laketown Dolomite and gave precise locality data for the collections described in this report. Sheehan (1980a) described the brachiopods from the lowermost, Tony Grove Lake Member of the Laketown Dolomite. This report describes the brachiopods from the remaining members of the Laketown. Several species of brachiopods from the Lone Mountain Dolomite and correlative but unnamed dolomites in southern Nevada are also included. The brachiopods are of Late Llandovery and Wenlock age.

The community ecology of the brachiopod guilds was discussed by Sheehan (1980b), and the species descriptions include the community affinities of the collections.

Locality numbers are those of the U.S. National Museum (USNM). Illustrated specimens will be deposited in the U.S. National Museum and have been assigned six digit USNM specimen numbers.

In the descriptions the locality numbers are followed by the number of specimens recovered at each locality.

This is a contribution to the UNESCO-IUGS International Geological Correlation Program Project Ecostratigraphy.

Locality Addenda.

Two localities were omitted from the previous reports.

USNM loc. 19067 was collected from platy chert in Unit 27 of the Portage Canyon Member of the Laketown Dolomite (Budge & Sheehan, 1980b, p. 35) in the Delamar Mountains Section, Nevada.

USNM loc. 19080 was collected from the very top of Unit 37 of the Jack Valley Member of the Laketown Dolomite (Budge and Sheehan, 1980b, p. 28) in the southern Egan Range I Section, Nevada.

SYSTEMATIC PALEONTOLOGY
Phylum BRACHIOPODA
Order ORTHIDA
Suborder ORTHOIDEA
Superfamily ORTHACEA Woodward, 1852
Family HESPERORTHIDAE Schuchert & Cooper, 1931
Subfamily HESPERORTHINAE Schuchert & Cooper, 1931
Genus HESPERORTHIS Schuchert & Cooper, 1931

Hesperorthis? sp.
pl. 1, figs. 1-8

Exterior: In lateral profile the ventral valve is convex and dome shaped. The dorsal valve is plane or weakly convex. The hinge line is straight and greater than 3/4 the maximum shell width, which occurs near mid-length. Width slightly exceeds length. The cardinal angles are abrupt. The ventral interarea is gently curved and short for the genus. The delthyrium includes an angle of about 40°. In one specimen what appears to be a poorly preserved remnant of a deltidium is present. The dorsal interarea is short but distinct.

The surface carries 18 to 22 rounded costae; costa width equals the width of the interspaces. All costae originate near the beak; none are added by branching or intercalation. Striae are present in the interspace.

Ventral Interior: The muscle field is impressed upon a slightly raised pad and is confined to the posterior third of the valve. The elongate diductor scars are parallel and extend anteriorly beyond the narrow, less deeply impressed adductor scars. A low rounded ridge extends forward a short distance from the receding dental plates. The impressions of the interspaces between costae are present distally around the shell, and each appears to bear a deep, median furrow. The teeth are small and bulbous.

Dorsal Interior: The floor of the notothyrial chamber is not raised on a platform. There is a low, short, broad ridge anterior of the notothyrial chamber. Brachio-phores and their bases are divergent. The cardinal process is a thin plate which extends the length of the notothyrial chamber. The muscle field is slightly impressed and extends beyond midlength.

Comparison: The plane or weakly convex lateral profile of the dorsal valve is similar to that found in *Hesperorthis* (See Schuchert & Cooper, 1932, p. 86). This profile is also found in "*Dolerorthis*" *flabellites euorthis*, though members of this subspecies have fewer costae and could not be confused with this species. The generic assignment is questioned for three reasons: 1) the apical angle of the delthyrium is rather wide (about 40°) for the genus 2) the interarea is rather short for the genus and 3) though there may be deltidium, poor preservation makes the presence of this critical feature uncertain.

Occurrence: Member C, unnamed Silurian formation, Ranger Mountain, Nevada. USNM locs. 19416 (2), 19421 (32). Age: Late Llandovery. Community: *Pentamerus* Community?

Subfamily DOLERORTHINAE Öpik, 1934
Genus DOLERORTHIS Schuchert & Cooper, 1931

***Dolerorthis?* sp.**
pl. 1, figs. 9-12

Only two dorsal valves were recovered. They are gently convex in lateral profile. There is a shallow sulcus. Ten mm from the beak there are about 26 costae which increase by implantation or bifurcation. The costae are steep sided with rounded apices.

Internally, the brachiophores form the margins of the notothyrium which has an apical angle somewhat greater than 90°. The notothyrial chamber is slightly raised on a sessile, notothyrial platform. There are distinct cavities beneath the brachiophores and sockets but not beneath the notothyrial platform. The cardinal process is blade-like.

Discussion: The anteriorly bifurcating costae are typical of *Dolerorthis* s.s.

Occurrence: Portage Canyon Member, Laketown Dolomite. Four Mile Canyon, Utah — USNM locs. 19070 (2). Age: Late Llandovery. Community: *Pentameroides* Community.

***"Dolerorthis" flabellites* (Foerste, 1889)**
pl. 1, figs. 13, 14, 17-20, pl. 2, figs. 1-14

Orthis calligramma Dalman *flabellites* Foerste, 1889, p. 308-312, pl. 6, figs. 4, 5.

Dolerorthis flabellites (Foerste). Schuchert & Cooper, 1932, p. 89, pl. 5, figs. 17, 22, 24.

Discussion: "*Dolerorthis" flabellites* is distinguished from *Dolerorthis* s.s. in that all costae originate at the beak rather than increasing in number by intercalation or division. Foerste erected four species which were subsequently reduced to varieties of *D. flabellites* by Schuchert & Cooper (1932, p. 89). Of these varieties *Orthis flabellites fissiplicata* Foerste (1895, p. 573) is a member of *Dolerorthis* s.s. as it has intercalating costae. The remaining varieties were differentiated by their lateral profiles which are dorsibiconvex in "*D.*" *f. dinorthis*, intermediate in "*D.*" *f. euorthis* (Foerste, 1895, p. 572). A fourth subspecies "*D.*" *f. militaris* (Foerste, 1909a, p. 75) is characterized by its large size, stronger, less numerous costae (20 to 24 rather than 25 to 30), and a broad, shallow sulcus near the dorsal beak.

"*D.*" *flabellites* and related species are often placed in *Hesperorthis*. However, individuals of *Hesperorthis* typically have plane to gently concave, rather than convex, dorsal valves; they also have a deltidium. Finally, the delthyrial angle is less than 30° in *Hesperorthis*; this angle is greater than 30° in most representatives of "*D.*" *flabellites*.

In my collections three distinctive groups of shells are present. Until a thorough revision of this taxon is undertaken, it is unwise to erect new names, so these three groups will be characterized informally.

GROUP 1**pl. 1, figs. 13, 14**

A single dorsal valve was collected from USNM loc. 19484. The valve, though now crushed, was weakly convex. It has about 26 rounded costae which originate at the beak. They are separated by flat interspaces which are equal in width to the costae. The interarea is weakly concave.

A thin, plate-like cardinal process is on a raised notothyrial platform which has distinct though small cavities beneath it.

The weakly convex dorsal valve and abundant costae are evidence for a possible affinity with "*D.*" *flabellites euorthis* or *Hesperorthis*.

Occurrence: High Lake Member Laketown Dolomite, Pancake Range, Nevada — USNM loc. 19484 (1).

GROUP 2**pl. 1, figs. 17-20**

USNM loc. 19546 and 19548 each have yielded three valves. Several shell fragments, questionably assigned to the group, were found at USNM loc. 19545. Specimens are ventribiconvex in lateral profile. Eighteen to twenty costae are present. The interspaces are flat and wider than the width of the costae; there are parvicostellae in the interspaces. The delthyrial angle is greater than 30°. The sides of the notothyrium include an angle of slightly less than 90°.

In the ventral interior the muscle field is bounded anteriorly by a well developed, rounded ridge which begins at the base of the dental plates. Flat ridges, formed by the impressions of the interspaces, are present along the margins of the shell, and each has a distinct furrow.

A blade-like cardinal process is on the notothyrial platform, and a broad steep sided median ridge extends beyond midlength. The muscle field is impressed.

This group can be distinguished easily from Group 1 as it has fewer costae and parvicostellae are present.

Occurrence: Gettel Member, Laketown Dolomite, Barn Hills, Utah — USNM loc. 19546 (1), 19548 (3). Questionably assigned to group 2 — High Lake Member, Laketown Dolomite, USNM loc. 19545 (1). Age: Could range from Lake Llandoverly to Early Wenlock. Community: *Cyrtia* Community.

GROUP 3**pl. 2, figs. 1-14**

The shells are ventri-biconvex and have 18 to 24 costae. The costae are rounded and have flat interspaces which are equal in width to the costae. The delthyrial angle is 20° to 30°. The notothyrial angle is slightly less than 90°. The ventral muscle field is bounded anterolaterally by a prominent ridge which is variably developed in length, but in no case does it bound the entire front of the muscle field. The notothyrial platform is raised off the floor of the dorsal valve and has distinct

cavities beneath it. Anteriorly, there is a median ridge which extends to about midlength. This ridge varies considerably in width from locality to locality. It is very thin in individuals from USNM loc. 19200, broad in individuals from USNM loc. 19203, 19185 and 19316. It is intermediate in breadth in most representatives in other collections. The dorsal muscle field is not impressed. Ventral valves of juveniles found in USNM 19187 and 19206 tend to be pyramidal with a distinct platform for muscle attachment.

A dorsal valve (pl. 2, fig. 12) from USNM loc. 19185 has two costae which bifurcate near the anterior margin.

Comparison: This group is easily distinguished from Group 1 in having fewer costae.

It can be distinguished from Group 2 on the basis of (narrower) interspaces between costae, in lacking a ridge which bounds the ventral muscle field anteriorly, in lacking parvicostellae and in lacking an impressed muscle field in the dorsal valve.

See also *Hesperorthis?* sp. for a comparison with this species.

Occurrence: Portage Canyon Member, Laketown Dolomite. Western Promontory Range, Utah — USNM loc. 19004 (3). Tony Grove Lake, Utah — USNM loc. 19322 (1). High Lake Member, Laketown Dolomite. Tony Grove, Utah — USNM loc. 19316 (1). Age: Late Llandovery (C₄₋₅).

High Lake Member Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19195 (1), 19200 (3), 19203 (1), 19204 (1). East side of southern Egan Range, Nevada — USNM loc. 19175 (32). Age: C₆-Early Wenlock.

Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19185 (9), 19206 (26), 19209 (3), 19211 (2). Assigned with question to Group 3: USNM loc. 19187 (2). Age: C₆-Early Wenlock.

Communities: *Pentameroides* Community (USNM locs. 19004, 19175, 19195, 19200, 19316). *Atrypina* Community (USNM locs. 19185, 19187, 19203, 19204, 19206, 19209, 19211).

DOLERORTHID sp. A

pl. 1, figs. 15, 16

Exterior: The lateral profile is plano-convex. There is a faint dorsal sulcus. The ventral interarea is broken; the dorsal interarea is about 1 mm high. The largest specimen is 13 mm long and 18 mm wide. The hinge line is nearly equal to the greatest width. There are 24 costae on the dorsal valve. The costae are high and separated by U-shaped interspaces.

Dorsal Interior: There is a very low median ridge. The notothyrial platform is sessile and has a broken plate-like cardinal process which extends to the front of the notothyrial chamber. The brachiophores form the sides of the notothyrium which has an apical angle of about 90°.

Occurrence: Portage Canyon Member, Laketown Dolomite, Sheep Rock Range,

Utah — USNM loc. 19576 (1). Age: Late Llandovery or Early Wenlock. Community: *Spirinella* Community?

Family PLECTORTHIDAE Schuchert & Cooper, 1931
Subfamily PLATYSTROPHIINAE Schuchert & Le Vene, 1929
Genus PLATYSTROPHIA King, 1850

***Platystrophia* sp.**
pl. 1, figs. 15, 16 B

Exterior: The elongate valves are dorsi-biconvex. The interareas are rather short. The narrow, well defined, flat-topped fold is very high with nearly vertical sides. The ventral sulcus is also steep-sided, well defined and has a flat floor. Anteriorly, the ventral sulcus projects dorsally as a tongue. The surface is costellate, and there are four costellae on both the fold and sulcus.

Comparison: *Platystrophia* sp. B has more costae in the sulcus than does *Platystrophia* sp. A from the Tony Grove Lake Member in the Egan Range (Sheehan, 1980b).

The sharply defined sulcus resembles *Platystrophia septentrionalis* Poulson (1943, p. 12-13, pl. 1, figs. 8-12) and *Platystrophia mimela* Lamont (1946, p. 3, pl. 1, figs. 5 & 6).

Occurrence: High Lake Member, Laketown Dolomite. Lakeside Mountains, Utah — USNM loc. 19040 (4). Age: Middle or Late Llandovery.

Suborder DALMANELLOIDEA
Superfamily DALMANELLACEA Schuchert, 1913
Family DALMANELLIDAE Schuchert, 1913
Genus RESSERELLA Bancroft, 1928

***"Resserella"* sp.**
pl. 2 figs. 17-20

Exterior: In lateral profile the ventral valve is strongly convex and the dorsal valve gently convex. The hinge line equals about half of the shell width. The margins of the ventral valve are broken, and the outline cannot be determined. In outline the dorsal valve is nearly round but the width slightly exceeds the length.

The apsacline ventral interarea is strongly curved and rather short. The small beak is strongly incurved but does not approach the plane of commissure. A small apical plate fills the apex of the delthyrium, which has an apical angle of about 45°. The anacline, dorsal interarea is short.

About 16 costellae are in a space of 5 mm, 10 mm from the beak.

Ventral Interior: The blunt and triangular teeth are supported by strong, ventrally divergent dental plates. Small crural fossettes are dorsally directed. Ridges extend forward from the dental plates bounding the muscle field laterally. The ridges converge anteriorly but do not reach the front of the muscle scars. The diductor scars are elongate and become narrow anteriorly; they are divided by a broad, low

ridge which carries the adductor scars posteriorly. The ridge expands anteriorly and extends beyond the front of the diductor scars. The muscle field is confined to the posterior third of the valve.

Dorsal Interior: The muscle scars are separated by a broad, low, flat-topped ridge which, in some shells, narrows anteriorly. The muscle scars are deeply impressed posteriorly but are indistinct anteriorly. They are bounded laterally by variably developed ridges which extend anteriorly from the brachiophore bases and occasionally reach the middle of the muscle scar. The brachiophores are high and triangular in cross section. The bases of the brachiophores are divergent anteriorly and well separated from each other. Small to massive pads of shell material are on the medial side of the brachiophores; these pads are convergent upon the median ridge.

The dental sockets are deep and bounded antero-laterally by a low ridge; they may represent crural plates which have been engulfed in shell material. The poorly preserved cardinal process is small and bulbous with a thin anterior plate.

Discussion: This species is assigned to "*Resserella*" because of the very deep ventral valve. *Resserella* s.s. has a more complex muscle bounding ridge pattern in the brachial valve than in this species in which simple ridges are confined to the posterior of the dorsal muscle scar. Muscle bounding ridges in the ventral muscle field of *Resserella* s.s. do not bound the diductor scars antero-medially as in "*Resserella*" sp.

Pads of shell material on the brachiophores resemble those described by Schuchert & Cooper (1932, p. 124) in *Levenea* and illustrated by them in *Resserella elegantula* (pl. 21, fig. 13).

The median ridge in the ventral valve resembles *Resserella ontarioensis* Chiang (1972) but that species has a wider hingeline and more prominent dorsal sulcus.

Occurrence: Member C. of unnamed Silurian formation. Ranger Mountain, Nevada — USNM loc. 19421 (18). Age: Late Llandovery or Early Wenlock.

Identified as ?"*Resserella*" sp. from High Lake Member Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19184 (1 ventral valve). Age: Late Llandovery or Early Wenlock.

Subfamily ISORTHINAE Schuchert & Cooper, 1931
Genus ISORTHIS Kozłowski, 1929

***Isorthis* sp.**
pl. 3, figs. 1-14

Exterior: This species is ventri-biconvex in lateral profile with a poorly defined, weak dorsal sulcus. It is subcircular with a straight hinge line that is equal to about three-fourths of the shell width. On the average, width is slightly greater than length. The largest individual measures about 7 x 7 mm. A small pedicle callist closes the apex of the delthyrium. Multicostellae increase by bifurcation. Commonly a few growth lines are prominent.

Ventral Interior: A low, rounded median ridge arises near the apex of the delthyrial cavity. Anteriorly, the ridge widens and increases in strength to about midlength where it is reduced and merges with the floor of the valve. The ridge is quite variable in robustness among individuals. Elongate adductor scars are located on the low posterior portion of the median ridge. Long, narrow, impressed diductor scars are on either side of the ridge; they end at midlength as does the median ridge. Postero-laterally, the muscle field is bounded by the bases of the divergent dental plates. Low, rounded, parallel ridges extend anteriorly from the dental plates, bounding the muscle field laterally. These ridges decrease in strength anteriorly and do not enclose the front of the muscle field. The teeth have crural fossettes.

Dorsal Interior: The quadripartite muscle field is weakly impressed and extends anteriorly slightly beyond midlength. The anterior adductor scars are about twice as large as the posterior ones. A broad, low, median ridge divides the muscle field. This ridge appears to increase in height anteriorly because the anterior adductor scars are more deeply impressed than the posterior scars. The muscle field is bounded laterally by a low ridge which extends forward from the bases of the brachiophores. The muscle bounding ridge is very faint or absent anteriorly. The anterior and posterior adductor scars are separated by a very low ridge which is situated perpendicular to the lateral muscle bounding ridges; it produces a bulge at the intersection of the ridges.

Posteriorly, the median ridge forms the floor of a low, broad notothyrial platform situated between the bases of the brachiophores. The simple cardinal process is a small, thin blade which extends the length of the notothyrial platform. The brachiophores are large, and their bases are well separated and divergent anteriorly. The outer faces of the brachiophores bound the dental sockets. Low ridges, which may be fulcral plates that have been engulfed by shell material, form the antero-lateral margin of the sockets.

Comparison: *Isorthis* sp. resembles other species of *Isorthis* in having brachiophores of average length that are set well apart, thereby producing a broad notothyrial platform. The cardinal process is smaller than that found in most species.

Isorthis sp. has weaker dorsal muscle bounding ridges than does *Isorthis* sp. Boucot, Johnson, Harper & Walmsley (1966, pl. 5, figs. 1, 2, 5, 6).

Isorthis macadamensis Harper (1973) from the French River, Doctor's Brook and Kerrowgare Formations of Nova Scotia differs from *Isorthis* sp. in having narrower ventral muscle scars and a broader dorsal median ridge.

Isorthis sp. differs from *Isorthis arcuaria* from the Silver Island Range (Sheehan, 1976) in having weaker dorsal muscle bounding ridges and also in that the dorsal median ridge does not extend anteriorly beyond the muscle field.

Occurrence: Portage Canyon Member, Laketown Dolomite, Portage, Utah — USNM locs. 19013 (2), 19014 (6), 19015 (1), 19016 (9). High Lake or Gettel Member, Southern Egan Range, Nevada — USNM locs. 19198 (10), 19200 (16), 19201 (21), 19203 (1). Identified as *Isorthis* sp.? Cherry Creek Range, Nevada — USNM loc. 19278 (6). Age: Late Llandovery (C₄₋₆) to Early Wenlock.

Communities: Pentameroides Community (USNM locs. 19198, 19200, 19278), *Microcardinalia* Community (USNM locs. 19013, 19014, 19015, 19016), *Atrypina* Community (USNM locs. 19201, 19203).

Family DICOELOSIIDAE Cloud, 1948
Genus DICOELOSIA King, 1850

***Dicoelosia biloba* (Linnaeus, 1758)**
pl. 3, figs. 18-26, pl. 4, figs. 1-3

Anomia biloba Linnaeus, 1758, p. 703.

Dicaelosia biloba (Linnaeus). King, 1850, p. 106.

Dicoelosia bilobella Amsden, 1968, p. 29.

Exterior: In lateral profile the ventral valve is convex; the brachial valve is nearly flat to gently convex. Near the beak all dorsal valves are gently convex. The shells have a length/width ratio which varies from 0.7 to 0.8. Maximum width occurs about 2/3 of the distance to the anterior margin. The length of the flat, apsacline ventral interarea is equal to about 1/6 of the shell length. The short dorsal interarea is anacline. The hinge line is extended into ears which produce a rather wide hinge line, with a hinge-line/shell-width ratio of 0.6 to 0.8. The anterior lobation is moderate with a median-length/length ratio varying from 0.70 to 0.75. The deep ventral interarea is equal to about 1/6 of the shell length. The short dorsal interarea is anacline. The hinge line is extended into ears which produce a rather wide hinge line, with a hinge-line/shell-width ratio of 0.6 to 0.8. The anterior lobation is moderate with a median-length/length ratio varying from 0.70 to 0.75. The deep ventral sulcus originates slightly in front of the beak and is about 1 mm wide measured 2 mm from the beak. The broad lobes have an angle of divergence (Wright, 1964, p. 228) which varies from 45° to 60°. The costellae are sub-angular to rounded in cross section. They increase by intercalation which occasionally mimics bifurcation where the new costella arises very close to an older costella (see Wright, 1968, p. 268). Along the crest of the lobes 5 costellae occur in the space of 1 mm measured 2 mm from the beak of the dorsal valve. The sulci generally lack costellae with the exception of a fine median costella on the floor of the ventral sulcus. Anteriorly, costellae are present high on the sides of the sulci. There are commonly one or more strongly pronounced growth lamellae. The shells are small for the genus; the largest valve is 3.0 mm long, 3.75 mm wide, and has a median length of 2.25 mm.

Ventral Interior: The triangular teeth are supported by receding dental plates which have been overgrown by secondary shell. The muscle field is situated on a low platform which extends anteriorly about one third of the distance to the anterior, median margin. The muscle field is divided by a low median ridge. Marginal ridges and grooves are very strongly developed.

Dorsal Interior: The internal surface of the valve is gently concave with the exception of the postero-lateral sides where the ears form flat shelves. The brachiophore bases, located along the inner margin of these shelves, diverge anteriorly at slightly less than 90°. The brachiophores are high plates which lie

perpendicular to the floor of the valve. There is a weak to strong median ridge extending the length of the valve. Anteriorly the ridge bifurcates and at the front margin is continuous with two very high, strongly developed marginal ridges and grooves. A cardinal process is present but poorly preserved. The muscle field was not preserved.

Comparison: With the exception of its wide hinge line and small size, this population compares well with *Dicoelosia biloba*. Though the hinge line is wide for the species, it lies within the range of variation of specimens assigned to *D. biloba* by Wright (1968, pl. 2, figs. 2 & 3). *Dicoelosia biloba* is normally somewhat larger than the individuals in this collection. The largest individual illustrated by Wright (pl. 1, fig. 13) is 6 mm in length whereas the longest in my collections is 3.0 mm long. I do not consider this size difference to be of specific importance. Bassett (1972, p. 59) reported *D. biloba* ranges from Early Wenlock to Early Ludlow.

In terms of its small size, outline and profile, the individuals in this collection agree well with *D. bilobella* (Amsden, 1968). However, they can be distinguished from it by their stronger, more angular costellation. *Dicoelosia bilobella* has been differentiated from *D. biloba* as follows (Amsden, 1968, p. 34): 1) *D. bilobella* has finer, more widely spaced costellae. 2) *D. bilobella* is not as deeply invaginated. 3) *D. bilobella* is smaller. Amsden based these distinctions on comparative material from the Slite Marlstone of Gotland which he considered to be characteristic of *D. biloba*. More recently Wright (1968, p. 263-267, pl. 1, figs. 1-4, 7) has described and illustrated the type material of *D. biloba*. In light of this work Amsden's species must be re-examined. Referring to *D. biloba*, Wright (p. 299) stated: ". . . mid-line length about three-quarters of maximum valve length;". This figure is larger than the 0.64 ratio obtained from Amsden's data (p. 34) for *D. biloba*; it agrees well with the 0.78 ratio of *D. bilobella*. In terms of the external ornament, the strength of costellae on the lectotype of *D. biloba* (Wright, pl. 1, figs. 1-4, 7) is more similar to *D. bilobella* Amsden (pl. 3, figs. 6a-g, & pl. 8, figs. 2a-g), than it is to the material which Amsden considered representative of *D. biloba* (pl. 8, figs. 3a-e). The size difference is the only valid one of the three characters used by Amsden to distinguish the two species. In view of the available evidence of *D. bilobella* is considered here to be a subspecies within *D. biloba*.

Dicoelosia sp. r of Merriam and McKee (1976) from the Roberts Mountains Formation of Nevada is more finely ribbed and has a wider hinge line than the Laketown species.

Occurrence: High Lake or Gettel Members, Laketown Dolomite, Southern Egan Range, Utah — USNM locs. 19201 (1), 19203 (2), 19204 (7). Identified as *Dicoelosia biloba*? — USNM loc. 19199 (1). Age: C₆ — Early Wenlock.

Communities: *Pentameroides* Community (19199), *Atrypina* Community (19201, 19203, 10204).

***Dicoelosia* sp.
(not illustrated)**

Exterior: The lateral profile is plano-convex to very slightly concavo-convex. The length/width ratio is about 1/1. In width the hinge line equals less than 4/10 of the

maximum width which occurs in the anterior quarter of the shell. The length of the apsacline ventral interarea equals about 1/8 of the valve length. The short dorsal interarea is anacline. The anterior lobation is strong with a median length/length ratio of 0.67 for both valves which could be measured. The lobes are narrow and have an angle of divergence of 35°. The sulci originate at the beak; the ventral sulcus has a width of about 1 mm measured 2 mm from the beak. The sharply rounded costellae have rather wide interspaces and increase by intercalation. There are 6 or 7 costellae in a space of 1 mm measured 2 mm from the dorsal apex on the crests of the lobes.

Dorsal Interior: The brachiophore bases are widely divergent but located well inside the margins of the valve.

Comparison: There is a close resemblance with *Dicoelosia verneuiliana* as described by Wright (1968, p. 312-316). The outlines are similar and the narrow lobes diverge at 35° in both cases. The median length/length ratios are the same. There are more costellae in the 1 mm space on *D. verneuiliana* than this group (most commonly 7 to 9 costellae compared with 6 or 7 costellae). The material is too poorly preserved to make a confident identification.

Dicoelosia sp. differs from *D. acutiloba* (Ringueberg, 1888, p. 134, pl. 7, fig. 5) in having a wider hinge line which results in a wider posterior outline.

Occurrence: Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19206 (3). Age: C₆ — Early Wenlock. Community: *Atrypina* Community.

Family RHIPIDOMELLIDAE Schuchert, 1913
Subfamily RHIPIDOMELLINAE Schuchert, 1913
Genus DALEJINA Havlíček, 1953

Dalejina sp.
 pl. 4, figs. 4-11

Exterior: The lateral profile is dorsi-biconvex. The valves are transverse with maximum shell width occurring near midlength. The hinge line is short. The curved ventral interarea is apsacline; the dorsal interarea is anacline. There are about 5 costellae in a space of 2 mm, 10 mm from the beak. Neither fold nor sulcus are developed.

Ventral Interior: In the back of the delthyrial chamber a prominent pedicle callist forms a platform which has an abrupt anterior margin. Stout, triangular teeth are supported by anteriorly divergent dental plates which are made obsolescent by the addition of shell material. The muscle field is impressed and is bounded posteriorly by the pedicle callist and laterally by the dental plates and broad low ridges which extend forward from the front of the dental plates. The muscle field is composed of a pair of diductor scars which flare anteriorly and a more deeply impressed but shorter pair of adductor scars. The adductor scars are separated by a low ridge which widens and increases in height in front of the adductor scars. A very low ridge divides each diductor scar posteriorly.

A single ventral valve from USNM loc. 19487 differs from the others in having shorter dental plates, shorter adductor scars, and a muscle field which is not as wide as found in individuals from the other collections. The specimen is questionably assigned to this species.

Dorsal Interior: The cardinal process is rod-shaped and bi-lobed distally. The brachiophores are short and have bases which are strongly divergent anteriorly and ventrally. A notothyrial platform is not developed. In front of the cardinal process there is a broad, low ridge on the floor of the valve. The ridge extends to about midlength. The muscle field is impressed medially. Dental sockets are widely divergent. Fulcral plates are not present. Crenulations along the margin of the valve are low and rectangular in cross section.

Dalejina sp. has more widely separated brachiophores bases than *D. henry-housensis* (Amsden, 1951, p. 74-75, pl. 15, fig. 17).

Dalejina sp. is more coarsely costellate than *D. newsomensis* (Foerste, 1909a, p. 73, pl. 4, fig. 72A, B), *Dalejina?* *lenticularis* (Foerste, 1909b, p. 72, pl. 2, figs. 28A, B), *Dalejina subtriangularis* (Amsden, 1951, p. 75, pl. 15, figs. 8-13), and *Dalejina?* *cliftonensis* (Amsden, 1949, p. 43, figs. 7-11).

A specific identification has not been attempted because there are numerous poorly described species of *Dalejina*.

Occurrence: Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada, USNM locs. 19185 (7), 19186 (1). High Lake or Gettel Member. USNM loc. 19201 (2). Identified as *Dalejina?* sp. — Portage Canyon Member, Laketown Dolomite. Pancake Range, Nevada — USNM loc. 19487 (1). Age: C₆ — Early Wenlock (USNM loc. 19487 may be either younger or older than C₆ — Early Wenlock). Community: *Atrypina* Community.

ORTHIDA (Coarse Ribbed)

Specimens identified as coarse ribbed Orthida, genus and species indeterminate:

High Lake Member of Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19175 (1), 19178 (1), 19183 (2), 19184 (1), 19197, 19198 Delamar Range, Nevada — USNM loc. 19522 (1). Barn Hills, Utah — USNM loc. 19541 (2). Spors Mountain, Utah — USNM loc. 19569 (2).

Jack Valley Member of Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19185 (4), 19206 (3), 19209 (4). Cherry Creek Range, Nevada — USNM locs. 19275 (1), 19276 (2).

Portage Canyon Member, Laketown Dolomite. Tony Grove Lake, Utah — USNM loc. 19319 (2).

?Laketown Dolomite. Cove Fort, Utah — USNM loc. 19430 (1).

ORTHIDA (Fine Ribbed)

Specimens identified as fine ribbed Orthida, genus and species indeterminate:

High Lake Member of Laketown Dolomite: Portage, Utah — USNM locs. 19029 (1), 19032 (1). Cherry Creek Range, Nevada — USNM loc. 19272 (1). Tony Grove Lake, Utah — USNM loc. 19314 (1). Southern Egan Range, Nevada — USNM locs. 19180 (3), 19197 (13), 19202 (3), 19203 (7), 19204 (2).

Portage Canyon Member of Laketown Dolomite. Portage, Utah — USNM locs. 19016 (1), 19020 (1), 19021 (2). Sheep Rock Range, Utah — USNM loc. 19576 (5).

Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19185 (1).

Member C of unnamed Silurian dolomite, Ranger Mountain, Nevada — USNM loc. 19419 (1).

Lone Mountain Dolomite. Mahogany Hills, Nevada — USNM loc. 19530 (4).

DOLERORTHIDAE

Identified as Family Dolerorthidae, genus and species indeterminate:

High Lake Member of Laketown Dolomite. Portage, Utah — USNM loc. 19032 (2). Pancake Range, Nevada — USNM loc. 19484 (1).

Portage Canyon Member of Laketown Dolomite. Sheep Rock Range, Utah — USNM loc. 19576 (1).

Order STROPHOMENIDA

Suborder STROPHOMENOIDEA

Superfamily PLECTAMBONITACEA Jones, 1928

Family SOWERBYELLIDAE Öpik, 1930

Subfamily SOWERBYELLINAE Öpik, 1930

Genus EOPLECTODONTA Kozłowski, 1929

Discussion: Havlíček (1967, p. 39, & p. 58-65) and Durkoop (1970, p. 183-185) reviewed *Plectodonta*, *Eoplectodonta* and related genera. Durkoop discussed and diagrammed changes in dorsal septal structures through time, but he made no specific assignments. His diagram (Abb. 17) shows the highlights of morphologic changes, but it does not represent the full range of morphologic variability at any time. As an example of the variability, the two species discussed in this paper are not illustrated in his diagram. He did not make the customary distinction between a ridge and a septum in his terminology and he refers to both as septa. Durkoop assigned forms which have either a dorsal median septum or a dorsal median ridge to *Eoplectodonta*. Forms which lack such dorsal median structures were placed in *Plectodonta*.

Havlíček (1967, p. 58) suggested that *Ygera* is intermediate between *Eoplectodonta* and *Plectodonta*. *Eoplectodonta* is characterized by a median dorsal septum which is not found in *Ygera*; *Ygera* may have a median dorsal ridge or have no dorsal median structure. *Ygera* was also distinguished from *Eoplectodonta* by visceral lobes which are defined anteriorly by ridges which are continuous with the medial septa. In *Eoplectodonta* the visceral lobes are not confined anteriorly.

Cocks (1970) examined a large collection of topotypic material of *Ygera sowerbyana*, the type species of *Ygera*. He concluded that *Ygera* should be placed in synonymy with *Eoplectodonta* because the intraspecific variability of the type species makes Havlíček's generic diagnosis unreliable. This taxonomic viewpoint is accepted here.

***Eoplectodonta* sp.**

pl. 4, figs. 12-20

Exterior: The ventral valve is strongly convex in lateral profile; maximum curvature occurs in the posterior third of the valve. The dorsal valve is very strongly concave. The semi-elliptical shells are transverse, and the ventral umbo projects well beyond the hinge line. Since the margins are broken in all specimens, the anterior outline is uncertain. The ventral beak is strongly incurved, and the short ventral interarea is anacline or orthocline. The very short dorsal interarea is hypercline. The external ornament is poorly preserved and consists of widely spaced costellae.

Individuals from USNM loc. 19201 assigned to *?Eoplectodonta* sp. have a convex pseudodeltidium which is confined to the posterior half of the delthyrium. A convex chilidium which fills the notothyrium has three ridges. The assignment of this collection is queried because no dorsal interiors were preserved.

Ventral Interior: Deep, conical adductor scars are excavated beneath a deposit of secondary shell in the apex of the valve. The adductor scars extend a short distance forward; they are divided by a weak to strong median ridge. The narrow diductor scars diverge anteriorly at about 60° and reach to about midlength. When the median ridge is strong, it bifurcates in front of the adductor scars and bounds the diductor scars medially. When the median ridge is weak it does not extend beyond the adductor scars. The muscle field is deeply impressed posteriorly. In those valves which have a strong median ridge the muscle field is well defined anteriorly; it is poorly defined anteriorly in valves which have weak septa. Most individuals are intermediate between these extremes.

Dorsal Interior: The cardinal process has not been preserved. A low, median ridge is present in the posterior third of the valve; in small specimens this ridge nearly reaches the front margin. The visceral field, composed of two lobes, extends two thirds of the distance to the anterior margin and has both inner and outer side septa. The very high inner side septa lie close together posteriorly, and the space between them is often filled with secondary shell. The inner side septa are anteriorly divergent. The outer septa are strong, but not as high as the inner ones. The visceral lobes are bounded laterally by strong, outwardly inclined ridges, and in front by low continuations of these ridges which join the front of the inner side septa.

Comparison: The dorsal septa of this species generally resemble the Late Llandovery (C_{1.6}) forms discussed and illustrated by Durkoop (1970). However, there are several differences. The outer septa in *Eoplectodonta* sp. are more widely separated from the medial septa than any of the forms Durkoop (1970, Abb. 17) illustrated. Further, though there is a secondary shell deposit between the septa, as

in Durkoop's C_6 forms, the septa are erect rather than laterally inclined as shown in Durkoop's illustrations.

Occurrence: Southern Egan Range, Nevada. High Lake or Gettel Member, Laketown Dolomite — USNM loc. 19198 (34). Identified as *?Eoplectodonta* sp. — USNM loc. 19199 (6), 19201 (10), 19204 (1). Jack Valley Member — 19209 (1) Age: C_6 — Early Wenlock.

Communities: *Pentameroides* Community (19198, 19199). *Atrypina* Community (19201, 19204, 10209).

Superfamily STROPHOMENACEA King, 1846
Family STROPHOMENIDAE King, 1846
Subfamily LEPTAENINAE Hall & Clarke, 1892
Genus LEPTAENA Dalman, 1828

Leptaena sp.
 pl. 4, figs. 21-23

Exterior: The posterior portion of the valves are concavo-convex; the anterior regions of all specimens have been broken away. The delthyrium is enclosed by a convex pseudodeltidium, which has a broad, median depression. The delthyrial angle is about 60° . A strong, convex chilidium fills the notothyrium. The ventral interarea has a maximum length of 1 mm, and the dorsal interarea is somewhat more than 1/2 mm long. Postero-laterally the margins of the dorsal interarea stand sharply above the plane of the dorsal valve. Radial ornament has not been preserved, but there are strong, rounded concentric rugae. The largest specimen, though broken, was over 24 mm in width.

Ventral Interior: Crenated denticular plates are supported by strong, divergent dental plates. The antero-median part of the dental plates have a shallow elongate groove. A short, strong median ridge (ventral process) separates the process pits. Beyond the dental plates the muscle field is not bounded by ridges.

Dorsal Interior: The cardinal process has not been preserved. The socket plates are divergent anteriorly. The sockets are elongate and deep in their posterior half. The front of the socket plates articulate with the groove on the dental plates. A notothyrial platform is present, and a median ridge divides the adductor muscle scars.

Comparison: The species cannot be placed in *Leptagonia* because the ventral muscle field is not surrounded by a ridge (see Havlíček, 1967, p. 86).

Occurrence: Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19187 (4), 19188 (1). Age: C_6 — Early Wenlock. Community: *Atrypina* Community.

Superfamily STROPHEODONTACEA Caster, 1939
(nom. transl. Sokolskaya, 1960, ex Strophodontidae, Caster, 1939)
Family STROPHEODONTIDAE Caster, 1939
Subfamily BRACHYPRIONINAE Harper & Boucot, 1978
Genus BRACHYPRION Shaler, 1865

Brachyprion (Eomegastrophia) geniculata (Waite, 1956)
pl. 4, figs. 24-25; pl. 5, figs. 1-19; pl. 6, figs. 1-8

Dowillina (Mesodowillina) geniculata Waite, 1956, p. 16, pl. 4 (explanation is labeled pl. 3), figs. 20-24.

Brachyprion (Eomegastrophia) geniculata (Waite), Harper & Boucot, 1978, p. 15, pl. 39, figs. 3, 6-15.

?*Brachyprion inflatus* Stearn, 1956, p. 97, pl. 11, figs. 22-23.

Exterior: The ventral valves are markedly convex; a slight increase in curvature about two-thirds of the distance to the anterior margin causes an anteriorly directed bulge in the semi-circular lateral profile. Until they attain a length of about 12 mm the valves are moderately convex; larger shells are distinctly domed. To obtain a measure of the height of the valves, specimens with the entire profile best preserved were measured; the results are as follows:

Locality	Width (w)	Length (l)	Height above plane of commissure (h)	Ratio h/l
USNM 19050	20 mm	17 mm	9 mm	0.53
USNM 19050	19	17	9	0.53
USNM 19050	19	14	9	0.64
USNM 19050	21	19	9	0.47
USNM 19054	24	23	13	0.50
USNM 19055	21	19	12	0.63
USNM 19055	18	16	10	0.62
USNM 19055	18	16	9	0.56
USNM 19056	24	22	11	0.50
USNM 19058	23	21	11	0.52

Average ratio of h/l: 0.55

In a few individuals there is a rather abrupt, but rounded increase in curvature at about 12 mm; since this is not an angular change, the term geniculate (the root of the specific name) is not appropriate, even in these shells. The ventral surface is evenly rounded with the exception of the alaeate postero-lateral extremities which are recurved and nearly flat. About the first 8 mm of the dorsal valve is very gently concave to nearly flat; beyond 8 mm the valve is strongly concave, and conforms to the curvature of the ventral valve. The shells are semi-elliptical in outline with the major axis of the ellipse along the midline of the shell. The length/width ratio averages 0.9 and varies from 0.8 to 1.0. These figures are based on 59 measured

specimens from USNM 19050, 19055, 19056, 19058. No significant differences in the average l/w ratios occur among these localities. The postero-lateral extremities are extended; many valves have only slight lateral extensions; one valve, with a width of 20 mm between the lateral margins (measured at midlength), has a 10 mm long spine-like protrusion of the wings (pl. 4, fig. 24); the spine has a slight posterior curvature. Some of the larger ventral valves have a slight fold in the anterior third of the valve.

In young shells the ventral interarea is apsacline and the dorsal interarea is anacline. However, with growth of the domed shells the plane of commissure rotated dorsally around an axis formed by the hinge line; the ventral interarea become anacline and the dorsal interarea strongly hypercline. In some shells the plane of the dorsal interarea lies in the plane of commissure.

The denticular plates are covered externally by thin "cover plates" which extend anteriorly only to the hinge line. The "cover plates" often break away when the valves become disarticulated. In well preserved specimens there is a distinct groove between the margins of the delthyrium and the "cover plates"; this groove lies over the junction of the denticular plates and the interarea. Williams (1953, p. 8) thought that the denticular plates originated beneath the lamellar layer of the interarea which bordered the delthyrium. In this species, at least, the denticular plates lie medial to the margins of the delthyrium and are covered by separate plates rather than by the interarea. The delthyrial margins are broadly divergent; the "cover plates" are separated by a triangular fissure that is filled apically with a convex pseudodeltidium, which has a broad, poorly defined median depression. The anterior margin of the pseudodeltidium is concave apically. A short chilidium covers the posterior bases of the cardinal process lobes. The chilidium has a deep, narrow depression. There is a triangular open area between the chilidium and the pseudodeltidium. The round, small pedicle opening is apical in the sense of Arber (1940, p. 162).

Several valves are markedly asymmetrical. The asymmetry was most likely caused by shell growth in confined space.

The shells can be grouped into two main types on the basis of their radial ornament. First, there are parvicostellate shells with the costellae of two sizes. The major costellae are regularly spaced across the valve, separating sub-equal areas of the shell surface which have much finer costellae. The main costellae tend to be added in ranks at certain growth stages. The costellae do not increase in strength anteriorly. Second, there are shells with costellae added erratically and within a short distance all costellae attain sub-equal strength. Many shells are intermediate between these extremes, and in a few specimens both types are developed on the same shell. More information concerning the costellae is given under the discussion of the subspecies.

Growth lines are very fine and preserved on only a few of the well preserved specimens. There are 14 to 18 growth lines in 1 mm. The largest valve (from USNM loc. 19063) is broken along its margins; it is 30 mm wide and 25 mm long.

Ventral Interior: The pseudodeltidium is supported by a short median callist (ventral process). The median callist does not exceed 1.5 mm in length and usually is shorter. A tube, which penetrates the middle of the pedicle callist connects the pedicle opening to the interior of the shell. In small (young) shells this tube is open, but in larger (older) shells the interior of the tube is plugged, though the remainder of the tube is not filled. The dorsal (external) surface of the denticular plates is grooved. The posterior three-fourths of the denticular plates are supported by thick dental plates which attach well to the side of the junctures of the denticular plates with the pseudodeltidium. The dental plates diverge anteriorly at about 90° , and they are continued for a short distance anteriorly as broad ridges on the floor of the valve. A long groove on the medial surface of each dental plate articulates with the socket plates of the dorsal valve. The tips of the socket plates rest upon the short ridges which project forward from the dental plates. Shallow process pits on either side of the median callist accommodate the cardinal process lobes.

The muscle field is very poorly defined and its margins are unclear. The narrow, elongate adductor muscle scars begin at a point which lies in front of the forward extension of the dental plates. The adductor scars are separated by a very narrow, but distinct ridge which begins at their posterior extremity. The ridge extends a variable distance anteriorly, but always far beyond the adductor muscle scars. The median ridge is rounded in cross section and is strongest between the adductor scars.

Dorsal Interior: The two high cardinal process lobes are postero-ventrally directed. On the midline a delicate, low, rounded process is commonly present between the cardinal process lobes. Strongly divergent socket plates rest on either side of the cardinal process lobes. The socket plates are gently curved and on their ventral surfaces bear medial grooves which articulate with the ridges extending from the dental plates as previously described on the ventral valve. A faint, anteriorly tapering notothyrial platform is present on a few valves. The widely separated adductor muscle scars are impressed posteriorly but are poorly defined anteriorly. There is a low, narrow, median ridge in the anterior half of the valve; its anterior extent is not known because the front margin of all the dorsal valves is broken.

Discussion: In the Kings Canyon partial section localities USNM loc. 19050 through 19059 were collected in stratigraphic sequence through an interval of 20 m in the Jack Valley Member of the Laketown Dolomite. A definite trend of morphologic change in the ventral ornament was seen through these localities. Two sub-species are based on these changes. In the earlier (stratigraphically lower) collections a large predominance of individuals has relatively strong primary costellae which define rather broad areas in which are 4 to 8 fine costellae. This differentiation is present over the entire valve. In specimens found higher in the section the primary costellae are more closely spaced. Fewer fine costellae occur between the primary costellae. These fine costellae are coarser than their counterparts on earlier valves. Anteriorly, in large shells the differentiation of costellae breaks down and all costellae are of sub-equal size. Some individuals exhibit no differentiation of costellae. Intermediate localities have individuals of

both types. The lower group is designated *Brachyprion geniculata* sub-species A (holotype USNM 219611, pl. 5, figs. 1 & 5); the upper is designated *B. geniculata* subspecies B (holotype USNM 219613, pl. 5, figs. 3 & 4). Subspecies A includes those collections in which nearly all individuals have coarse costellae which border fields of fine costellae and includes those collections from USNM loc. 19059 & 19058. Subspecies B includes those collections dominated by individuals which have no obvious fields of fine costellae and includes the collection from USNM loc. 19050. The intermediate collections, (USNM loc. 19054; 19055; 19056) in which individuals of both types are common, are not assigned to a subspecies. The holotype (Waite, 1956, pl. 3, fig. 22) has the morphology of subspecies B. Since the collections of Waite (University of Calif. Mus. Paleont. B-1408), from which the type was selected, are dominated by this morphology, the type specimen is assigned to subspecies B.

The sediment types and associated faunas are similar through the series of collections from the Kings Canyon Section. This is suggestive of an evolutionary change rather than a lateral invasion associated with changing ecologic conditions.

Fifteen miles southeast of the Kings Canyon Section USNM loc. 19550, from the lower part of the Jack Valley Member of the Laketown Dolomite in the Ibex Hills, has *B. geniculata* subspecies A. USNM loc. 19536 from the Tony Grove Lake Member of the Laketown Dolomite in the same section has a collection tentatively assigned to the subspecies. The identification is questioned because no interiors are available; the external ornament allies it with subspecies A.

In the Tony Grove Lake Section, low in the High Lake Member, a number of molds from USNM locs. 19312, 19313, 19314 are tentatively assigned to this species (see pl. 6, fig. 4). The size and strong convexity of these shells agrees with *B. geniculata*. A ventral process and dental plates are present, and the muscle field is weakly impressed. No dorsal valves were preserved. The shells are costellate, but the preservation is too poor to allow comparison with other members of the species.

Also in the Tony Grove Lake Section in the Jack Valley Member, USNM loc. 19324 has a single specimen assignable to *B. geniculata* sub sp. A?. Both external and internal features are visible on this broken, articulated individual and it conforms in all respects with the species. The sub-specific assignment is uncertain because the subspecies are based on relative abundance of ornament type and this cannot be determined since only a single valve is present.

Mode of Life: Large, markedly concavo-convex strophomenid brachiopods are generally thought to live concave side up in soft, fine grained sediment (Lamont, 1934, Rudwick, 1965, Richards, 1970). Since the pedicle tube as open in young *B. geniculata*, they probably were attached by their pedicle to the substrate or to an object. Larger shells lived unattached as evidenced by the plugged pedicle tunnel. The cavity formed by the concave dorsal valve was filled, at least in part, by fine grained non-carbonate silt, which is commonly preserved as a silty cover over the upward facing surface of the valve, including the interareas. These silty films do not cover the ventral surfaces. In the few completely unbroken specimens the plane of commissure always includes the line formed by the interarea. It seems that the

valves were rather deeply buried, and the deep convexity was formed as the anterior margin grew upward to keep pace with the in-filling sediment, thus causing the plane of commissure to remain parallel with the surface of this sediment. The wings and their extensions into lateral spines may have served as pivot points which aided in keeping the hinge line on top of the sediment during growth.

Since the degree of convexity may be closely related to the rate of sedimentation this feature is of limited use for taxonomic purposes.

Many shells, especially those from USNM loc. 1950, are also covered by a tar-like film on only the dorsal surfaces, clearly indicating that the tar was present in the depositional environment and did not move into the rocks during or after lithification.

A few shells have corals growing on their convex, ventral surfaces; they must have been overturned after their death. The absence of sedimentary structures such as cut and fill, together with the coral morphology, indicate a quiet water environment. Since the environment was probably not disturbed by currents, the shells may have been overturned by vagile benthos.

I can suggest no ecologic factors which, in an obvious way, would serve to discipline the evolution of the observed change in external ornament.

The partly in-sediment mode of life is similar to that of many productid brachiopods (Grant, 1968, 1970), and *B. geniculata* is one of the earliest brachiopods to utilize this mode of life.

Comparison: the genus *Brachyprion* has been extensively revised by Harper and Boucot (1978). They assigned this species to *Brachyprion (Eomegastrophia) ethica* Cocks (1967) and other species he assigned to the subgenus in having stronger socket plates and a median ridge in the dorsal valve which originates far to the front of, rather than immediately in front of, the notothyrial platform.

The genus *Brachyprion* includes several species with stronger convexity than is found in other early stropheodontids. This character must be used with care, however, as its expression is probably quite susceptible to environmental conditions. This species also has weakly impressed muscle scars, as is characteristic of *Brachyprion*.

The C₆ — Early Wenlock age of this collection clearly indicates that this species is off the main line of stropheodontid evolution, since the principal derivative stocks were already established (Williams, 1953, p. 20). Dental plates were maintained longer in this species than in other stocks (see Harper & Boucot, 1978).

Brachyprion inflatus Stearn (1956) from the Cross Lake Member of the Cedar Lake Formation, southern Manitoba, Canada is tentatively placed in synonymy with *B. geniculata*. The only obvious difference is that, according to Stearn, the dental plates are weak, rather than strong; however, Stearn noted that the interiors were poorly preserved in his collections. Stearn described the length/height ratio as about 1:3, but the ratio of the holotype, based on Stearn's measurements is 0.53, closely comparable to the average of 0.55 which was found in *B. geniculata*. The

synonymy is queried at this time pending study of specimens of *B. inflatus*. Priority is given to *B. geniculata* as Waite's publication was in the January, 1956, issue of the *Journal of Paleontology*, while Stearn's publications bear the date May 15, 1956. The costellae of *B. inflatus* lack conspicuous alternation (Stearn, p. 79) and affinities are probably with subspecies *B.*

At a specific level the strong convexity, prominent socket plates, and dental plates distinguish *B. geniculata* from most species referable to *Brachyprion*.

As described by Stearn (1956, p. 96, pl. 11, figs. 20, 21, 24, 25) *Brachyprion* (*Eomegastrophia*) *acanthopterus* (Whiteaves) from the Cedar Lake Formation of southern Manitoba, Canada, has a strong convexity, though less than *B. geniculata* (= *B. inflatus*) from the Cross Lake Member of the Cedar Lake Formation. The dental plates are also smaller than in *B. geniculata*. Finally, *B. geniculata* does not have two low ridges surrounding a small pit in the apex of the ventral valve as found in *B. acanthopterus*.

B. robustum Twenhofel, 1928, is more transverse with a length/width ratio of 0.6 from Twenhofel's data, or 0.75 from Stearn (1956, p. 99). In addition the convexity is apparently less than in *B. geniculata*, and the ventral median ridge figured by Shrock & Twenhofel (1939, pl. 29, fig. 17) is stronger than *B. geniculata*. The presence or absence of dental plates is unknown.

Brachyprion polaris Andreeva (in Nikiforova and Andreeva, 1961) is strongly concavo-convex and may be related; however, the ornament is less strongly developed and the interior morphology is unknown. Specimens assigned to *B. polaris* by Lopushinskaya (1976) seem to be more coarsely ribbed and have less differentiated ornament than specimens illustrated by Andreeva.

Brachyprion omnutakhensis Lopushinskaya (1976) from northern Siberia has similar curvature, but primary costellae that are stronger than those of *B. geniculata*. Internally the ventral valve of *B. omnutakhensis* has strongly impressed muscle scars and lacks a median ridge.

Brachyprion sp. A of Amsden (1978) from the Wenlockian Quarry Mountain Formation of Oklahoma is more finely ribbed and has weaker dental plates than *B. geniculata*.

Brachyprion waltonii (Davidson) and *Brachyprion dayi* (Davidson) from Wales are less convex than *B. geniculata* (see Bassett, 1977).

Occurrence: Jack Valley Member of Laketown Dolomite. Confusion Range, Utah — USNM locs. 19050 (384), 19054 (32), 19055 (60), 19056 (129), 19057 (90), 19058 (78), 19059 (13), 19063 (1). Barn Hills, Utah — USNM loc. 19550 (5). Tony Grove Lake, Utah — USNM loc. 19324 (2). Age: C₆ — Lower Wenlock. Community: *Spirinella* Community.

Identified as ?*B. geniculata*: Tony Grove Lake Member of Laketown Dolomite. Barn Hills, Utah — USNM loc. 19536 (8). High Lake Member of Laketown Dolomite. Tony Grove Lake, Utah — USNM locs. 19312 (12), 19313 (3), 19314 (1). Age: Upper Llandovery (C₁₋₃). Community: *Pentamerus* Community.

STROPHEODONTID sp. A
(not illustrated)

Discussion: The lateral profile is concavo-convex. The shell is transverse, 25 mm wide and 13 mm long. The dorsal and ventral interareas lie in nearly the same plane. External ornament has not been preserved.

In the ventral valve a low, median ridge bifurcates posteriorly. The muscle field is strongly impressed in back and broadly expanded toward the front. The cardinal process is composed of two stout lobes.

Occurrence: Jack Valley Member of Laketown Dolomite. Southern Egan Range, Utah — USNM loc. 19185 (3). Age: Confined to C₆ — Early Wenlock through Ludlow. Community: *Atrypina* Community.

STROPHOMENIDA

Identified as Strophomenida genus and species indeterminate: High Lake Member of Laketown Dolomite. East side of southern Egan Range, Nevada — USNM loc. 19175 (5). Cherry Creek Range, Nevada — USNM loc. 19271 (3). Spors Mountain, Utah — USNM loc. 19569 (1). High Lake or Gettel Members. Southern Egan Range, Nevada — USNM loc. 19194 (1), 19203 (1).

Jack Valley Member. Southern Egan Range, Nevada — USNM loc. 19187 (1), 19206 (10).

DAVIDSONIACEA

Identified as Superfamily Davidsoniacea genus and species indeterminate: High Lake or Gettel Member of Laketown Dolomite. Southern Egan Range, Utah — USNM loc. 19197 (1).

PLECTAMBONITACEA

Identified as Superfamily Plectambonitacea genus and species indeterminate. High Lake Member of Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19180 (1).

Suborder CHONETOIDEA

Superfamily CHONETACEA Bronn, 1862

Family CHONETIDAE Bronn, 1862

Subfamily DEVONCHONETINAE Muir-Wood, 1962

Genus PROTOCHONETES Muir-Wood, 1962

Protochonetes elyensis n. sp.

pl. 6, figs. 5-9

Exterior: The valves are strongly concavo-convex, with the height of the ventral valve as much as 4/10 its length. The curvature is strongest at, or slightly behind, midlength. The anterior margins of all valves are broken and the outline is not known. The cardinal extremities are slightly alate. The interareas are very short. Both a pseudodeltidium and a bulbous chilidium are present. There are six or more

spines on the margin of the ventral interarea. The spines extend postero-laterally at about 30° to the hinge line.

There are 10 to 12 fine, rounded costellae in a space of 1 mm measured 5 mm from the beak. The largest individual is 12 mm wide; the anterior margin is broken so the length is uncertain but must have exceeded 10 mm. Most shells are considerably smaller. All ventral valves over 4 mm in width are distinctly convex.

Ventral Interior: A strong ridge, not over 1 mm long, divides the shallow process pits. The indistinct muscle field is not bounded by postero-lateral ridges. The shells are thin.

Dorsal Interior: The two small cardinal process lobes bifurcate distally. The low socket ridges are strongly divergent. A rounded anderidium bisects each of the dorsal adductor muscle scars. The anderidia are anteriorly divergent, but posteriorly they do not extend as far as the cardinal process lobes.

Comparison: The species is assigned to *Protochonetes* because of the presence of marginal spines which are inclined about 30° to the hinge line, fine costellae, small size, and presence of anderidia but no other ridges in the dorsal muscle field. Boucot and Harper (1968, p. 49) note that the angle at which the spines meet the hinge line is the only feature which consistently differs between species of *Protochonetes* and *Strophochonetes*. This species lacks the strong median costella characteristic of all *Strophochonetes*.

Members of the species are more finely costellate than are members of *Eoplicanoplia* or *Eccentricosta*.

The costellae are unusually fine for *Protochonetes*. The rather-deep convexity and fine costellation ally this species with *P. striatellus* (see Boger, 1968; Muir-Wood, 1962, p. 52, pl. 8, figs. 1-2). The two species are easily differentiated, however, for *Protochonetes elyensis* is of nearly equal length and width, while *P. striatellus* is transverse.

P. ludloviensis Muir-Wood (1962, p. 51-52, text fig. 9, pl. 3, figs. 1-5), *P. novascotius* (Hall, 1860, p. 144-145, fig. 2) and *P. tenuistriata* (Hall, 1860, p. 145, fig. 3) are less strongly convex and more transverse than *Protochonetes elyensis* (see also Harper, 1973). Individuals of *P. novascotius* from Nova Scotia often have an enlarged median costella (Hall, 1860, p. 145), while all individuals of this species recovered by Hall from the Waldron Formation in Indiana have an enlarged median costa (Hall, 1882, p. 294). *P. stonehousensis* has a ventral sulcus and a bilobed rather than quadrilobed cardinal process as found in *P. elyensis*.

Protochonetes minimus (J. de C. Sowerby) (= "*Chonetes*" *ceratoides* Reed) is smaller, more coarsely ribbed, and more transverse than *Protochonetes elyensis* (See Bassett, 1978, pl. 43, figs. 5-15). In addition *P. minimus* has a ventral median septum which is lacking in *P. elyensis*.

Protochonetes sp. A of Bassett (1978) from the Wenlock of Wales is coarser ribbed, more transverse and less strongly concavo-convex than *Protochonetes elyensis*.

The holotype is USNM 219628, pl. 6, figs. 5-7.

Occurrence: Jack Valley Member of Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19187 (6), 19188 (29), 19189 (1). Age: C₆ — Early Wenlock. Community: *Atrypina* Community.

Order PENTAMERIDA
Suborder SYNSTROPHIOIDEA
Superfamily CAMERELLACEA Hall & Clarke, 1895
Family CAMERELLIDAE Hall & Clarke, 1895
Genus CAMERELLA Billings, 1859

Camerella? sp.
 pl. 6, figs. 10-13

Exterior: The lateral profile is ventri-biconvex. The outline is subcircular in its anterior half; posteriorly it is dominated by an angular beak. The postero-lateral margins are straight and diverge at 90°. The length/width ratio varies from 1.0 to 1.1. The middle of the ventral valve bears a low fold which becomes weaker anteriorly and is not present at the front of the valve. The very poorly defined dorsal sulcus is broad and very shallow. The narrow ventral interarea is orthocline. The delthyrium is open. Rounded costae begin at 2 mm from the beak. There are 9 or 11 costae on the ventral valve and 8 or 10 on the dorsal valve. The costae are strongest medially and are progressively weaker laterally. The interspaces are gently rounded in cross section with the exception of the median one on the dorsal valve which is prominent, narrow and steep sided. The largest shell is 5 mm long. The interiors were not seen.

Discussion: This species is assigned to *Camerella* on the basis of its external shape and ornament. Without knowing the character of the internal structures even the ordinal assignement is in doubt.

Occurrence: Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19187 (19), 19189 (3). Age: C₆ — Early Wenlock. Community: *Atrypina* Community.

Suborder PENTAMEROIDEA
Superfamily PENTAMERACEA M'Coy, 1844
Family PENTAMERIDAE M'Coy, 1844
Subfamily PENTAMERINAE M'Coy, 1894
Genus PENTAMEROIDES Schuchert & Cooper, 1931

Pentameroides sp. A
 pl. 6, figs. 14-21

Exterior: No complete specimens or valves are present in the collections. The large majority of specimens are broken beak ends. The few valves which have significant portions of the shell preserved show the ventral valve to be moderately to strongly convex. The ventral beak is incurved with the greatest curvature developed posteriorly. The dorsal valves are gently to moderately convex; the greatest

curvature in lateral profile is near the beak. The length/width ratio and outline are not known due to the poor preservation. The shells are smooth.

In many of the valves the posterior half of the delthyrium is covered by a deep, concave pseudodeltidium. The pseudodeltidium is a robust structure and it is often preserved on shells which have had their anterior and lateral portions broken away.

Ventral Interior: The large spondylium is supported by a high median septum which extends as far forward as any of the shells are preserved. In smaller shells the height of the median septum at any one point is about equal to the distance from that point to the apex of the valve. Larger specimens tend to have relatively lower septa. In larger shells (greater than 10 mm in length) the ratio of height/length ranges from slightly under 1/2 to about 3/4, with the exception that the ratio in large shells from USNM 19279 ranges from 3/4 to nearly 1/1. One valve from USNM 19276 in the Cherry Creek section also has an abnormally high ratio of about 3/1. The sides of the spondylium are convex dorsally and are closely set near the base of the spondylium. The largest valve present, from the Thomas Range, USNM 19571, is 21 mm in length. Most shells recovered are half that size or less.

The apical region including the median septum is thickened by secondary shell deposition in larger valves.

Dorsal Interior: Traces of the inner socket ridges are preserved on only a few valves. The inner socket plates are gently convex near the inner socket ridges but are sharply flexed medially and the closely spaced inner plates are nearly perpendicular to the floor of the valve and nearly parallel with each other. The outer plates are directed medially and they coalesce to form the cruralium. The cruralium is sessile posteriorly, but anteriorly it is supported by a thick median septum which does not exceed 1 mm in height. The median septum is quite variable in development. In most specimens it begins 2 to 3 mm from the beak, but in others the cruralium is sessile for a longer distance anteriorly and the median septum begins much farther to the front. Rarely the cruralium is sessile throughout its length. The width of the floor of the cruralium is nearly constant throughout its length.

Brachial process bases were not preserved. There is a slight lateral flexure near the junction of the inner and outer plates, but this feature is not recognizable as a brachial process base in the sense of Gauri & Boucot (1968, p. 112). The largest cruralium present (from USNM 19571 in the Thomas Range) is 19 mm in length.

Discussion: Individuals from USNM loc. 19278 and 19279 (Deep Creek Range) tend to be somewhat more elongate than those found at other localities, with the possible exception of individuals from USNM locs. 19275 and 19276 (Cherry Creek Range). The height of the median ventral septum in these elongate forms is proportionally higher than is normal for the species. In addition the dorsal part of the ventral septum is narrower than usual and the brachial plates are somewhat more closely spaced.

Comparison: *Pentameroides* sp. A is characterized by a robust pseudodeltidium and a partially or completely sessile dorsal cruralium. *Pentameroides* ranges from Late Llandovery (C₄₋₅) through Wenlock. *Pentameroides* of C₄₋₅ age are transitional

between *Pentamerus* and *Pentameroides*, and are characterized by the incipient development of a dorsal cruralium.

Occurrence: High Lake Member Laketown Dolomite. Portage, Utah — USNM loc. 19027 (380), 19028 (9), 19029 (114), 19030 (244), 19031 (97), 19032 (63), 19033 (38), 19034 (3), 19035 (473). Spors Mountain, Utah — USNM loc. 19569 (3), 19571 (132).

Portage Canyon Member, Laketown Dolomite. Portage, Utah — USNM loc. 19010 (18). West side of Promontory Range, Utah — USNM locs. 19002 (33), 19003 (25), 19004 (51). Four Mile Canyon, Utah — USNM loc. 19070 (289). Tony Grove Lake, Utah — USNM locs. 19321 (4), 19322 (139). Cherry Creek Range, Nevada — USNM locs. 19275 (8), 19276 (6). Deep Creek Range, Utah — USNM locs. 19278 (48), 19279 (60). Age: Late Llandovery (C_{4.5}). Community: *Pentameroides* Community, *Microcardinalia* Community (USNM loc. 19010).

***Pentameroides* sp. B**
pl. 6, figs. 22-25; pl. 7, figs. 1-5

Exterior: The ventral valve is strongly convex with an incurved beak. A small, deeply concave pseudodeltidium is present in the apex of the delthyrium.

Ventral Interior: The narrow spondylium is supported by a long median septum. The ratio of height of septum to length of spondylium varies from 1/1 in small specimens to 4/1 in larger valves. The median septum is thickened by thin sheets of secondary shell material.

Dorsal Interior: The cruralium is raised on a low median septum, which is more than 1 mm in height in valves that have a cruralium that is more than 15 mm long. In small valves, with a cruralium less than 5 mm in length, the median septum may be very low, but in at least some specimens of this size the median septum is more than 1 mm high.

Comparison: *Pentameroides* sp. B has a median septum which supports the dorsal cruralium throughout its length; it is thus typical of C₆ — Early Wenlock species of *Pentameroides* sp. B than in *Pentameroides* sp. A.

Occurrence: High Lake or Gettel Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19195 (2), 19196 (7), 19198 (24), 19199 (11), 19200 (2). Age: C₆ — Early Wenlock. Community: *Pentameroides* Community?

High Lake Member, Laketown Dolomite. East side southern Egan Range, Nevada — USNM loc. 19175 (97). Age: C₆ — Early Wenlock. Community: *Pentameroides* Community.

Identified as ?*Pentameroides* sp. B. Southern Egan Range, Nevada — USNM locs. 19185 (2), 19201 (2), 19206 (4). Age: C₆ — Early Wenlock. Community: *Atrypina* Community.

Family STRICKLANDIIDAE Schuchert & Cooper, 1931
Genus MICROCARDINALIA Boucot & Ehlers, 1963

Discussion: *Microcardinalia* has previously not been known to range above the Late Llandovery (C₄₋₅) (Berry & Boucot, 1970, p. 29-30; Boucot & Ehlers, 1963). *Microcardinalia* sp. B of this report has a range of Late Llandovery (C₄₋₅) to C₆ — Early Wenlock in the Laketown Dolomite. The absence of plicate ornament and the presence of outer plates distinguish *Microcardinalia* sp. B from *Plicostricklandia* which has plicate ornament and lacks outer plates (Boucot & Ehlers, 1963; Amsden, 1966, p. 1015). The range of *Microcardinalia* must be extended upwards to C₆ — Early Wenlock.

***Microcardinalia* sp. A**
pl. 7, figs. 6-10

Exterior: The lateral profile is ventri-biconvex. The hinge line is wide. No fold or sulcus is present. The margins of the delthyrium diverge at somewhat less than 90°. The concave interarea has an angular juncture with the sides of the valve. No external ornament was observed, and the shells appear to be smooth.

Ventral Interior: The spondylium is narrower than in *Microcardinalia* sp. B. The floor of the spondylium is nearly flat and on some specimens it is longitudinally grooved. A short, thin septum supports the posterior part of the spondylium.

Dorsal Interior: The elongate sockets are anteriorly divergent. Socket plates support the dorsal segment of the inner plates. The gently concave inner plates lie above, but nearly parallel to, the inner surface of the dorsal valve. The tall, erect brachiophore process bases are ventrally convergent though they do not join. The brachiophore process bases rest directly on the floor of the valve; there are no outer plates. Vertical flanges of the brachiophore process bases extend ventrally beyond their juncture with the inner plates. The anteriorly divergent brachiophores are elliptical in cross section. A low ridge lies on the floor of the cavity between the brachiophore process bases. Elongate adductor muscle scars lie in front of the cardinalia. They are divided by a low ridge posteriorly; the ridge decreases in height anteriorly and does not reach the front of the muscle scars.

Comparison: This species resembles *M. triplesiana* (Foerste, 1885) in the size of the cardinalia and attitude of the inner plates which are sub-parallel to the plane of commissure. Externally a fold and sulcus is lacking in both species.

Microcardinalia pyriformis also lacks a fold and sulcus, but this species has flaring inner plates (Boucot & Ehlers, 1963, p. 54, pl. 1, fig. 6, 7) which distinguish it from *Microcardinalia* sp. A.

Microcardinalia sp. B, *M. mullochensis*, *M. raberensis*, and *M. protriplesiana* differ from *M. sp. A* in having a fold and sulcus. *M. sp. B*, *M. mullochensis*, and *M. protriplesiana* also differ in having well developed outer plates. *Microcardinalia protriplesiana* has inner plates which are strongly inclined to the plane of commissure, whereas *M. sp. A* has inner plates disposed nearly parallel to the plane of commissure.

The internal features of *M. microcamerus* are too poorly known to allow comparison with this species.

Occurrence: Member C of unnamed Silurian formation. Ranger Mountain, Nevada — USNM loc. 19419 (31). Age: Late Llandovery. Community: *Pentamerus* Community.

***Microcardinalia* sp. B**
pl. 7, figs. 11-21

Exterior: No complete valves of this species were recovered. The shells are ventri-biconvex. A well defined ventral sulcus begins at the beak. The depth of the sulcus is quite variable. A very low dorsal fold is present on some individuals. The long, strongly concave ventral interarea has angular postero-lateral margins. The delthyrial angle is about 90°. The convexity of the valve is distorted in one individual from USNM loc. 19031, and the sulcus is skewed to one side. The shells appear to be smooth.

Ventral Interior: The floor of the broad spondylium bears longitudinal depressions which are probably diductor muscle scars. In some specimens there is a low ridge, and in one specimen a pair of ridges, on the midline of the spondylium. The spondylium is supported posteriorly by a short median septum, which is highly variable in development. In some individuals the septum is very thin while in others it is thick and engulfed in secondary shell material. Most specimens have a median septum of intermediate size.

Dorsal Interior: The socket plates define elongate, anteriorly divergent sockets. Inner plates merge with the brachial process bases. The brachial process bases are lenticular in cross section; they lie perpendicular to the shell. Ventrally directed flanges of the brachial process bases extend above their juncture with the inner plates. Brachial processes are preserved in only a few specimens; they are gently divergent anteriorly. The brachial process bases are supported partially or entirely by outer plates. The outer plates are continued anteriorly as low divergent ridges. Poorly preserved impressions of the adductor muscle scars lie in front of the cardinalia.

Comparison: *Microcardinalia* sp. A can be distinguished from *Microcardinalia* sp. B by the absence of a ventral sulcus in the former. In addition distinct outer plates are lacking in *M. sp. A*; the spondylium is narrower than in *M. sp. B*. The ventral septum is much more robust in *M. sp. B* than in *M. sp. A*.

Microcardinalia sp. B can be distinguished from *M. microcamerus* (M'Coy), *M. pyriformis* (Savage), *M. triplesiana* (Foerste) and *M. raberensis* Boucot & Ehlers as these species lack a sulcus and also lack outer plates.

M. mullochensis (Reed) has both a sulcus and outer plates, but from figures in Reed (1917, pl. 23, figs. 7-8) it appears to have a shorter interarea than *M. sp. B*.

M. protriplesiana has a narrower spondylium than *Microcardinalia* sp. B (see Amsden, 1966, pl. 115, fig. 8); the outer plates of *M. protriplesiana* are longer than in *M. sp. B* (see Amsden, pl. 115, figs. 11, 14-21). *M. protriplesiana* has a ventral sulcus

and dorsal fold, but they do not extend to the beak area as in *M. sp. B.*

This is the first report of a species of *Microcardinalia* as young as C_{4-5} age that has outer plates (Boucot & Ehlers, 1963, p. 51; Amsden, 1966, text fig. 1).

This species ranges into C_6 — Early Wenlock and is thus the youngest species of *Microcardinalia*. *Microcardinalia sp. B* is also included in Late Llandovery (C_{4-5}) age collections. USNM loc. 19013 with this species underlies USNM loc. 19010 which contains the C_{4-5} age *Pentameroides sp. A.*

In the southern Egan Range, Nevada, *Microcardinalia sp. B* was collected in USNM loc. 19206 which overlies several localities that contain the C_6 — Early Wenlock age *Pentameroides sp. B.* USNM loc. 19206 also overlies collections (USNM locs. 19187, 19188, 19189, 19190, 19191) of *Paleocyclus n. sp.* which D.R. Budge (1972) considers to be of C_6 or younger age.

Occurrence: Portage Canyon Member Dolomite. Portage, Utah — USNM locs. 19013 (15), 19015 (17), 19016 (15), 19020 (28), 19021 (135). Southern Egan Range, Nevada — USNM loc. 19206 (22).

Identified as ?*Microcardinalia sp. B.* High Lake Member Laketown Dolomite. Portage, Utah — USNM locs. 19029 (5), 19030 (4), 19031 (1), 19032 (1). Tony Grove Lake, Utah — USNM loc. 19319 (2). Spors Mountain, Utah — USNM loc. 19569 (1). Southern Egan Range — USNM loc. 19196 (1). Pancake Range, Nevada — USNM loc. 19484 (12). Portage Canyon Member, Laketown Dolomite. Portage, Utah — USNM locs. 19009 (1), 19014 (2), 19017 (2), 19018 (3), 19019 (1), 19022 (24). West side of Promontory Range, Utah — USNM locs. 19003 (1), 19004 (1). Four Mile Canyon, Utah — USNM loc. 19070 (1). Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19209 (1). Age: Late Llandovery (C_{4-5}) to C_6 — Early Wenlock. Communities: Unnamed coral dominated community with *Microcardinalia sp. B.*, *Atrypina* Community, *Pentameroides* Community.

PENTAMERIDA

Identified as Pentamerida, genus and species indeterminate.

High Lake Member, Laketown Dolomite. Blacksmith Fork Canyon, Utah — USNM loc. 19038 (3). Lakeside Mountains, Utah — USNM loc. 19039 (26), 19040 (2). Southern Egan Range, Nevada — USNM 19177 (3). Cherry Creek Range, Nevada — USNM loc. 19271 (12). Delamar Range, Nevada — USNM locs. 19515 (4), 19522 (23), 19523 (17).

Portage Canyon Member, Laketown Dolomite. Portage, Utah — USNM locs. 19013 (2), 19014 (2), 19017 (2), 19018 (3), 19020 (2), 19021 (3), 19022 (14). Sheeplock Range, Utah — USNM loc. 19576 (1).

?Laketown Dolomite. Cove Fort, Utah — USNM loc. 19430 (2). Member A unnamed formation. Sheep Range, Nevada — USNM loc. 19405 (3).

Member C unnamed formation. Ranger Mountain, Nevada — USNM loc. 19421 (3).

Identified as Stricklandidae genus and species indeterminate.

Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19185 (1).

Gettel or High Lake Member Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19195 (9), 19201 (1).

Order RHYNCHONELLIDA
Suborder RHYNCHONELLOIDEA
Family RHYNCHOTREMATIDAE Schuchert, 1913
Subfamily RHYNCHOTREMATINAE Schuchert, 1913
Genus FERGANELLA Nikiforova, 1937

Ferganella borealis (Schlotheim, 1832)

pl. 8, figs. 1-10

Terebratula borealis Schlotheim, 1832, p. 65.

Rhynchonella borealis (Schlotheim). Davidson (pars), 1869, p. 174, pl. 21, figs. 14-18, non figs. 19-20.

Ferganella cf. *borealis* (Schlotheim). Nikiforova, 1937, p. 42, pl. 6, fig. 17.

Camarotoechia borealis (Schlotheim). St. Joseph, 1937, p. 33, figs. 1-5.

Camarotoechia (?) *borealis* (Schlotheim). Nikiforova, 1954, p. 98, pl. 10, fig. 4.

Ferganella borealis (Schlotheim). Sheehan, 1976, p. 729, pl. 5, figs. 1-5.

Exterior: The outline is transverse with a length/width ratio ranging from 0.7 to 0.8. The small ventral beak is narrow. The postero-lateral margins diverge at about 90° and are straight or slightly concave. The lateral margins are abruptly rounded and the anterior margin is nearly straight or only slightly convex.

The lateral profile is dorso-biconvex. The ventral valve has an incurved beak, but anteriorly it has a nearly flat profile. The shell is truncated in front thus producing an anterior face which is perpendicular to the plane of commissure. The dorsal profile is gently curved to about midlength where, coincident with the development of a strong fold, the profile is deflected ventrally. In front of this deflection the dorsal profile is straight and is joined by an acute angle to the perpendicular anterior face.

Poorly preserved deltidial plates restrict the delthyrium. The mesothyrid pedicle foramen is small and round.

The strong dorsal fold, which begins 3 to 4 mm from the beak, is flat-topped. Both the fold and sulcus are defined laterally by the inner faces of strong, bounding costae. The narrow costae are strong with angular apices. There are four costae on the fold, three in the sulcus, and most commonly four, occasionally five on each flank. Laterally the costae are progressively weaker. In the largest individuals the costae which border the sulcus are deflected upwards near their anterior margin. The perpendicular anterior face of the shell extends between those costae on the flanks of the shell which bound the fold.

Concentric ornament consists of faint growth laminae which are most prominent in the anterior 2/3 of the shell. An especially prominent laminae is often present where the fold and sulcus first become strongly developed.

The two largest shells are both 14 mm wide; one is 10 mm and the other is 11 mm long.

Ventral Interior: Small, bulbous teeth are supported by high dental plates which are restricted to the umbonal part of the valve. The umbonal chambers are either partly or entirely filled by shell material.

The muscle field is deeply impressed and extends forward about 3/4 of the length. Postero-laterally the diductor scars are bounded by dental plates. The adductor scars are moderately to deeply impressed. In front of the adductor scars is a variably developed ridge which extends to the front of the muscle field. The anterior half of the muscle field lies on a platform made by the impression of the sulcus. The two best preserved interiors (both from USNM loc. 19206) have rather distinctive ventral muscle fields. In one the diductor scars are deeply impressed as far anteriorly as the front of the deeply impressed adductor scars. Beyond this point the diductor scars are only slightly impressed and are bounded by a low ridge. The median ridge in the anterior part of the field is broad. In the other specimen the diductors are deeply impressed for their entire length. In the anterior quarter of their length the margins of the diductor scars are slightly roofed over by shell material of the floor of the dorsal valve. The median ridge is narrow.

Dorsal Interior: There is a low median ridge which extends anteriorly nearly to midlength. The ridge is flanked by faintly impressed muscle scars. Posteriorly the median ridge is divided; it supports the crural bases and the hinge plates. The septalium bears a thin septiform cardinal process which has broken away in many shells. The hinge plates have gently concave surfaces. The crura are strongly curved in a ventral direction.

Discussion: The transverse outline, strong fold and sulcus, angular plicae and thin, septiform cardinal process support the assignment of this species to *Ferganella*. The assignment to *Ferganella borealis* was discussed by Sheehan (1976).

In my collections the external morphology of individuals is remarkably uniform. On the other hand, the characters of the ventral muscle field appear to be quite variable (see description of ventral interior).

Comparison: *Ferganella borealis* was compared to several other species previously (Sheehan, 1976). *Ferganella chattertoni* Lenz (1977) is less transverse and has a less well defined ventral muscle field.

Occurrence: Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19206 (32), 19209 (4). Age: C₆ — Early Wenlock. Community: *Atrypina* Community.

Identified as ?*F. borealis*. Portage Canyon Member, Laketown Dolomite. Cherry Creek Range, Nevada — USNM loc. 19275 (talus) (3). Age: Late Llandovery (C_{4.5}).

Community: *Pentameroides* Community. Jack Valley Member Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19080 (1).

Family TRIGONIRHYNCHIIDAE Schmidt, 1965
Genus ANCILLOTOECHIA Havlíček, 1959

Ancillotoechia perryi n. sp.

pl. 9, figs. 1-15

Exterior: The lateral profile is mildly ventri-biconvex. The ventral beak is slightly incurved. The shells are transverse with a length/width ratio of 0.9. The outline is rhynchonelliform; maximum shell width occurs in front of midlength. The straight to slightly concave postero-lateral margins diverge at about 90°.

There is an inconspicuous dorsal fold which begins near midlength and a ventral sulcus which is deep only in its anterior third. There are three costae on the fold and 4 or 5 on each flank of the dorsal valve. Ventrally, there are two costae in the sulcus and 4, rarely 5, on the flanks. The outer costae on the flanks are very weak. In the posterior the two ventral median costae which occupy the sulcus are equal in strength to the lateral costae. However, at midlength where the sulcus starts, the lateral costae are much stronger than those on the sulcus. Though the costae in the sulcus continued to enlarge anteriorly during growth, those on the flanks enlarged more rapidly as they grew anteriorly.

On the fold of the dorsal valve the costae are more robust and have wider bases than do the costae on the flanks.

Young forms (to 4 mm long) which had not begun to develop a fold and sulcus are equally costellate. In many young forms a very slight ventral fold and dorsal sulcus are present (the reverse of the adult situation).

The costae are crossed by concentric growth lamellae which give the costae an irregular lateral profile.

Conjunct deltidial plates are present. The pedicle opening is round and rather large.

The largest valve is 9 mm in length.

Ventral Interior: The teeth are elongate. They are underlain by a robust ridge which in turn is supported by thin, receding dental plates which lie close to the walls of the valve producing small, narrow umbonal chambers. Muscle scars have not been preserved.

Dorsal Interior: There is a short median ridge which is divided posteriorly and each division supports a crural base. Hinge plates attach laterally to the crural bases. The inner margins of the crural bases (inner hinge plates) slightly overlap the edges of the septalium.

Because of poor preservation the presence or absence of a cardinal process cannot be established.

Discussion: The septalium is slightly covered by the margins of the crural bases

(inner hinge plates). Since *Ancillotoechia* commonly has a completely covered septalium the generic assignment is questioned. Whether the dental sockets are crenulate could not be determined. The large pedicle opening excludes this species from the Uncinulidae. The species is named after David G. Perry. The holotype is USNM 219676, pl. 9, figs. 1-4.

Occurrence: Jack Valley Member, Laketown Dolomite: Tony Grove Lake, Utah — USNM loc. 19324 (69). Age C₆ — Early Wenlock. Community: *Spirinella* Community.

Identified as *Ancillotoechia* sp. *perryi*? Portage Canyon Member, Laketown Dolomite. Tony Grove Lake, Utah — USNM loc. 19323 (1). Jack Valley Member Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19187 (4), 19190 (1), 19191 (1).

***Ancillotoechia? pahrnagatensis* (Waite, 1956)
pl. 8, figs. 11-19**

Camarotoechia pahrnagatensis Waite, 1956, p. 16, pl. 3, figs. 1-5.

Camarotoechia pahrnagatensis Waite. Merriam 1973, p. 40, pl. 11, figs. 7-9.

Exterior: The lateral profile is equally biconvex. The shells are transverse. The outline of the single shell from USNM loc. 19050 is skewed. The poorly defined ventral sulcus begins 4 mm from the beak and a very weak fold begins about 5 mm from the beak. The costae have sharply rounded apices with narrow interspaces. The mesothyrid pedicle opening is large and round. Deltidial plates, if present, were not preserved. The beak is moderately incurved. The largest ventral valve is 11 mm long and 13 mm wide.

Ventral Interior: Small, rounded teeth are supported by strong dental plates. The delthyrial chamber is not filled by shell material.

Dorsal Interior: A low median septum extends to about midlength. Posteriorly the septum is divided, forming a septalium. The lateral margins of the crural bases (inner hinge plates) cover the margins of the septalium. There is no cardinal process.

Discussion: The septalium is covered laterally by the margins of the inner hinge plates, but since it is not completely covered the generic assignment is questioned. The pedicle opening is large, and the surface is costate.

The collection agrees closely with *C. pahrnagatensis* Waite. However, the shells which Waite described from the Pahrnagat Range are larger, attaining an average length of 16 mm. The size difference cannot be completely explained by considering the forms in my collections to be immature individuals. The sulcus originates 4 mm from the beak in my collection, but 6 mm forward in Waite's collections, suggesting that at least this growth stage was attained by my shells when they were smaller than those from the Pahrnagats. Finally the apex of each costa is more angular in representatives of this species illustrated by Waite (1956, pl. 4, figs. 1-4) and Merriam (1973).

Ancillotoechia borealis Lenz from the Whittaker and Allen Bay Formations, Northwest Territories, Canada is very similar and has been compared to this species by Lenz (1974). The angular ribs of *A. borealis* closely resemble those on the specimens originally described by Waite. The main characters which distinguish the species are the better developed fold and sulcus in *A. borealis*.

Occurrence: Jack Valley Member, Laketown Dolomite. Confusion Range, Utah — USNM locs. 19052 (3), 19057 (1). Age: Confined to the C₆ — Early Wenlock to Ludlow interval. Community: *Spirinella* Community.

***Ancillotoechia?* sp.**

pl. 8, figs. 20-23

Exterior: The lateral profile is dorse-biconvex. The shell is transverse. There are three angular costae on both the prominent dorsal fold and ventral sulcus. There are 5 or 6 costae on each flank. The costae are crossed by faint, concentric growth lamellae.

Ventral Interior: Fragments of dental plates are preserved on one specimen.

Dorsal Interior: A short median ridge forms a septalium posteriorly. The septalium is covered along its edges by the inner sides of the crural bases (inner hinge plates). There is no cardinal process.

Comparison: There is a strong similarity with the exterior of *Camarotoechia* sp. b illustrated by Merriam (1973) from the Lone Mountain Dolomite in the Fish Creek Range.

Occurrence: Lone Mountain Dolomite. Mahogany Hills, Nevada — USNM loc. 19530 (8).

RHYNCHONELLIDA

Assigned to Rhynchonellida genus and species indeterminate: Portage Canyon Member, Laketown Dolomite. West side Promontory Range, Utah — USNM loc. 19003 (10). Cherry Creek Range, Nevada — USNM locs. 19275 (1), 19276 (1). Pancake Range, Nevada — USNM loc. 19485 (2). Delamar Range, Nevada — USNM loc. 19067 (1). Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19185 (1), 19187 (1).

Order ATRYPIDA

Suborder ATRYPOIDEA

Superfamily ATRYPACEA Gill, 1871

Subfamily CATAZYGINAE Copper, 1977

Genus PENTLANDELLA Boucot, 1964

Discussion: Some minor revisions of the diagnosis of *Pentlandella* presented by Boucot (1964, p. 104) are necessary. The genus was originally described as having bifurcating plications and a cardinal plate. The bifurcating plications are present in the type species, but in the original description of *Zygospira haswelli* Reed (1908, p. 435) the ribs are described as "... not increasing by division or interpolation near

the margins." Further his illustrations (Reed, 1908, pl. 14, figs. 8 & 9) do not show bifurcating costellae. Boucot (1964) indicated that both the type species, *Pentlandella pentlandica* (Haswell), and *Pentlandella haswelli* (Reed) have a cardinal plate. However, *Pentlandella merriami* n. sp., described here, and *Pentlandella tenuistriata* Rubel (1970) have disjunct inner plates. A paralectotype of *P. haswelli*, selected by Copper (1977, pl. 39, fig. 13), also has disjunct inner plates. The presence of a cardinal plate in the type species needs confirmation. In any event the diagnosis of *Pentlandella* must be revised to include species with both nonbranching costellae and disjunct inner hinge plates. These differences are not sufficient to require erection of a new genus, since *Meifordia*, a related genus, has species with similar differences. Compare these structures in *Meifordia subundata* (McCoy) forma typica s.s. Williams (1951, p. 109, text fig. 12a) with disjunct inner hinge plates to *Meifordia ovalis* Williams (1951, p. 110, text fig. 13a) with a cardinal plate.

Pentlandella can be distinguished from *Catazyga* by "... a median septum rather than myophragm in the ventral valve . . . , *Catazyga* has a trapezoidal, depressed, anteriorly expanding muscle field in the pedicle valve rather than an anteriorly bifurcating, raised field" (Boucot 1964, p. 104). His distinction, based on nonbifurcating plications in *Pentlandella*, no longer holds. Additionally, *Catazyga* differs from *Pentlandella* in having a simpler jugum, larger spiralia, and possessing massive, bulbous shell material surrounding the crural bases (Copper, 1977).

Pentlandella was probably derived from *Catazyga*. The adductor platform in the ventral valve of *Catazyga* (Boucot *et al.*, 1965, p. H634) is a structure from which the muscle platform in *Pentlandella* could be derived. The similar external ornament and shape of both genera support this derivation.

Copper (1973) suggested the Lissatrypidae may have been derived from one of the Middle Ordovician species assigned to *Protozyga*, *Cyclospira* or *Idiospira*. However, *Pentlandella* has a marked morphologic affinity with the Lissatrypidae. Indeed, compared to early species of *Meifordia*, *Glassia*, and *Lissatrypa* the only significant difference is the presence of costellae. The ventral muscle field with a steep fronted adductor platform and splayed diductor scars is of lissatrypid nature. The apical structures of the dorsal valve are similar to several lissatrypid species (see the comparison of *P. n. sp.* with *Meifordia subundata*). With the elimination of the Septatrypinae from the Lissatrypidae (Johnson & Boucot, 1970, p. 267) the phylogeny of the lissatrypids presented by Boucot *et al.*, (1964, text fig. 3) must be revised. Morphologically *Pentlandella* is a logical intermediate form for the derivation of the lissatrypids from *Catazyga*, but its earliest known occurrence post-dates *Meifordia*. Presently known species of *Pentlandella* most likely shared a common ancestor with *Meifordia*. This common ancestor may well have been an as yet unknown species of *Pentlandella*.

***Pentlandella merriami* n. sp.**

pl. 9, figs. 16-30

Exterior: The valves are ventri-biconvex. In lateral profile the ventral valve is most strongly curved near the umbo. The beak is strongly incurved and overlaps the umbo of the dorsal valve. The large pedicle foramen is mesothyrid. In some of the

larger individuals a narrow, shallow sulcus is present near the anterior margin of the ventral valve. The surface has fine costellae which are weak and often are not preserved. There are 10 to 12 costellae in a space of 2 mm measured 5 mm from the beak. No costellae were seen to bifurcate, but as they are poorly preserved the absence of bifurcations is not certain. The length/width ratio varies from 0.8 to 1.0. The largest valves are 9 mm in length, but most individuals are 6 to 7 mm long.

Ventral Interior: The shell is thick. The large teeth are triangular, and in young forms they are supported by small dental plates. During early growth the dental plates were engulfed in secondary shell material. The delthyrial chamber is narrow and deeply impressed in secondary shell which fills the apex of the valve. The deeply impressed, narrow diductor scars are broadly flaring and separated by a triangular platform which was the site of adductor muscle attachment. The adductor platform has a low, rounded ridge which in some cases extends posteriorly into the delthyrial chamber. The surface of the adductor platform is strongly convex. The anterior face of the platform is steep. The platform served to increase the efficiency of the adductor muscles by providing more favorable leverage. The muscle field extends nearly to midlength. In some valves divergent vascula media extend anteriorly from the front of the diductor scars. Costellae are not impressed on the interior.

Dorsal Interior: A median ridge which divides the adductor scars decreases in height anteriorly and extends to about midlength. The adductor scars are impressed both posteriorly and adjacent to the median ridge. A very weak to moderate longitudinal ridge lies in the middle of each adductor scar. Posteriorly, the median ridge is divided into two shafts which support the disjunct inner hinge plates. The inner hinge plates are sub-parallel at their bases and are steeply inclined; between them is a deep narrow cavity. Ventrally, the inner hinge plates curve away from each other. Secondary shell material is commonly deposited upon these apical structures. In about a third of the valves the cavity between the inner hinge plates is filled with shell material and a bulbous cardinal process is present. The deep sockets are divergent. Spiralia are preserved as fragments in one valve but their attitude is unknown.

Discussion: The external surfaces of most valves are very poorly preserved (probably as a result of pre-diagenetic leaching) and the radial ornament can be seen in only a small percentage of the valves.

The species is named after C.W. Merriam. The holotype is USNM 219690, pl. 9, figs. 24-25.

Specimens questionably assigned to this species from USNM locs. 19321, 19322, 19070, and 19419 have the distinctive ventral muscle impressions and adductor muscle platform, but the exteriors are too poorly preserved to determine whether radial ornament was present and an assignment to the lissatrypids cannot be excluded.

Comparison: *Pentlandella merriami* can be distinguished from *P. pentlandica* (Haswell) by the former's weaker costellae which are not impressed on the interior. The adductor muscle platform is larger than in *P. pentlandica* (compare to Davidson, 1868, pl. 22, figs. 15, 16a, 19a, and Copper, 1977, pl. 39, fig. 11). In

addition the outline tends to be transverse rather than elongate, and the ventral beak is not erect (see Davidson, 1868, pl. 22, fig. 14). A cardinal plate has been reported in *P. pentlandica* but in *P. merriami* the inner hinge plates are disjunct.

Pentlandella merriami is similar to *P. haswelli* (Reed) but can be distinguished by its weaker costellae which are not impressed internally.

Pentlandella merriami is smaller and finer ribbed than *P. tenuistriata* Rubel (1970) from Estonia (see also Copper 1977).

Externally there is a resemblance to *Atrypa gabrielsi* Norford, 1962. Internally the two species are easily differentiated; *A. gabrielsi* lacks inner hinge plates (Norford, 1962, pl. 4, figs. 8 & 13). It also lacks an adductor muscle platform except in gerontic individuals (see Norford 1962, pl. 4, fig. 7).

An external resemblance also exists between *Pentlandella merriami* and both *Nalivkinia gruenwaldtiaeformis* and *N. sibirica* (see Bublichenko, 1927, pl. 50, figs. 1-10). *Pentlandella merriami* can easily be distinguished from them, however, because *Nalivkinia* does not have deeply impressed ventral muscle scars (see Bublichenko, 1927, pl. 49, figs. 2 & 7, text fig. 1).

Distribution: *Pentlandella* is known from beds of Early Llandovery through C₆ — Lower Wenlock in the British Isles (Boucot, 1964) and Late Llandovery to C₆ — Lower Wenlock in Estonia Rubel (1970).

Occurrence: High Lake Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19180 (356), 19193 (76). Age: Late Llandovery or Early Wenlock.

Community: *Pentlandella* Community.

Identified as ?*Pentlandella merriami*. Portage Canyon Member, Laketown Dolomite. Tony Grove Lake, Utah — USNM locs. 19321 (7), 19322 (20). Four Mile Canyon, Utah 19070 (19). Member C of unnamed Silurian formation. Ranger Mountain, Nevada — USNM loc. 19419 (2). Age: Late Llandovery and possibly Wenlock. Communities: *Pentameroides* Community, *Pentamerus* Community.

Subfamily ATRYPINAE Gill, 1871

Genus ATRYP A Dalman, 1828

Discussion: Intraspecific variation in *Atrypa* has never been adequately studied. The variability among individuals is high even in collections from single localities which may be interpreted to represent local populations. Since many species have been erected but few carefully described, specific identifications are in most cases unverifiable. I believe it is best to stabilize the present nomenclature until a revision of *Atrypa* is undertaken. Until this is completed, minor taxonomic changes — either erecting new species or placing old ones in synonymy — are useless.

Atrypa cf. *A. parva* Hume, 1925

pl. 10, figs. 1-14

Atrypa reticularis var. *parva* Hume, 1925, p. 63.

Atrypa parva Hume. Norford, 1962, p. 16, pl. 3, figs. 5-13.

Exterior: Both valves are rather deep, and the lateral profile is subequally biconvex. Most commonly the dorsal valve is the more convex, but occasionally the ventral one is. The rather strongly ventri-biconvex shells from USNM loc. 19287 are questionably assigned to this species. The ventral beak is incurved. The outline is subcircular and slightly transverse in the few unbroken specimens. The hinge line equals about three-fourths of the shell width. The cardinal extremities are sharply rounded.

A faint, very poorly defined ventral sulcus is found at the very front of large individuals. A narrow, shallow sulcus is often present near the beak of the dorsal valve. Costellae are coarse for the genus with about 15 in a space of 10 mm counted 10 mm from the beak. Growth lamellae are prominent; occasionally the lamellae are frilled near the anterior. In one specimen from USNM loc. 19175 the frills are extended into short spines. The largest individual is 15 mm in length.

Ventral Interior: The high prominent teeth are on a pedestal and are supported by receding dental plates in many valves, while in others dental plates are either absent or have been overgrown by the shell. Between the teeth and the shell margin are long, deep, narrow ventral sockets.

The short, elongate, impressed adductor muscle scars are located about the same distance anteriorly as the teeth. The diductor muscle scars are flabellate and extend to about midlength. Anteriorly the diductor scars are bounded by a broad, curved ridge. A low, broad longitudinal ridge is often present in the middle of each diductor scar. This ridge commonly extends beyond the ridge which bounds the front of the diductor scars and reaches nearly to the anterior margin. The costellae are not impressed on the interiors of the valves.

Dorsal Interior: There is a low, broad median ridge which does not reach midlength. The hinge plates are high; their disjunct bases diverge by about 90°. In one specimen from USNM loc. 19029 pads of shell material have been deposited on the anterior face of the hinge plates. Distally the hinge plates are strongly curved toward the posterior; they serve as dorsal teeth which articulate with the ventral sockets. The muscle field is not visible.

Discussion: A single ventral valve from USNM loc. 19031 has a similar interior morphology but much finer costellae (more than 30 in 10 mm, counted 10 mm from the beak).

The collection from USNM loc. 19278 is characterized by a more convex ventral valve, weaker muscle scars and bounding ridges.

Comparison: This species most closely resembles *A. parva* Hume from the Sandpile Group of British Columbia (Norford, 1962, p. 16-18, pl. 3, fig. 5-13). The similarities include costellae of similar strength, a rather strongly convex ventral valve, dental plates and accessory sockets in the ventral valve, and a low ridge surrounding the muscle field anteriorly.

Differences from *A. parva* are the dorsi-biconvex rather than ventri-biconvex

lateral profile. This group does have a more convex ventral valve than usually found in *Atrypa*. Further, no ridge divides the ventral adductor scars, and the costellae were not impressed on the interiors of the valves.

Though this group is similar to *A. parva* a confident identification is not possible.

Distribution: *A. parva* occurs in the Thornloe Formation of Lake Timiskaming (Hume, 1925; Norford, 1962, p. 18) and in the middle of the Sandpile Group of British Columbia, just below and in the Coraline Member of Norford (1962). The Thornloe Formation has an age span of Late Llandovery to Wenlock (Berry & Boucot, 1970, p. 129, pl. 2). A similar age for the Sandpile Group is indicated by the presence of "*Pentamerus*" (probably *Pentameroides*, see Norford, 1962, pl. 2, fig. 21, which shows a cruralium).

Occurrence: High Lake Member, Laketown Dolomite, Portage, Utah — USNM locs. 19029 (15), 19032 (21), 19035 (9). East side southern Egan Range, Nevada — USNM loc. 19175 (32). Portage Canyon Member, Laketown Dolomite, West side Promontory Range, Utah — USNM loc. 19003 (7). Four Mile Canyon, Utah — USNM loc. 19070 (12). Jack Valley Member, Laketown Dolomite, Southern Egan Range, Nevada — USNM loc. 19206 (53), 19208 (1), 19209 (9). Age: Late Llandovery to Early Wenlock. Communities: *Pentameroides* Community, *Atrypina* Community.

Identified as *Atrypa* cf. *A. parva*? High Lake Member, Laketown Dolomite, Portage, Utah — USNM loc. 19031 (1). Portage Canyon Member, Laketown Dolomite, Deep Creek Range, Utah — USNM loc. 19278 (15). Member C unnamed Silurian formation, Ranger Mountain, Nevada — USNM loc. 19419 (2). Communities: *Pentamerus* Community, *Pentameroides* Community.

***Atrypa hedei* Struve, 1966, *americensis* n. subsp.
pl. 10, figs. 15-23**

Atrypa (Gotatrypa) hedei Struve, 1966, p. 130, T. 15, figs. 4-6.

Atrypa hedei Struve, Rubel, 1970, p. 36, pl. 18, figs. 1-19, pl. 19, figs. 13-16; pl. 20, figs. 2-11, 22.

Exterior: Both valves are strongly convex, but because all valves are broken it cannot be determined which valve has the greater convexity. The beak is incurved and rests on the dorsal valve. The surface is costellate with about 18 costellae occupying a space of 10 mm measured 10 mm from the beak. Growth lamellae are present.

A juvenile ventral fold is maintained in the adult as a slight carination along the midline in the posterior of the valve. A very faint corresponding sulcus is present in the dorsal valve. The largest shell is 13 mm long.

Ventral Interior: The hinge teeth are elongate and supported by dental plates only in juvenile shells. Ventral sockets are present between the teeth and the shell margin. The muscle field is impressed in secondary shell material. The posterior part of the muscle field is very narrow and very deeply impressed; beyond this the field is flabellate and only moderately impressed.

Individuals from USNM loc. 19549 generally have less secondary shell in the ventral interior and because of this the posterior part of the muscle field does not tend to be as deeply impressed as in individuals from other localities.

The muscle field is bounded laterally by a low muscle callosity and anteriorly by a variably developed ridge. The surface of the muscle field has several low, longitudinal ridges.

Dorsal Interior: The short, broad median ridge has an angular crest. The hinge plates are discrete; distally their outer margins are turned outward to roof over the sockets and serve as accessory dorsal teeth. The rod-shaped crural bases are joined to the hinge plates. The back of the median ridge forms a platform between the hinge plates. Low longitudinal ridges are on the floor of the valve.

Comparison: The specimens under study compare closely with *Atrypa hedei* Struve, originally described from the Upper Visby Marl of Gotland, especially the interiors figured by Rubel (1970, pl. 19, figs. 13-16) from the G and H beds of Estonia. Dr. Rubel kindly allowed me to examine specimens of *A. hedei* in Tallin in 1972. The specimens from Estonia are somewhat more finely ribbed than are those from the Great Basin, but the ventral interiors with the narrow, deeply impressed, posterior position of the ventral muscle field are very similar. The dorsal interiors are also similar in having outer margins of the hinge plates which serve as secondary teeth that roof over the sockets.

A new subspecies is proposed here to encompass the more coarsely ribbed American representatives of the species. The holotype is USNM 219706, pl. 10, figs. 18, 19.

Occurrence: High Lake Member, Laketown Dolomite. Barn Hills, Utah — USNM loc. 19543 (3). Gettel Member, Laketown Dolomite. Barn Hills — USNM loc. 19546 (9). Age: Probably $C_{4.5}$ and/or C_6 — Early Wenlock. Community: *Cyrtia* Community.

Jack Valley Member, Laketown Dolomite. Ibex Hills, Utah — USNM loc. 19549 (230). Age: Probably $C_{4.5}$ or C_6 — Early Wenlock; could be as young as Ludlow.

Genus SPIRIGERINA d'Orbigny, 1849

Spirigerina sp. A pl. 10, figs. 24, 25

Exterior: The lateral profile is dorsi-biconvex. The beak is slightly incurved. The fold and sulcus are prominent. The costae are strong and have a rounded cross section. Five mm from the beak there are 8 costae on each flank and four on both the fold and sulcus. Fragments of deltidial plates have been preserved on two specimens. The largest valve is 11 mm long.

Ventral Interior: The teeth are supported by receding dental plates which lie close to the shell wall. The triangular muscle field is weakly impressed and bounded anteriorly by a broad, low ridge.

Dorsal Interior: A low, broad median ridge extends about a third of the distance to

the anterior margin. Posteriorly the median ridge fills the space between the disjunct, curved hinge plates. A low ridge, associated with attachment of the diductor muscles, extends the length of the platform.

Occurrence: High Lake Member of Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19180 (6). Age: Late Llandovery or Early Wenlock. Community: *Pentlandella* Community.

***Spirigerina* sp. B**

pl. 11, figs. 1-3

The lateral profile is biconvex. The coarse costae are angular in cross section. Five mm from the beak there are 10 to 12 costae on the flanks and five on both the fold and sulcus. Along the anterior margin the growth lamellae are slightly frilled. The largest individual is 13 mm long.

Comparison: This variety differs from *Spirigerina* sp. A in having more numerous and more angular costae.

Occurrence: High Lake Member, Laketown Dolomite. Delamar Range, Nevada — USNM loc. 19522 (16). Age: Late Llandovery (C₄₋₅) or Early Wenlock.

Genus PLECTATRYPA Schuchert & Cooper, 1930

***Plectatrypa* cf. *P. Imbricata* (J. de C. Sowerby, 1839)**

pl. 10, figs. 26, 27

Terebratula imbricata J. de C. Sowerby, 1839, p. 624.

The single articulated specimen has one weak costa in the ventral sulcus and two on the dorsal fold. The outline is sub-quadrate.

Occurrence: Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19209 (1). Age: C₆ — Early Wenlock. Community: *Atrypina* Community.

ATRYPIDA

Identified as *Atrypa* sp., but not described:

Tony Grove Lake Member, Laketown Dolomite. Tony Grove Lake, Utah — USNM locs. 19308 (40), 19309 (6). Age: Late Llandovery. Community: *Pentamerus* Community.

Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19080 (1).

Identified as *Atrypa?* sp., but not described.

High Lake Member, Laketown Dolomite. Cherry Creek Range, Nevada — USNM loc. 19272 (2). High Lake or Gettel Member. Southern Egan Range, Nevada — USNM locs. 19196 (5), 19198 (1), 19202 (1), 19204 (1). Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19187 (1), 19188 (1). Jack Valley or Portage Canyon Member, Laketown Dolomite. Cherry

Creek Range, Nevada — USNM loc. 19275 (1). Portage Canyon Member, Laketown Dolomite. Pancake Range, Nevada — USNM locs. 19485 (5), 19486 (2), 19487 (3), 19488 (4). Lone Mountain Dolomite. Mahogany Hills, Nevada — USNM loc. 19530 (3).

Identified as *Atrypida*, genus and species indeterminate:

High Lake Member Laketown Dolomite. Tony Grove Lake, Utah — USNM locs. 19313 (1), 19317 (1). Lakeside Mountains, Utah — USNM loc. 19039 (1). Portage Canyon Member, Laketown Dolomite. Sheep Rock Range, Utah — USNM loc. 19576 (4). Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19180 (5).

Superfamily CARINATINACEA Rzhonsnitskaya,

1960 *nom. transl.* Johnson, 1974

Family CARINATINIDAE Rzhonsnitskaya,

1960 *nom. transl.* Johnson, 1974

Subfamily ATRYPININAE McEwan, 1939

Genus ATRYPINA Hall & Clarke, 1893

***Atrypina erugata* Amsden, 1968**

pl. 13, figs. 1-13

Atrypina erugata Amsden, 1968, p. 77, pl. 10, fig. 4 a-p.

Exterior: In lateral profile the dorsal valve is weakly convex, and the ventral valve is gently to moderately convex. The length/width ratio ranges from 0.9 to 1.3, averaging 1.08. The anterior outline is circular; the postero-lateral sides are nearly straight and intersect at the apex, including an angle of 80° to 100°. The hinge line is curved and is slightly over one-fourth the shell width. The delthyrium is partially closed by poorly preserved deltidial plates.

The valves have coarse costae, most commonly 5, occasionally 7 dorsally, and most commonly 6, occasionally 8 ventrally. Costae rarely bifurcate, and those that do are the medial ones. The costae on the three individuals of this species from USNM loc. 19199 bifurcate, producing nearly twice the number of costae which are typical of the species. Ventrally the two median costae are so much stronger than the lateral ones that they form a fold. Dorsally there is a weak sulcus containing a strong costa. The strength of the lateral costae of both valves varies considerably among individuals. In some specimens the costae are weak undulations and in others from the same collection they are steep-sided with sharply rounded apices and narrow interspaces. Though the surfaces are poorly preserved a few indistinct growth lines are commonly present anteriorly. Specimens of *A. erugata* from USNM loc. 19201, 19202, and 10204 differ from other individuals in having bumpy plications, which may be poorly preserved growth lamellae. These individuals also have a length/width ratio which averages 1.14, somewhat greater than the average of 1.08 for the species as a whole.

Ventral Interior: The small teeth are on the lateral margins of the valve.

Dorsal Interior: Small but stout hinge plates are convergent posteriorly. There is a

short, stout myophragm in front of the hinge plates. Spiralia were not observed.

Discussion: This species exhibits a rather large variation in the length/width ratio. A similar variation was found in small, spire-bearing brachiopods by Beecher & Clarke (1889, p. 65) in *Atrypina disparillis* and by Nikiforova (1937, p. 93, pl. 14) in *Retzia (Retziella) weberi*.

Comparison: This species of *Atrypina* is characterized by its rotund outline and the absence of imbricate growth lamellae.

Though similar in most respects to the individuals of this species described by Amsden (1968) from the St. Clair Limestone of Arkansas, the specimens from Nevada tend to be more coarsely plicate, and the dorsal valve is slightly more inflated.

Atrypina talenti Savage (1970, p. 59-66, pl. 102, figs. 32-42) from the Lower Devonian of New South Wales is another species which lacks strong concentric ornament. *A. talenti* is more elongate and in outline the lateral margins are more nearly straight than in *A. erugata*.

It differs from *Atrypina disparillis* in having a more convex dorsal valve and in other features described by Amsden (1968, p. 78).

Atrypina gramma Wang, 1974 from southwest China is more transverse, has stronger median plications on the ventral valve, and has a less pronounced beak than *Atrypina erugata*.

Atrypina dichotoma Kulkov (in Ivanova and Kulkov, 1974) lacks the strong naviculation which characterizes *Atrypina erugata*.

Occurrence: Southern Egan Range, Nevada. High Lake or Gettel Member, Laketown Dolomite — USNM locs. 19193 (2), 19199 (3), 19201 (23), 19202 (3), 10203 (11), 19204 (4), Jack Valley Member, Laketown Dolomite — USNM locs. 19206 (393), 19208 (32), 19209 (319), 19210 (18), 19211 (2). Age: Possibly Late Llandovery (C₄₋₅); C₆ — Early Wenlock. Communities: *Atrypina* Community, *Penilandella* Community, *Petameroides* Community.

Suborder ATHYRIDOIDEA
Superfamily ATHYRIDACEA M'Coy, 1844

ATHYRIDACID sp. A
pl. 11, figs. 4-8

Exterior: The lateral profile is ventri-biconvex. The outline is subcircular, with the angular ventral beak projected posteriorly. Most shells are elongate, though a few are transverse. The open delthyrium is long and has a narrow apical angle. The ventral beak is incurved. The dorsal beak is incurved into the delthyrium. The surface has a few weak growth lines but otherwise is smooth. Juvenile forms are more lenticular than adults and have a more prominent beak, which is not as strongly incurved as in the adults.

Ventral Interior: One specimen from USNM loc. 19056 has dental plates

preserved. The dental plates are continued anteriorly as low ridges which bound the posterior of the slightly impressed muscle field. The front half of the muscle field has not been observed.

Dorsal Interior: A single valve from USNM loc. 19055 has laterally directed spiralia. The jugum has not been preserved.

Discussion: The athyridacean nature of this smooth shelled species is indicated by the laterally directed spiralia.

Occurrence: High Lake Member, Laketown Dolomite. Spors Mountain, Utah — USNM loc. 19569 (3). Age: Late Llandovery (C₄₋₅). Community: *Pentameroides* Community.

Portage Canyon Member, Laketown Dolomite. Delamar Range, Nevada — USNM loc. 19067 (1). Jack Valley Member, Laketown Dolomite, Confusion Range, Utah — USNM locs. 19050 (45), 19054 (1), 19055 (4), 19056 (18). Age: Confined to the C₆ — Early Wenlock through Ludlow interval. Community: *Spirinella* Community.

Order SPIRIFERIDA
Suborder SPIRIFEROIDEA
Superfamily CYRTIACEA Frederiks, 1919 (1924)
Family CYRTIIDAE Frederiks, 1919 (1924)
Subfamily CYRTIINAE Frederiks, 1919 (1924)
Genus CYRTIA Dalman, 1928

Cyrtia sp. A
 pl. 11, figs. 9-15

Exterior: The ventral valve is pyramidal; the dorsal valve is gently convex. The shells are transverse and greatest width occurs at the straight hinge line. Most commonly, the ventral interarea is gently concave though in some specimens it is nearly flat. Maximum curvature of the interarea is near the apex of the shell. The strongly arched deltidium is separated from the margins of the narrow delthyrium by a deep, narrow groove. Near the apex of the shell, the surface of the deltidium lies in the plane of the interarea. Anteriorly, however, the "deltidial plate" increasingly protrudes above the plane of the interarea. The narrow ventral sulcus is well defined. There are no plications; the coarse silicification has destroyed the fine ornament.

The largest valve is 8 mm long and 11 mm wide, but the margins of this shell have been broken.

Ventral Interior: Dental plates are strong. The bases of the dental plates lie directly opposite the margins of the ventral sulcus and extend anteriorly as low ridges which bound the muscle field. A broad, median ridge is formed by the impress of the sulcus. On the crest of this broad ridge is a low, narrow ridge. Impressed diductor scars lie on either side of the broad median ridge. Adductor scars are not preserved. The apex of large shells, including the umbonal cavities, is filled by pads of secondary shell material.

Dorsal Interior: Only three fragments of dorsal valves have been recovered. The crural plates are long and only slightly divergent anteriorly. The crural plates are supported laterally by chilidial plates and also by hinge plates which are raised above the floor of the valve and form the bases of the dental sockets.

Discussion: *Cyrtia* rested on its interarea (Rudwick, 1965, p. H201), and the large interarea prevented the shell from sinking into a soft substrate. The localities from which *C. sp. A* is found are quite argillaceous and a soft substrate was present. The deposition of secondary shell material in the apex and around the dental plates probably served to weight the base of the shell, thereby increasing its stability. Secondary shell deposits in the umbonal cavities have not been reported previously in *Cyrtia* (Boucot, 1963, p. 702).

The valves are coarsely silicified and rather poorly preserved, but even with this in mind the margins of the valves appear to have been abraded or leached prior to diagenesis. There are no articulated specimens; the ventral valves are far more numerous than the dorsal valves. This is suggestive of a sorting mechanism, which may have been either winnowing by current action or more rapid destruction by solution of the thinner dorsal valves. The presence of considerable silt in these localities is suggestive of relatively quiet water and the abraided appearance is probably due to leaching. *Pentlandella merriami* is also found in a silty unit and it too has a poorly preserved external surface which probably resulted from leaching.

Occurrence: High Lake Member, Laketown Dolomite. Barn Hills, Utah — USNM loc. 19543 (6), 19544 (185).

Identified as *Cyrtia sp. A?* Gettel Member, Laketown Dolomite. Barn Hills, Utah — USNM loc. 19548 (13). Age: Late Llandoverly or Wenlock (Could be as young as Ludlow). Community: *Cyrtia* Community.

***Cyrtia* spp.**
pl. 11, figs. 16-18

Exterior: The ventral valve is pyramidal. The interarea is gently curved. The narrow delthyrium is filled by convex "deltidial plates". There is a ventral sulcus.

Ventral Interior: Dental plates are strong. There are pads of secondary shell material beneath the deltidial plates. The umbonal cavities are not filled by secondary shell material.

Comparison: Specimens referred to *Cyrtia* spp. can be distinguished from those of *Cyrtia sp. A* by the absence of secondary shell material in the umbonal cavities.

Occurrence: Portage Canyon Member, Laketown Dolomite. Four Mile Canyon, Utah — USNM loc. 19070 (3).

High Lake Member, Laketown Dolomite. East side of southern Egan Range, Nevada — USNM loc. 19175 (4).

High Lake or Gettel Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19198 (2), 19199 (1), 19201 (2), 19202 (3).

Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19209 (1). Age: Late Llandovery to Early Wenlock. Communities: *Pentameroides* Community, *Atrypina* Community.

Subfamily EOSPIRIFERINAE Schuchert & LeVene, 1929
Genus HEDEINA Boucot, 1957

Hedeina? sp.
pl. 11, figs. 19-23

Exterior: The lateral profile is ventri-biconvex. The shells are transverse; the hinge line nearly equals the maximum width which occurs in the posterior quarter of the valve. The long, catacline ventral interarea is strongly curved near the apex. The short, curved, dorsal interarea is apsacline. The flat-topped fold and U-shaped sulcus are well defined. The sulcus originates at the ventral beak as an interspace between two plica. At the dorsal beak there are three plications; the central one developed into a fold during growth by increasing in height and width more rapidly than the lateral plications. Each valve has 4 plications. The medial plications which bound the fold and sulcus are strong; the lateral plications are much weaker. The better preserved specimens are small; larger specimens may bear a third pair of very weak plications on each valve. The plications and broad interspaces are evenly rounded. The anterior commissure is uniplicate with the ventral valve projecting as a tongue upward but not forward. The largest specimen, though broken, was originally at least 20 mm wide and 13 mm long.

Ventral Interior: The long dental plates are high and strong. The muscle field is impressed.

Dorsal Interior: The hinge plates are gently curved and inclined baso-medially; they define a narrow chamber posteriorly. The hinge plates are supported by long crural plates which are situated on the strong impresses of the interspaces which lie on either side of the fold. The dental sockets are elongate and in cross section are gently curved. The edges of the interarea cover the margins of the dental sockets.

Discussion: This species cannot be confidently assigned to *Hedina* because small individuals, as are present here, cannot be distinguished from *Janius*. The age of these localities is C₆ — Early Wenlock. *Janius* is not known below the Late Wenlock (Boucot, 1963) so this species is most likely a member of *Hedina*, but the assignment cannot be proved on the basis of its morphology.

Comparison: This species is characterized by fewer plications than is normal for the genus. In this respect it resembles *Eospirifer* sp. Kirk & Amsden, 1952, p. 63, pl. 10, fig. 6), and also *Eospirifer radiatus* Borisyak, non Sowerby, see Borisyak (1955, pl. 11, fig. 7b). The latter two species have been assigned to *Macroleura* (= *Hedeina*) by Boucot (1963, p. 692-693). There is also a close similarity to *Macroleura?* sp. Johnson & Reso (1964, p. 82, pl. 20, fig. 1-7), but their species has a distinct anterior projection of the fold which is not found here. Further, their species is less transverse.

Occurrence: Jack Valley Member, Laketown Dolomite. Southern Egan Range,

Nevada — USNM locs. 19191 (1), 19206 (6), 19209 (1). Age: C₆ — Early Wenlock.
Community: *Atrypina* Community.

Superfamily DELTHYRIDACEA Phillips, 1841

Family DELTHYRIDIDAE Phillips, 1841

Subfamily DELTHYRIDINAE Phillips, 1841

Genus HOWELLELLA Kozłowski, 1946

HOWELLELLA sp.

pl. 11, figs. 24-28

Exterior: The lateral profile is ventri-biconvex. The ventral sulcus is defined by two large, rounded plications. There are 3 or 4 plications on each flank of the ventral valve; the plications are successively weaker away from the sulcus. The dorsal valve has a prominent flat-topped fold and three to four plications on each flank. Growth lines are not prominent.

Ventral Interior: Strong dental plates are anteriorly divergent. There is no median septum.

Dorsal Interior: Only one fragment of a dorsal interior was recovered. The inner hinge plates are small. Two specimens, one from USNM loc. 19203 and one from USNM loc. 19202, have well preserved dorsal valves. However, the assignment of these specimens is uncertain as no ventral valves have been recovered. They have a crenulated cardinal process and inner hinge plates which are united at their posterior extremities.

Discussion: Specimens from USNM locs. 19202, 19203 and 19486 are questionably referred to *Howellella*. Since no ventral valves are present from these localities the presence or absence of a ventral median septum could not be determined. Although there is an overall similarity with *Howellella smithi* Waite (1956) from the Pahrnatagat Range and the Fish Creek Range (Merriam, 1973) this species is more coarsely ribbed.

Occurrence: Portage Canyon Member, Laketown Dolomite. Sheep Rock Range, Utah — USNM loc. 19576 (11). Age: Late Llandovery (C₄₋₅) or Early Wenlock. Community: Possibly *Spirinella* Community.

Identified as ?*Howellella* sp. High Lake or Gettel Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19202 (1), 19203 (3). Portage Canyon Member, Laketown Dolomite. Pancake Range, Nevada — USNM loc. 19486 (1).

Superfamily RETICULARIACEA Waagen, 1883

Family RETICULARIIDAE Waagen, 1883

Genus SPIRINELLA Johnston, 1941

***Spirinella pauciplicata* (Waite, 1956)**

pl. 11, figs. 29-31; pl. 12, figs. 1-18

Howellella pauciplicata Waite, 1956, p. 17, pl. 4 (mislabeled pl. 3), figs. 6-10.

?*Howellella pauciplicata* Waite. Norford, 1962, p. 24, pl. 4, figs. 14-17.

Spirinella pauciplicata (Waite). Johnson, 1970, p. 208.

Howellella pauciplicata Waite. Merriam, 1973, p. 41, pl. 12, figs. 20-24.

Spirinella cf. *S. pauciplicata* (Waite). Lenz, 1974, p. 1134, p. 3, figs. 24, 25, 27-31.

Exterior: The ventral valve is high; the dorsal valve is gently convex. Shell thickness was measured perpendicular to the greatest shell length which was obtained as a line from the anterior commissure through the ventral beak. In 20 measured valves the ratio of thickness/length ranges from 0.64 to 0.75 and averages 0.70. The shells are transverse. The length/width ratio of 30 dorsal valves ranges from 0.58 to 0.81; the average is 0.70. The length/width ratio in the six valves measured from USNM loc. 19324 (Tony Grove Lake Section) is below average, ranging from 0.58 to 0.72, and averaging 0.63. The largest specimen (from USNM loc. 19058, Confusion Range Section) has a dorsal valve 14 mm long and 18 mm wide; but few individuals attain a length of even 8 mm.

In outline the hinge line is straight and wide; the cardinal angles are rounded. Maximum shell width occurs about 4/10 of the distance to the anterior margin. The antero-lateral margins are evenly rounded. The outline is straight at the front of the valve, between the fold and sulcus. The ventral beak extends well behind the hinge-line. The beak is incurved. The apsacline ventral interarea is long and strongly curved, especially near the beak. In well preserved material the lateral margins of the interarea, though rounded, are abrupt. The short dorsal interarea is anacline. The delthyrial angle is less than 60°. The margins of the delthyrium bear short, erect plates. The interarea is laterally striate.

The shallow sulcus, which begins at the apex of the ventral valve, is well defined by a pair of low, rounded plications. In most valves the flanks of the shell are smooth; however, a second pair of faint plications are occasionally developed. The second pair of plications is found on most of the larger shells in collections of a new subspecies from the southern Egan Range section (USNM 19185, 19187, 19190, 19191). Representatives of this new subspecies also tend to have more robust medial plications. The dorsal valve bears a broad, flat-topped fold and a pair of low lateral plications. The strength of these plications is quite variable. Rarely a second pair of lateral dorsal plications is developed, generally associated with the second pair of lateral plications on the ventral valve. Again, larger valves from the southern Egan Range are typified by this feature. The anterior commissure is deflected by the fold, sulcus and plications. Individuals from USNM 19324 in the Tony Grove Lake Section have a stronger deflection of the commissure associated with the fold and sulcus than do specimens from other localities. Closely set, but irregularly spaced growth lines can be seen on many valves. The micro-ornament is very delicate and is well preserved only on specimens from USNM locs. 19058 and 19059 in the Confusion Range Section. There are about 8 growth lines in a space of 2 mm measured 5 mm from the ventral beak. The growth lines are composed of regularly spaced, radial ridges. There are about 15 of these ridges in 1 mm.

Ventral Interior: The triangular hinge teeth are supported by plates which are composed of two segments. The first segment (adminiculum of Waterhouse, 1971,

text fig. 1), is a flat, thin plate that rises perpendicularly from the inner surface of the shell. The second, shorter segment (the dental plate) lies just beneath the tooth and is gently inclined away from the midline of the shell. The junction between the dental plate and adminiculum is angular. Long, narrow crural fossettes lie just below the teeth. In living position only a small segment of the crural fossettes are used in articulation and the major portion of the groove represents the position of the crural fossettes during growth.

The dental plates are gently divergent anteriorly. The impress of the sulcus forms a low, broad, flat-topped elevation on the interior of the valve. A very short, median ridge, or in some specimens a pair of ridges lies in the apex of the valve. In front of the ridge the median elevation bears longitudinal striae of variable strength and number.

The diductor muscle scars are poorly defined but lie in depressions which border the median elevation and represent the impress of the plicae that border the sulcus. The bases of the dental plates lie on the outer margin of these depressions and thus bound the muscle field laterally. The front of the muscle field is very poorly defined, but it may extend beyond midlength. The adductor muscle scar is situated upon the median elevation but its extent is not clear.

Dorsal Interior: There is a small, flat, crenulate cardinal process. The linear dental sockets are broadly divergent anteriorly. Unsupported socket plates give rise distally to small crura that serve as accessory teeth which articulate with the crural fossettes. The triangular crural plates are weakly concave and convergent toward the midline. They are disjunct and free except at their posterior extremity where they meet the floor of the valve. Thin pads of secondary shell material line the back part of the medial surface of the crural plates. Muscle scars are not present. A pair of slightly divergent elevations are produced by the impress of the external depressions between the fold and the plicae. A low ridge is often developed upon the crest of these ridges, and a faint median ridge is usually present. In some valves other weak, longitudinal ridges are also present.

The primary lamellae are ribbon-like and sub-parallel. Ventrally directed jugal processes lie immediately in front of the crural plates. The spiralia are laterally directed and have 5 or more volutions.

Comparison: *Spirinella* cf. *S. pauciplicata* has been identified from the Allen Bay Formation of the Northwest Territories, Canada, by Lenz (1974). The interior features are closely comparable, but the ventral sulcus is more narrow (Lenz, 1974, pl. 3, figs. 24, 28).

The exteriors are closely comparable to *Quadrithyris sinuata* Rubel (1970) from the K₂ beds of Estonia.

Occurrence: Gettel Member, Laketown Dolomite, Barn Hills, Utah — USNM loc. 19546 (1).

Jack Valley Member, Laketown Dolomite, Barn Hills, Utah — USNM locs. 19549 (1), 19550 (230), 19551 (1). Confusion Range, Utah — USNM locs. 19050 (49), 19052 (2), 19053 (64), 19054 (17), 19055 (280), 19056 (393), 19057 (321), 19058

(354), 19059 (330). Tony Grove Lake, Utah — USNM loc. 19324 (296). Age: Confined to the Late Llandovery through Ludlow interval. Community: *Spirinella* Community.

Identified as ?*Spirinella pauciplicata*. Portage Canyon Member, Portage, Utah — USNM loc. 19020 (1). Age: Late Llandovery (C₄₋₅) or Early Wenlock. Community: *Microcardinalia* Community.

***Spirinella pauciplicata eganensis* n. subsp.
pl. 12, figs. 15-18**

Discussion: Several collections from the southern Egan Range have yielded individuals of *S. pauciplicata* which have consistent morphologic differences from other collections of the species. Lateral ribbing in the new subspecies is more pronounced than in other populations of *S. pauciplicata*. In the new subspecies two weak lateral plications are commonly present on each valve, even in relatively small individuals. In addition the ventral beak is not as prominent as in other populations of *S. pauciplicata*.

Comparison: Specimens of *Spirinella pauciplicata* from the upper part of the Lone Mountain Dolomite, Mahogany Hills, Nevada, illustrated by Merriam (1973, pl. 12, figs. 20-24) are members of this subspecies.

Specimens referred to *S. pauciplicata* by Norford (1962) have a strong median plication and may be members of this subspecies.

Spirinella pauciplicata eganensis has a striking resemblance to *Tenellodermis matrix* from the Roberts Mountains Formation at Birch Creek and the Tor Limestone in Nevada (See Johnson, Boucot, and Murphy, 1973; Johnson and Boucot, 1970). The overall shape and interior features are quite similar, including the ventral plates bordering the margins of the delthyrium. The two species can be distinguished by the coarser plications and stronger growth lines of *T. matrix*. The new subspecies has one low plication and a trace of a second plication on each flank of the dorsal valve, whereas *T. matrix* has two plications and traces of a third. In view of their similar interior morphology, *S. pauciplicatus* may have been the ancestor of *T. matrix*, in which case the new subspecies was an intermediate morphologic stage.

The holotype is USNM 219743 p. 12, figs. 16, 17.

Occurrence: Jack Valley Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM locs. 19185 (2), 19187 (41), 19188 (2), 19189 (3), 19190 (35), 19191 (15), 19080 (2), 19206 (6), 19209 (2), 19211 (1). Gettel or High Lake Member, Laketown Dolomite — USNM loc. 19203 (4).

Identified as ?*Spirinella pauciplicata eganensis*. Gettel or High Lake Member, Laketown Dolomite. Southern Egan Range, Nevada — USNM loc. 19199 (2). Age: C₆ — Early Wenlock. Community: *Spirinella* Community.

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PLATE 1

Figures 1-8. *Hesperorthis* sp.

Member C. Unnamed Silurian Formation, Ranger Mountain, Nevada, USNM loc. 19421

1,2, Dorsal interior, exterior, X3.0. USNM 219560.

3,4, Ventral exterior, interior, X2.5. USNM 219561.

5,6, Dorsal interior, exterior, X2.5. USNM 219562.

7 Ventral exterior, X2.5. USNM 219563.

8 Ventral posterior, X2.5. USNM 219564.

Figures 9-12. *Dolerorthis?* sp.

Portage Canyon Member, Laketown Dolomite, Four Mile Canyon, Utah, USNM loc. 19070.

9,10, Dorsal interior, exterior, X2.0. USNM 219565.

11,12, Dorsal exterior, interior, X2.0. USNM 219566.

Figures 13-14. "*Dolerorthis*" *flabellites* (Foerste, 1889) group 1.

High Lake Member, Laketown Dolomite, Pancake Range, Nevada, USNM loc. 19484.

13,14, Dorsal exterior, interior, X2.0. USNM 219567.

Figures 15-16. *Dolerorthis* sp.

Portage Canyon Member, Laketown Dolomite, Sheep Rock Mountains, Utah, USNM loc. 19576.

15,16, Dorsal interior, exterior, X3.0. USNM 219568.

Figures 17-20. *Dolerorthis flabellites* (Foerste, 1889) group 2.

Gettel Member, Laketown Dolomite, Barn Hills, Utah. Figures 17, 20, USNM loc. 19548; figures 18, 19, USNM loc. 19546.

17,20, Ventral interior, exterior, X1.5. USNM 219569.

18,19, Dorsal interior, exterior, X2.0. USNM 219570.

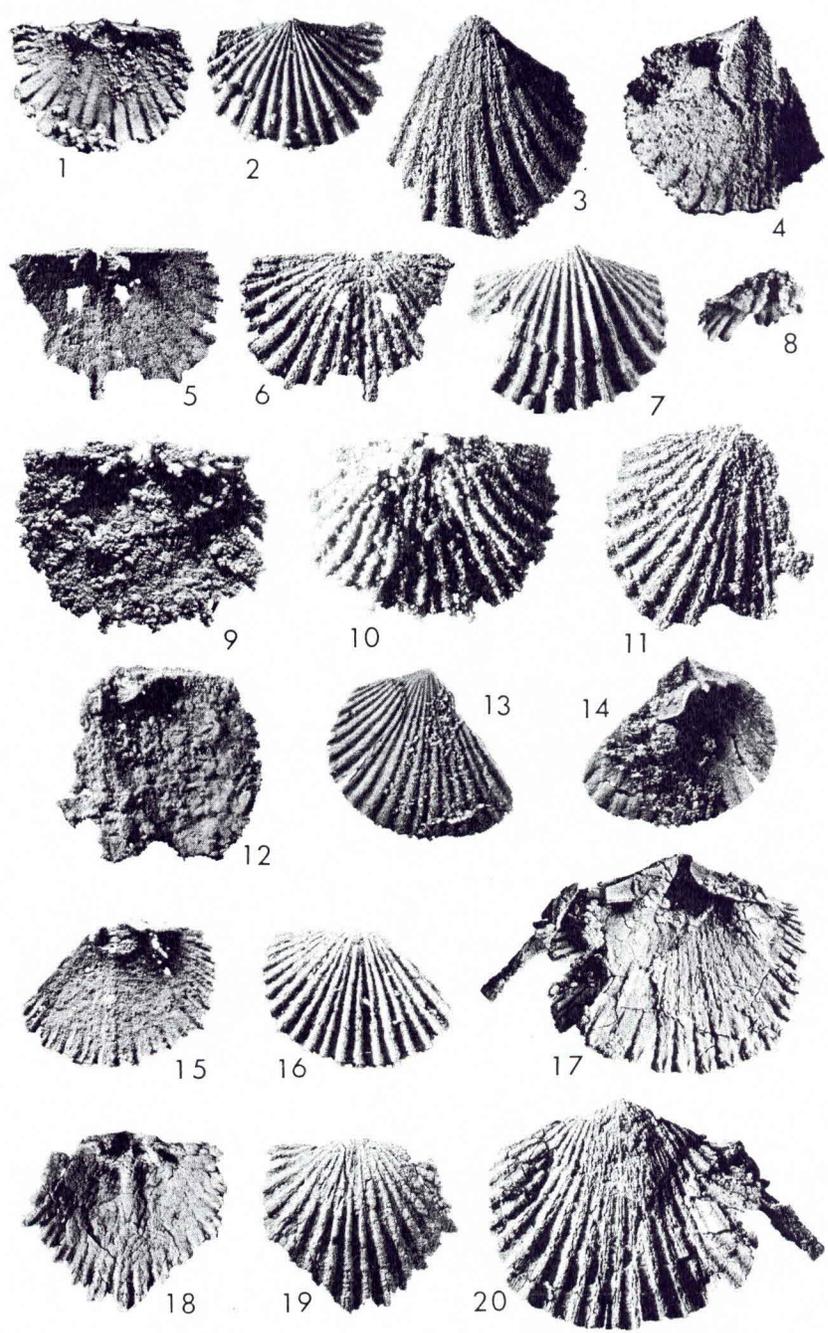


PLATE 2

Figures 1-14. *Dolerorthis flabellites* (Foerste, 1889) group 3.

High Lake or Gettel Members, Laketown Dolomite, southern Egan Range, Nevada. Figs.

1-3, USNM loc. 19195; figs. 4, 5, 10, 11, USNM loc. 19200; figs. 13, 14, USNM loc. 19203.

Jack Valley Member, Laketown Dolomite, figs. 7-9, 12, USNM loc. 19185. High Lake Member, Laketown Dolomite, Tony Grove Lake, Utah, fig. 6, USNM loc. 19316.

1,2,3, Ventral exterior, dorsal exterior, lateral, X2.0. USNM 219571.

4,5, Dorsal exterior, interior, X1.5. USNM 219572.

6 Dorsal interior, X1.5. USNM 219573.

7,8, Ventral exterior, interior, X1.5. USNM 219574.

9,12, Dorsal interior, exterior, X1.5. USNM 219575.

10,11, Ventral exterior, interior, X1.5. USNM 219576.

13,14, Dorsal exterior, interior, X2.0. USNM 219577.

Figures 15-16. *Platystrophia* sp. B

High Lake Member, Laketown Dolomite, Lakeside Mountains, Utah, USNM loc. 19040.

15,16, Ventral, dorsal exterior, X2.0. USNM 19578.

Figures 17-20. *Resserella* sp.

Member C, unnamed Silurian formation, Ranger Mountain, Nevada, USNM loc. 19421.

17-19, Ventral exterior, posterior, interior, X2.0, X2.0, X2.5. USNM 219579.

20 Ventral interior, X2.5. USNM 219580.

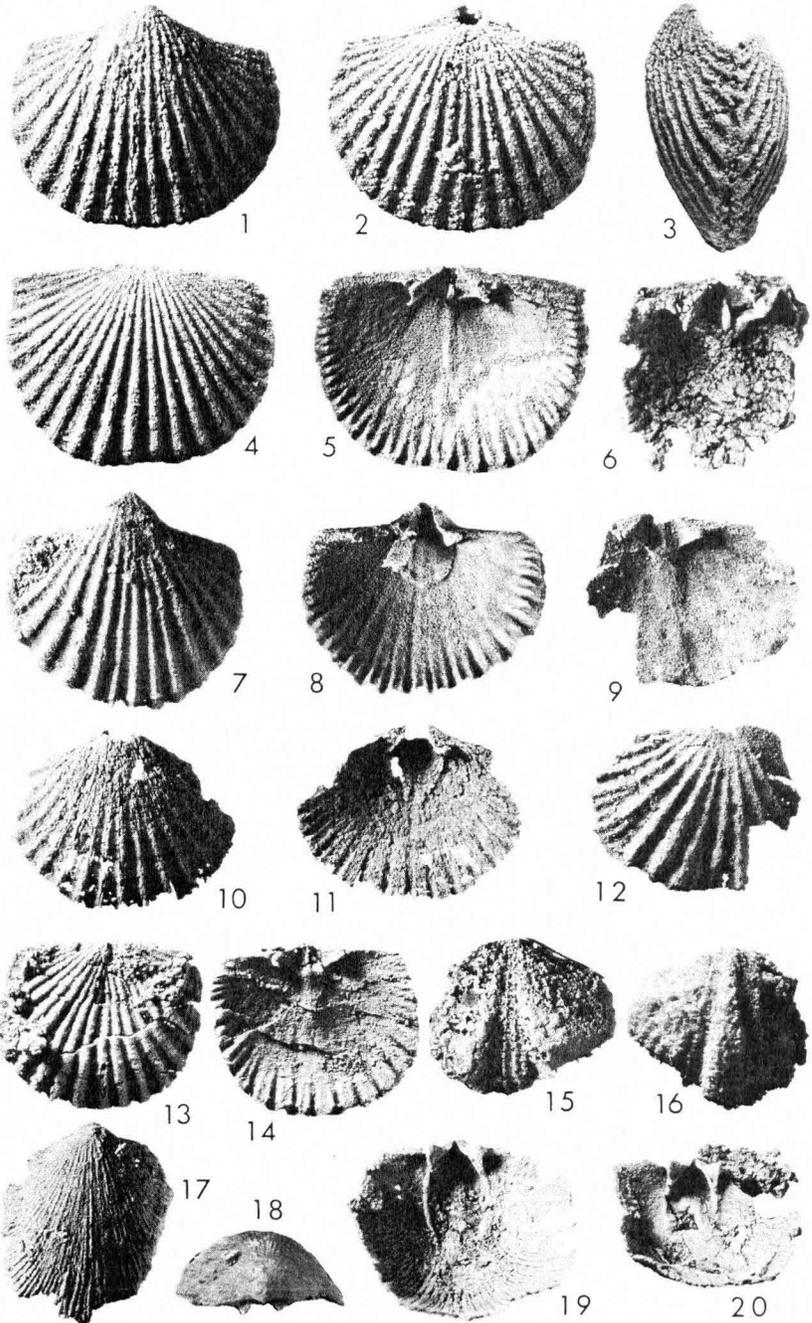


PLATE 3

Figures 1-3. "*Resserella*" sp.

Member C, unnamed Silurian formation, Ranger Mountain, Nevada, USNM loc. 19421.

1 Dorsal interior, X2.5. USNM 219581.

2,3, Dorsal exterior, interior, X2.5. USNM 219582.

Figures 1-17. *Isorthis* sp.

Portage Canyon Member, Laketown Dolomite, Portage, Utah, fig. 4, USNM loc. 19013; figs. 5, 14, 15, USNM loc. 19016. High Lake or Gettel Members, Southern Egan Range, Nevada, figs. 6, 7, USNM loc. 19203; fig. 9, USNM loc. 19201; figs. 16-17, USNM loc. 19200. Deep Creek Range, Nevada, figs. 8, 10-13, USNM loc. 19278.

4, Ventral interior, X3.5. USNM 219583.

5, Ventral interior, X3.5. USNM 219584.

6,7, Ventral interior, exterior, X4.0. USNM 219585.

8, Ventral interior, X5.0. USNM 219586.

9, Ventral interior, X5.0. USNM 219587.

10,11, Ventral, dorsal exterior, X5.0. USNM 219588.

12,13, Dorsal exterior, interior, X5.0. USNM 219589.

14,15, Dorsal interior, exterior, X3.5. USNM 219590.

16,17, Dorsal interior, exterior, X4.0. USNM 219591.

Figures 18-26. *Dicoelosia biloba* (Linnaeus, 1758)

High Lake or Gettel Members, Laketown Dolomite, Southern Egan Range, Nevada, figs. 18-20, USNM loc. 19203; figs. 21-26, USNM loc. 19204.

18-20, Ventral interior, interior, exterior, X8.0. USNM 219592.

21-23, Ventral exterior, dorsal exterior, lateral, X8.0. USNM 219593.

24-25, Ventral interior, exterior, X8.0. USNM 219594.

26, Dorsal exterior, X8.0. USNM 219595.

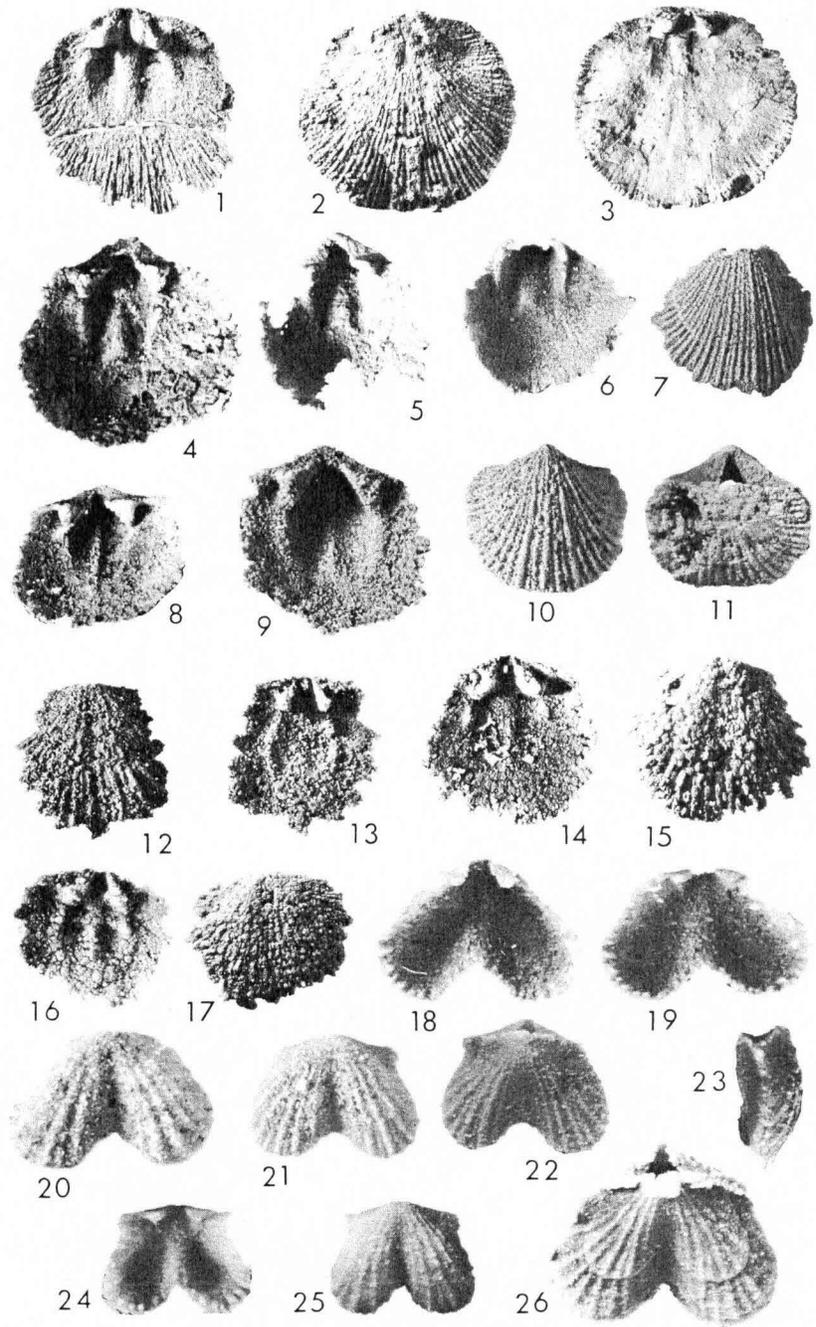


PLATE 4

Figures 1-3. *Dicoelosia biloba* (Linnaeus, 1758)

High Lake or Gettel Members, Laketown Dolomite, southern Egan Range, Nevada, Fig. 1, USNM loc. 19204; figs. 2, 3 USNM loc. 19201.

1, Dorsal interior, X8.0. USNM 219596.

2,3, Dorsal interior, exterior, X8.0. USNM 219597.

Figures 4-11. *Dalejina* sp.

Jack Valley Member, Laketown Dolomite, southern Egan Range, Nevada, Figs. 4, 5, 8, 9, USNM loc. 19185; figs. 6, 7, USNM loc. 19186; High Lake or Gettel Members, figs. 10, 11, USNM loc. 19201.

4,5, Ventral interior, exterior, X3.5. USNM loc. 219598.

6,7, Ventral exterior, interior, X3.0. USNM 219599.

8,9, Dorsal interior, exterior, X2.5. USNM 219600.

10,11, Dorsal exterior, interior, X2.5. USNM 219601.

Figures 12-20. *Eoplectodonta* sp.

High Lake or Gettel Members, Laketown Dolomite, southern Egan Range, Nevada, figs. 16-20, USNM loc. 19198. ?*E.* sp. A figs. 12-15, USNM loc. 19201.

12-14, Ventral, dorsal, posterior exteriors, X2.5. USNM 219602.

15, Ventral exterior, X2.5. USNM 219603.

16, Ventral interior, X4.0. USNM 219604.

17, Ventral interior, X4.0. USNM 219605.

18, Dorsal interior, X3.5. USNM 219606.

19, Dorsal interior, X4.0. USNM 219607.

20, Dorsal interior, X4.0. USNM 219608.

Figures 21-23. *Leptaena* sp.

Jack Valley Member, Laketown Dolomite, southern Egan Range, Utah, fig. 21, USNM loc. 19188; figs. 22-23, USNM loc. 19187.

21, Dorsal interior, X2.1. USNM 219609.

22, Ventral interior, X2.6. USNM 219610.

23, Posterior exterior, X3.0. USNM 219611.

Figures 24-25. *Brachyprion* (*Eomegastrophia*) *geniculata* (Waite, 1956)

Jack Valley Member, Laketown Dolomite, Confusion Range, Utah, USNM loc. 19050.

24, Ventral exterior, X1.25. USNM 219612.

25, Ventral exterior, X1.25. USNM 219613.

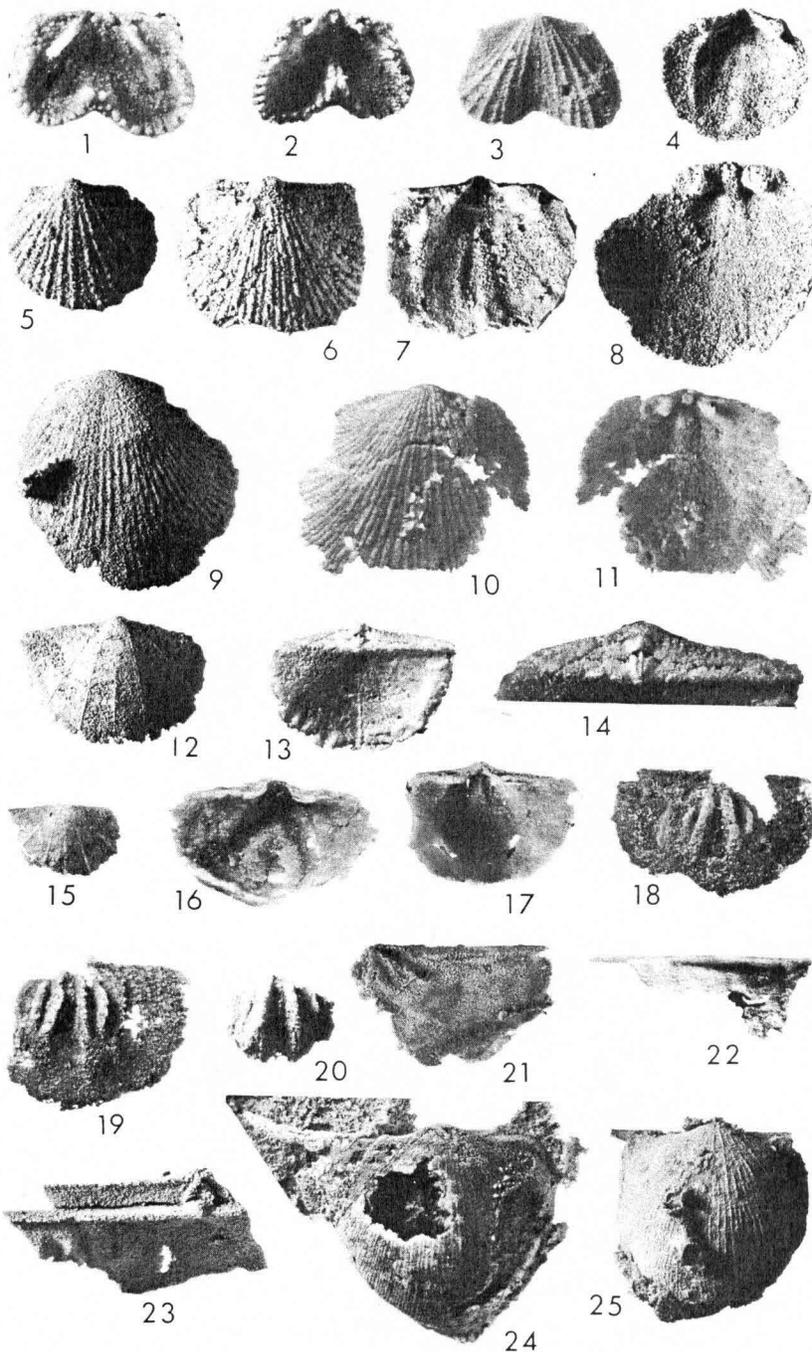


PLATE 5

Figures 1-19. *Brachyprion (Eomegastrophia) geniculata* (Waite, 1956)

Jack Valley Member, Laketown Dolomite, Confusion Range, Utah, figs. 1, 5, 7-11, 13, 18, 19, USNM loc. 19058; figs. 2, 6, USNM loc. 19054; figs. 3-4, 12, 14-15, USNM loc. 19050; figs. 16, 17, USNM loc. 19056.

1,5, Ventral exterior, X3.0, X1.25. USNM 219614.

2,6, Ventral exterior, X2.5, X1.25. USNM 219615.

3,4, Ventral exterior, X3.0, X1.25. USNM 219616.

7,8,10,11,13, Dorsal, lateral, ventral, anterior, posterior exterior, X1.25, X1.25, X1.25, X3.0. USNM 219617.

9, Ventral exterior, X1.25. USNM 219618.

12,14, Ventral Exterior, X1.25. USNM 219619.

15, Ventral exterior, X1.25. USNM 219620.

16, Ventral interior, X2.5. USNM 219621.

17, Posterior of articulated valves, X3.5. USNM 219622.

18, Ventral interior, X3.0. USNM 219623.

19, Ventral interior, X2.0. USNM 219624.

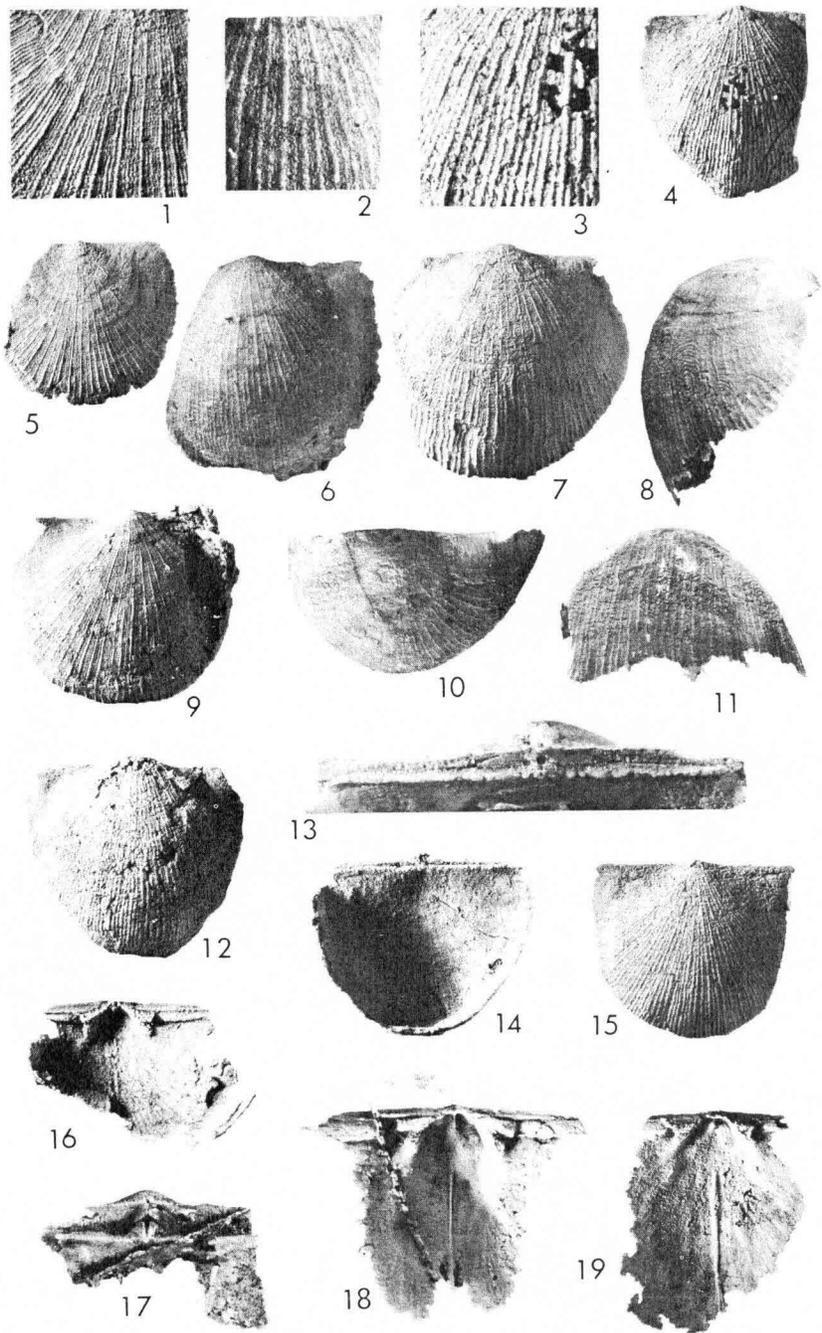


PLATE 6

Figures 1-8. *Brachyprion (Eomegastrophia) geniculata* (Waite, 1956)

Jack Valley Member, Laketown Dolomite, Confusion Range, Utah, figs. 1, 2, 3, USNM loc. 19058; ?*B. geniculata* High Lake Member, Laketown Dolomite, Tony Grove Lake Utah, fig. 4, USNM loc. 19312.

1, Dorsal interior, X3.5. USNM 219625.

2,3, Dorsal posterior, interior, X2.8, X2.0. USNM 219626.

4, Mold, ventral interior, X2.0. USNM 219627.

Figures 5-9. *Protochonetes elyensis* n. sp.

Jack Valley Member, Laketown Dolomite, southern Egan Range, Nevada, figs. 5-7, USNM loc. 19187; figs. 8, 9, USNM loc. 19188.

5,6,7, Lateral, ventral, dorsal exterior, X2.5. USNM 219628.

8, Ventral exterior, X2.5. USNM 219629.

9, Dorsal interior, X4.0. USNM 219630.

Figures 10-13. *Camarella?* sp.

Jack Valley Member, Laketown Dolomite, southern Egan Range, Nevada, USNM loc. 19187.

10,11, Ventral, dorsal exterior, X4.0. USNM 219631.

12,13, Ventral, dorsal exterior, X4.0. USNM 219632.

Figures 14-21. *Pentameroides* sp. A

Portage Canyon Member, Laketown Dolomite, Deep Creek Range, Utah, figs. 14, 16, 17, 21, USNM loc. 19278. High Lake Member, Laketown Dolomite, Portage, Utah, figs. 15, 18. USNM loc. 19031, fig. 19, USNM loc. 19032. Portage Canyon Member, Cherry Creek Range, Nevada, fig. 21, USNM loc. 19275 Talus.

14, Ventral interior, X2.0. USNM 219633.

15, Ventral interior, X2.0. USNM 219634.

16, Ventral interior, X2.0. USNM 219635.

17, Dorsal interior, X2.0. USNM 219636.

18, Dorsal interior, X2.0. USNM 219637.

19, Dorsal interior, X2.0. USNM 219638.

20, Dorsal interior, X2.0. USNM 219639.

21, Dorsal interior, X2.0. USNM 219640.

Figures 22-25. *Pentameroides* sp. B

High Lake Member, Laketown Dolomite, east side, southern Egan Range, Nevada, fig. 22, USNM loc. 19175. Southern Egan Range, Nevada, figs. 23, 24, 25, USNM loc. 19198.

22, Ventral interior, X1.5. USNM 219641.

23,24, Dorsal interior, exterior, X2.0. USNM 219642.

25, Ventral interior, X3.0. USNM 219643.

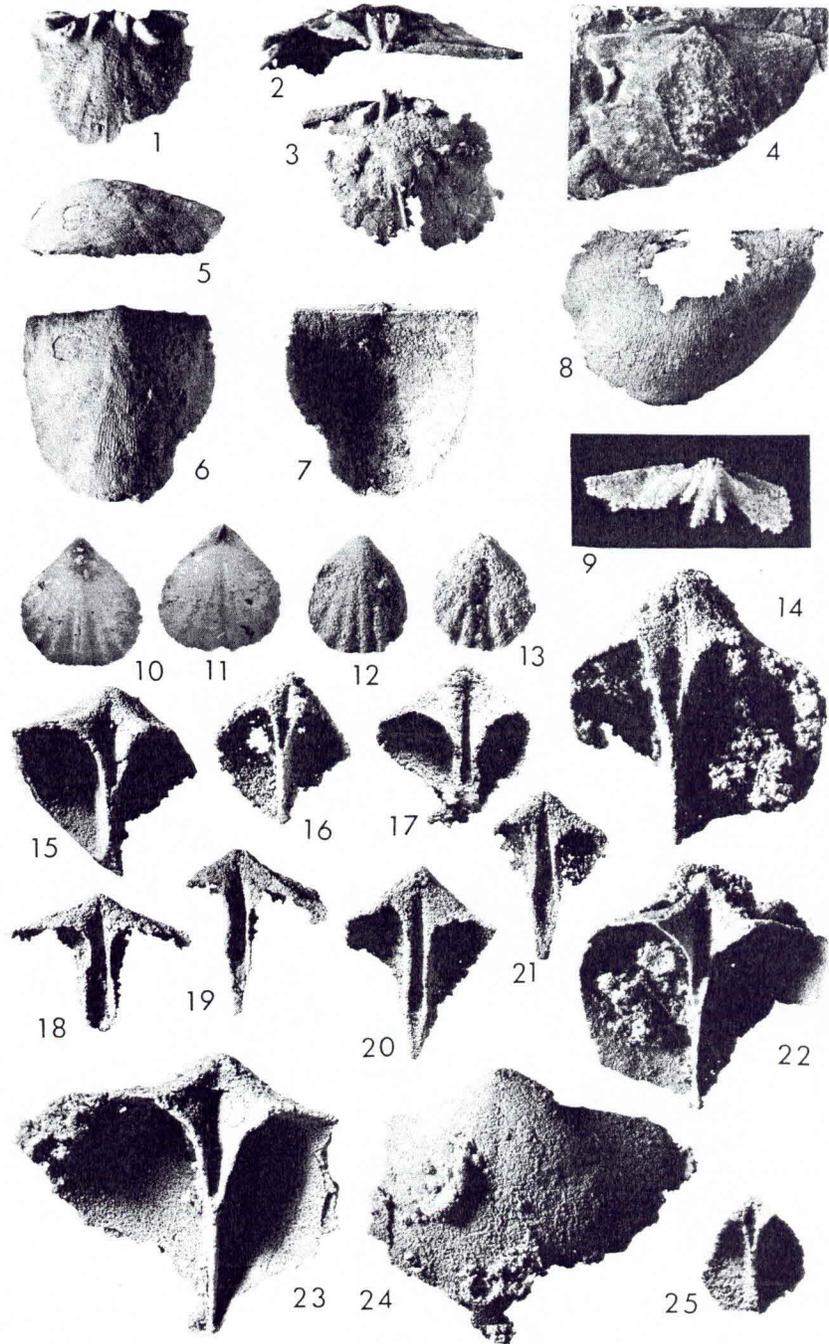


PLATE 7

Figure 1-5. *Pentameroides* sp. B

High Lake or Gettel Member, Laketown Dolomite, southern Egan Range, Nevada, figs. 1, 2, USNM loc. 19196; Fig. 5, USNM loc. 19198. East side, southern Egan Range, Nevada, figs. 3, 4, USNM loc. 19175.

1,2, Dorsal interior, lateral view of dorsal interior, X2.5, X2.8. USNM 21644.

3, Dorsal interior, X2.0. USNM 219645.

4, Dorsal interior, X2.5. USNM 219646.

5, Dorsal interior, X2.5. USNM 219647.

Figures 6-10. *Microcardinalia* sp. A

Unnamed Silurian dolomite, Ranger Mountain, Nevada, USNM loc. 19419.

6,7, Ventral exterior, interior, X2.5. USNM 219648.

8, Ventral interior, X2.5. USNM 219649.

9, Dorsal interior, X3.3. USNM 219650.

10, Dorsal interior, X1.5. USNM 219651.

Figures 11-21. *Microcardinalia* sp. B

Portage Canyon Member, Laketown Dolomite, Portage, Utah, figs. 11, 12, 18, 21, USNM loc. 19021; fig. 20, USNM loc. 19016. Southern Egan Range, Nevada, Jack Valley Member, 13, 14, 17, 19, USNM loc. 19206; High Lake or Gettel Member, figs. 15, 16, USNM 19196.

11,12, Ventral exterior, interior, X2.0. USNM 219652.

13,14, Ventral exterior, interior, X2.0. USNM 219653.

15,16, Ventral interior, exterior, X2.5, X2.0. USNM 219654.

17, Dorsal interior, X2.5. USNM 219655.

18, Dorsal interior, X2.5. USNM 219656.

19, Dorsal interior, X2.5. USNM 219657.

20, Ventral posterior, X2.0. USNM 219658.

21, Dorsal interior, X2.5. USNM 219659.

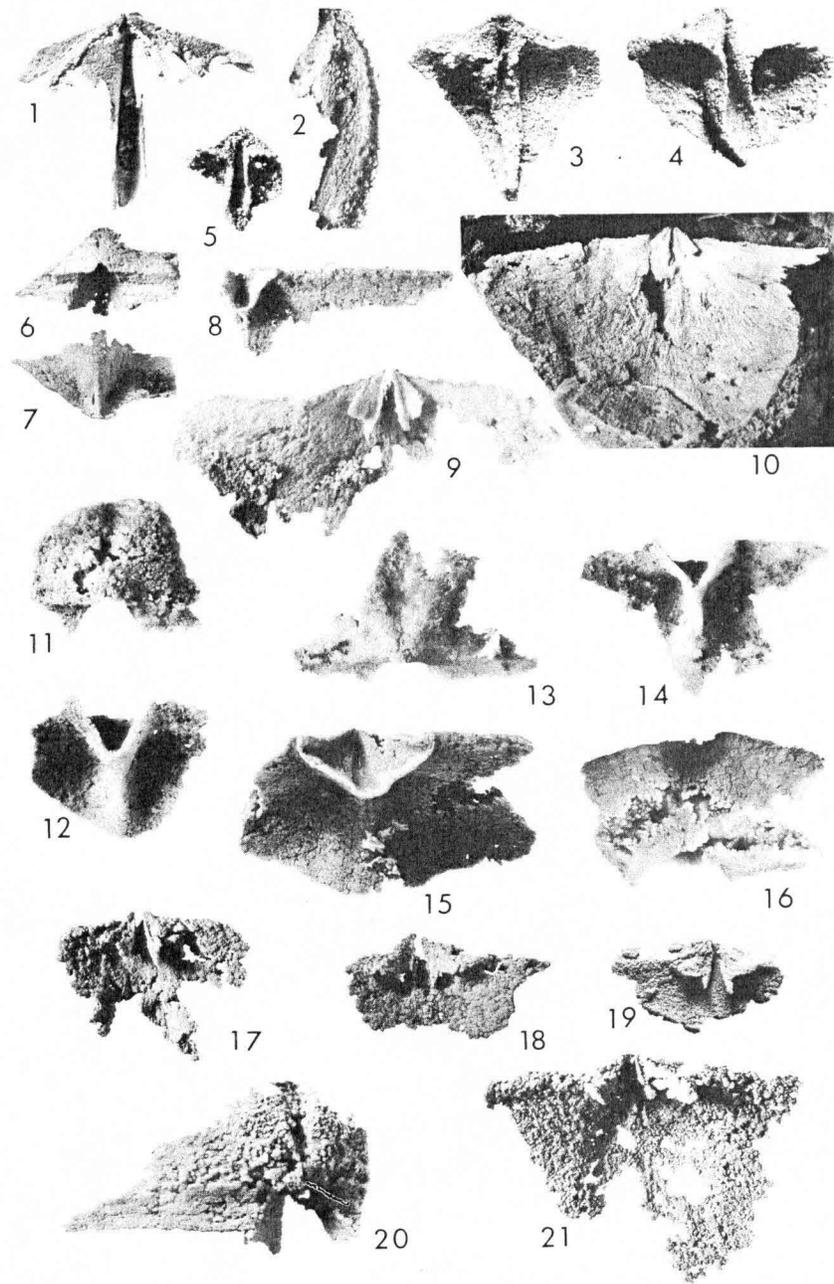


PLATE 8

Figures 1-10. *Ferganella borealis* (Schlotheim, 1832)

Jack Valley Member, Laketown Dolomite, southern Egan Range, Nevada. USNM loc. 19206.

1-4, Ventral, dorsal, anterior, lateral exterior, X2.5. USNM 219660.

5, Posterior exterior, X2.5. USNM 219661.

6, Ventral exterior, X2.5. USNM 219662.

7-8, Dorsal exterior, interior of articulated valves, X2.5. USNM 219663.

9, Ventral interior, X2.5. USNM 219664.

10, Dorsal interior, X3.0. USNM 219665.

Figures 11-19. *Ancillotoechia? pahrnagatensis* (Waite, 1956)

Jack Valley Member, Laketown Dolomite, Confusion Range, Utah, figs. 11, 12, 15, USNM loc. 19053; figs. 13, 14, USNM loc. 19057. Ibex Hills, Utah, figs. 16-19, USNM loc. 19551.

11,12, Ventral, dorsal exterior, X2.5. USNM 219666.

13,14, Ventral, dorsal exterior, X2.5. USNM 219667.

15, Dorsal exterior, X2.5. USNM 219668.

16, Ventral interior, X3.0. USNM 219669.

17, Dorsal interior, X3.5. USNSM 219670.

18, Dorsal interior, X5.0. USNM 219671.

19, Dorsal interior, X3.0. USNM 219672.

Figures 20-23. *Ancillotoechia? sp.*

Lone Mountain Dolomite, Mahogany Hills, Nevada USNM loc. 19530.

20, Ventral exterior, X2.0. USNM 219673.

21, Anterior exterior, X2.0. USNM 219674.

22,23, Dorsal exterior, interior, X2.5. USNM 219675.

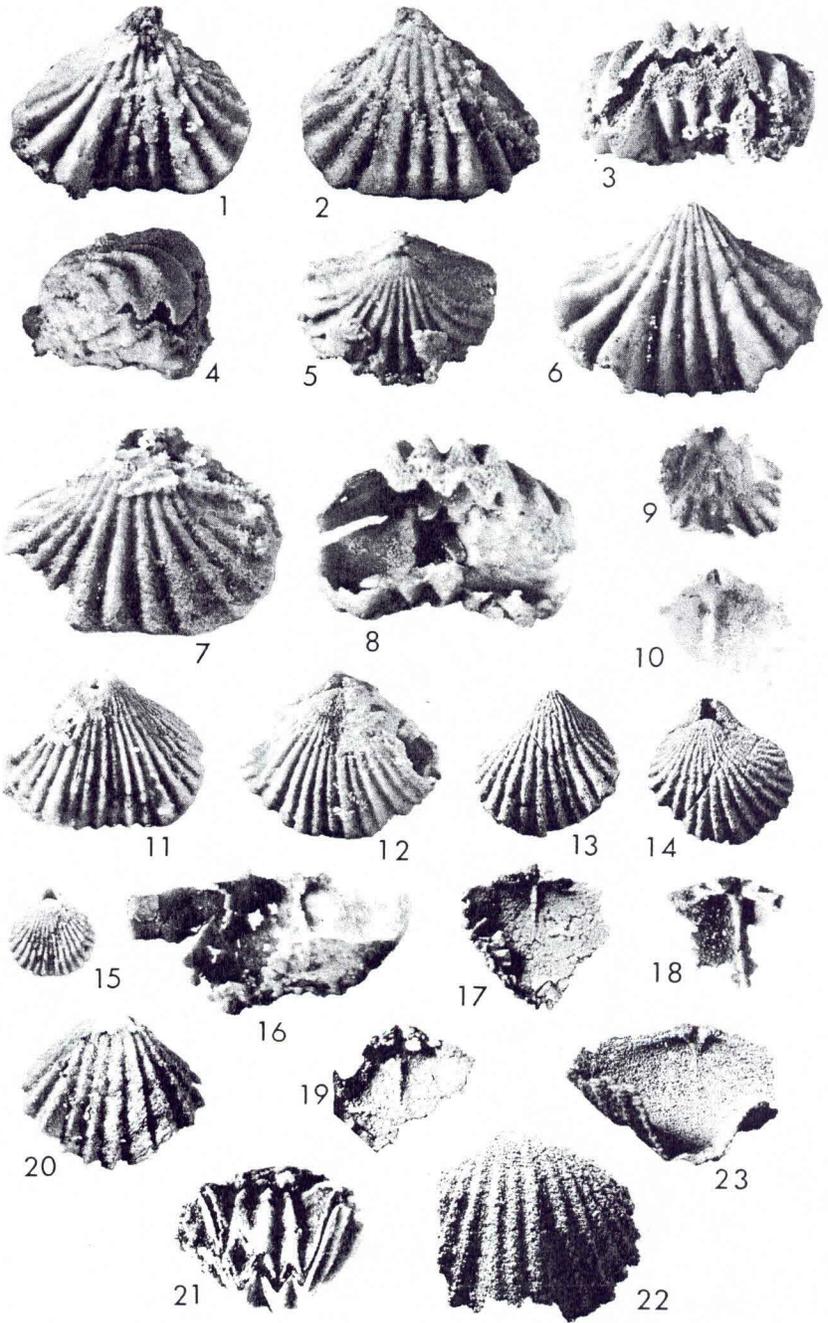


PLATE 9

Figures 1-15. *Ancillotoechia perryi* n. sp.

Jack Valley Member, Laketown Dolomite, Tony Grove Lake, Utah, figs. 1-11, USNM loc. 19324. *Ancillotoechia perryi*? southern Egan Range, Nevada, figs. 12, 13, USNM 19190; figs. 14-15, USNM loc. 19187.

1-4, Dorsal, ventral, lateral, anterior exterior, Holotype, X3.0. USNM 219676.

5,6, Dorsal, ventral exterior, X3.0. USNM 219677.

7,8, Ventral exterior, interior, X3.0. USNM 219678.

9,10, Dorsal exterior, interior, X3.0. USNM 219679.

11, Lateral interior (note crura), X3.0. USNM 219680.

12,13, Ventral, dorsal exterior, X3.0. USNM 219681.

14,15, Dorsal exterior, interior, X3.0, X3.5. USNM 219682.

Figures 16-30. *Pentlandella merriami* n. sp.

High Lake Member, Laketown Dolomite, southern Egan Range, Nevada, USNM loc. 19180.

16, Ventral interior, X2.5. USNM 219683.

17, Ventral interior, X3.0. USNM 219684.

18, Ventral interior, X3.0. USNM 219685.

19, Ventral interior, X2.5. USNM 219686.

20,21, Ventral interior, exterior, X3.0. USNM 219687.

22,26, Dorsal exterior, interior, X2.5, X5.0. USNM 219688.

23, Ventral exterior, X3.0. USNM 219689.

24,25, Ventral, dorsal exterior, Holotype, X3.0. USNM 219690.

27, Dorsal interior, X3.0. USNM 219691.

28, Dorsal interior, X2.5. USNM 219692.

29, Anterior view of dorsal interior, X2.5. USNM 219693.

30, Dorsal interior, X2.5. USNM 219694.

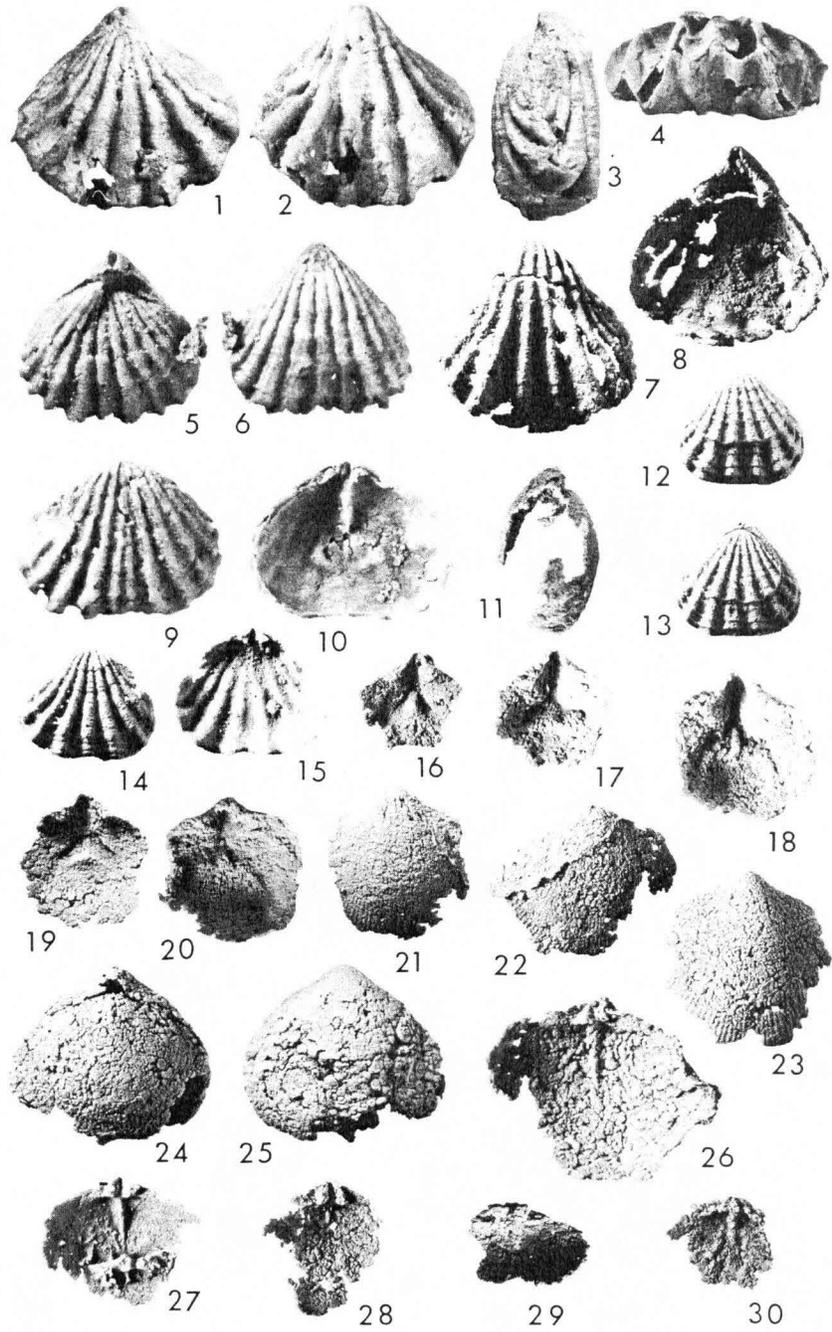


PLATE 10

Figures 1-14. *Atrypa* cf. *A. parva* Hume, 1925

Jack Valley Member, Laketown Dolomite, southern Egan Range, Nevada, figs. 1-7, 9, USNM 19206. Portage Canyon Member, Deep Creek Range, Utah, figs. 10-12, USNM loc. 19278. High Lake Member, Laketown Dolomite, Portage, Utah, fig. 8, USNM loc. 19029; *A. cf. A. parva?* figs. 13, 14, USNM loc. 19031.

1,2, Dorsal, ventral exterior, X2.0. USNM 219695.

3,4, Ventral exterior, interior, X2.0. USNM 219696.

5,6, Dorsal, ventral exterior, X2.0. USNM 219697.

7, Ventral interior, X2.0. USNM 219698.

8, Ventral interior, X2.0. USNM 219699.

9, Dorsal interior, X3.5. USNM 219700.

10, Dorsal interior, X2.0. USNM 219701.

11,12, Ventral exterior, interior, X2.0. USNM 219702.

13,14, *A. cf. A. parva* fine ribbed form, ventral exterior, interior, X2.0. USNM 219703.

Figures 15-23. *Atrypa hedei* Struve, 1966, *americensis* n. subsp.

Jack Valley Member, Laketown Dolomite, Barn Hills, Utah, USNM loc. 19549.

15, Ventral interior, X2.5. USNM 219704.

16,17, Ventral interior, exterior, X2.5. USNM 219705.

18,19, Ventral interior, exterior, X2.0. USNM 219706.

20, Dorsal interior, X2.5. USNM 219707.

21, Interior of articulated valves, X2.5. USNM 219708.

22,23, Dorsal exterior, interior, X2.0. USNM 219709.

Figures 24-25. *Spirigerina* sp. A

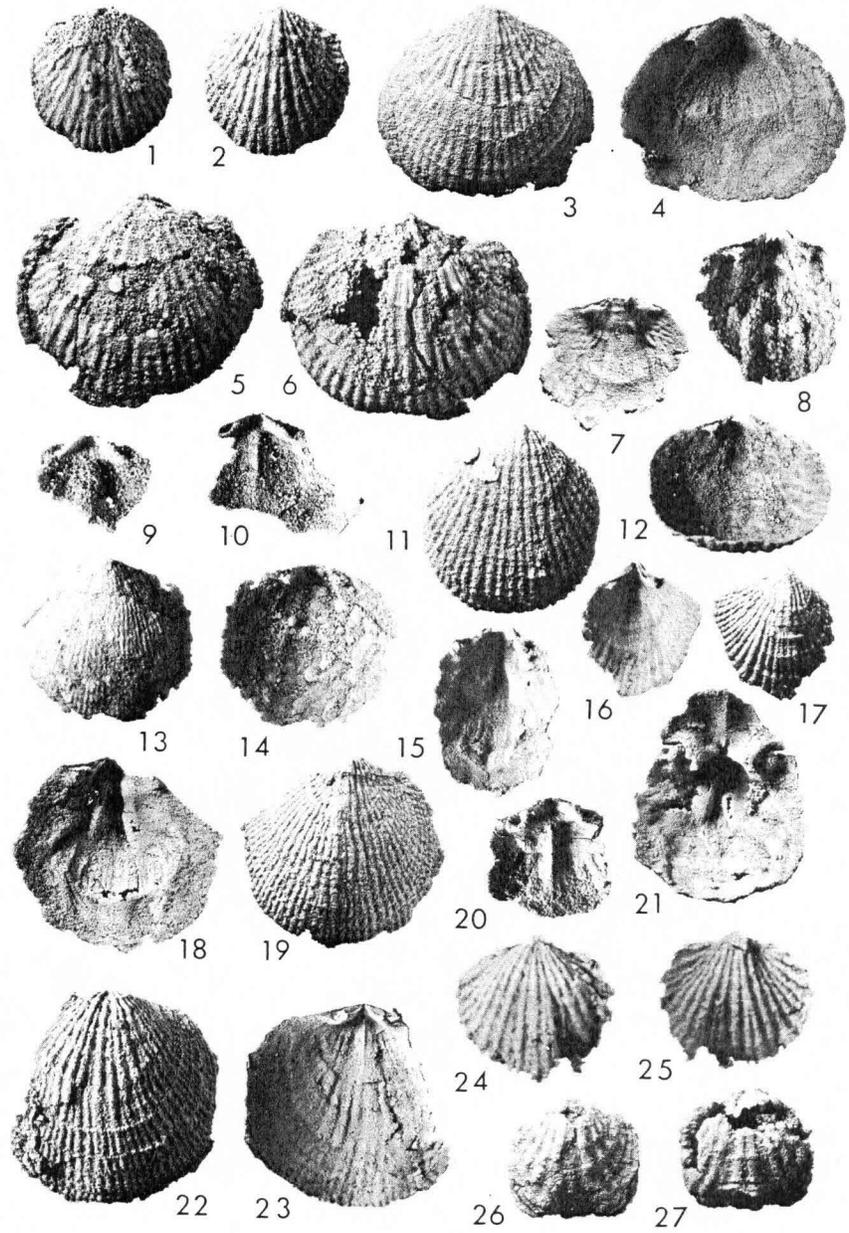
High Lake Member, Laketown Dolomite, southern Egan Range, Nevada, USNM loc. 19180.

24,25, Dorsal, ventral exterior, X2.0. USNM 219710.

Figures 26, 27. *Plectatrypa* cf. *P. imbricata* (J. de C. Sowerby, 1839)

Jack Valley Member, Laketown Dolomite, southern Egan Range, Nevada, USNM loc. 19209.

26,27, Ventral, dorsal exterior, X2.5. USNM 219711.



Figures 1-3. *Spirigerina* sp. B

High Lake Member, Laketown Dolomite, Delamar Range, Nevada, USNM loc. 19522.

1, Anterior exterior, X2.0. USNM 219712.

2, Ventral exterior, X2.0. USNM 219713.

3, Mold of dorsal exterior, X2.0. USNM 219714.

Figures 4-8. *Athyridacid* sp. A

Jack Valley Member, Laketown Dolomite, Confusion Range, Utah, fig. 4, USNM loc. 19055; figs. 5-8, USNM loc. 19056.

4, Dorsal exterior, X2.0. USNM 219715.

5-7, Dorsal, ventral, lateral exterior, X2.0. USNM 219716.

8, Dorsal exterior, X2.5. USNM 219717.

Figures 9-15. *Cyrtia* sp. A

High Lake Member, Laketown Dolomite, Barn Hills, Utah, figs. 9-14. USNM loc. 19544; fig. 15, USNM loc. 19543.

9, Dorsal interior, X3.0. USNM 219718.

10-11, Ventral posterior, interior, X3.2. USNM 219719.

12-14, Ventral interior, posterior, exterior, X3.2. USNM 219720.

15, Ventral interior, X2.5. USNM 219721.

Figures 16-18. *Cyrtia* spp.

High Lake or Gettel Member, Laketown Dolomite, southern Egan Range, Nevada, figs. 16-17, USNM loc. 19198. Portage Canyon Member, Laketown Dolomite, Four Mile Canyon, Utah, fig. 18, USNM loc. 19070.

16-17, Ventral interior, exterior, X3.0. USNM 219722.

18, Ventral posterior, X2.5. USNM 219723.

Figures 19-23. *Hedeina?* sp.

Jack Valley Member, Laketown Dolomite, southern Egan Range, Nevada, figs. 19, 20, USNM loc. 19209; figs. 21-23, USNM loc. 19206.

19,20, Dorsal anterior, posterior, X3.0. USNM 219724.

21-23, Posterior, dorsal, ventral exterior, X2.5. USNM 219725.

Figures 24-28. *Howellella* sp.

Portage Canyon Member, Laketown Dolomite, Sheep Rock Mountains, Utah, figs. 24-27, USNM loc. 19576. Pancake Range, Nevada, *Howellella?* sp., fig. 28, USNM loc. 19486.

24, Ventral interior, to show common preservation of dental plates, X3.0. USNM 219752.

25,26, Ventral interior, exterior, X3.0. USNM 219726.

27, Ventral exterior, X3.0. USNM 219727.

28, Dorsal exterior, X3.0. USNM 219728.

Figures 29-31. *Spirinella pauciplicata* (Waite, 1956)

Jack Valley Member, Laketown Dolomite, Tony Grove Lake, Utah, figs. 29, 30, USNM loc. 19324. Confusion Range, Utah, fig. 31, USNM loc. 19059.

29,30, Ventral, dorsal exterior, X3.0. USNM 219729.

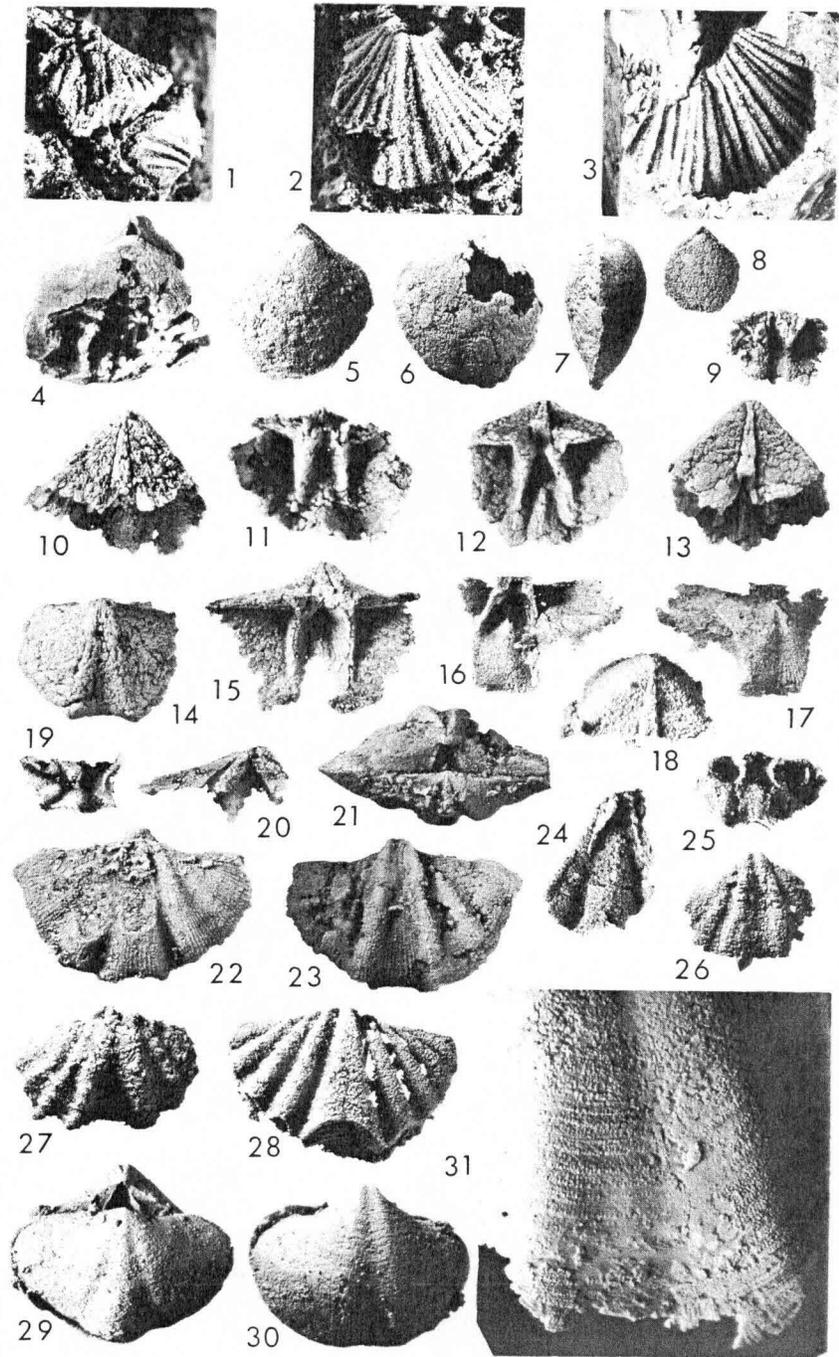


PLATE 12

Figures 1-14. *Spirinella pauciplicata* (Waite, 1956)

Jack Valley Member, Laketown Dolomite, Confusion Range, Utah, figs. 1-3, USNM loc. 19050; figs. 4-6, 9, 11, USNM loc. 19059; figs. 7, 8, 10, 11-14, USNM loc. 19058.

1-3, Ventral, dorsal, posterior exterior, X2.5. USNM 219731.

4, Ventral exterior, X2.5. USNM 219732.

5, Dorsal exterior, X2.5. USNM 219733.

6, Ventral interior, X3.2. USNM 219734.

7, Dorsal exterior, X2.5. USNM 219735.

8, Interior of articulated valves, X2.5. USNM 219736.

9, Ventral interior, X4.0. USNM 219737.

10, Dorsal interior, X2.5. USNM 219738.

11, Dorsal interior, X3.0. USNM 219739.

12, Dorsal interior, X3.0. USNM 219740.

13,14, Dorsal, ventral exterior, X3.0. USNM 219741.

Figures 15-18. *Spirinella pauciplicata* (Waite, 1956) *eganensis* n. subsp.

Jack Valley Member, Laketown Dolomite, southern Egan Range, Nevada, figs. 15, 18, USNM loc. 19206; figs. 16, 17, USNM loc. 19190.

15,18, Ventral interior, exterior, X3.0. USNM 219742.

16,17, Ventral, dorsal exterior, Holotype, X3.0. USNM 219743.

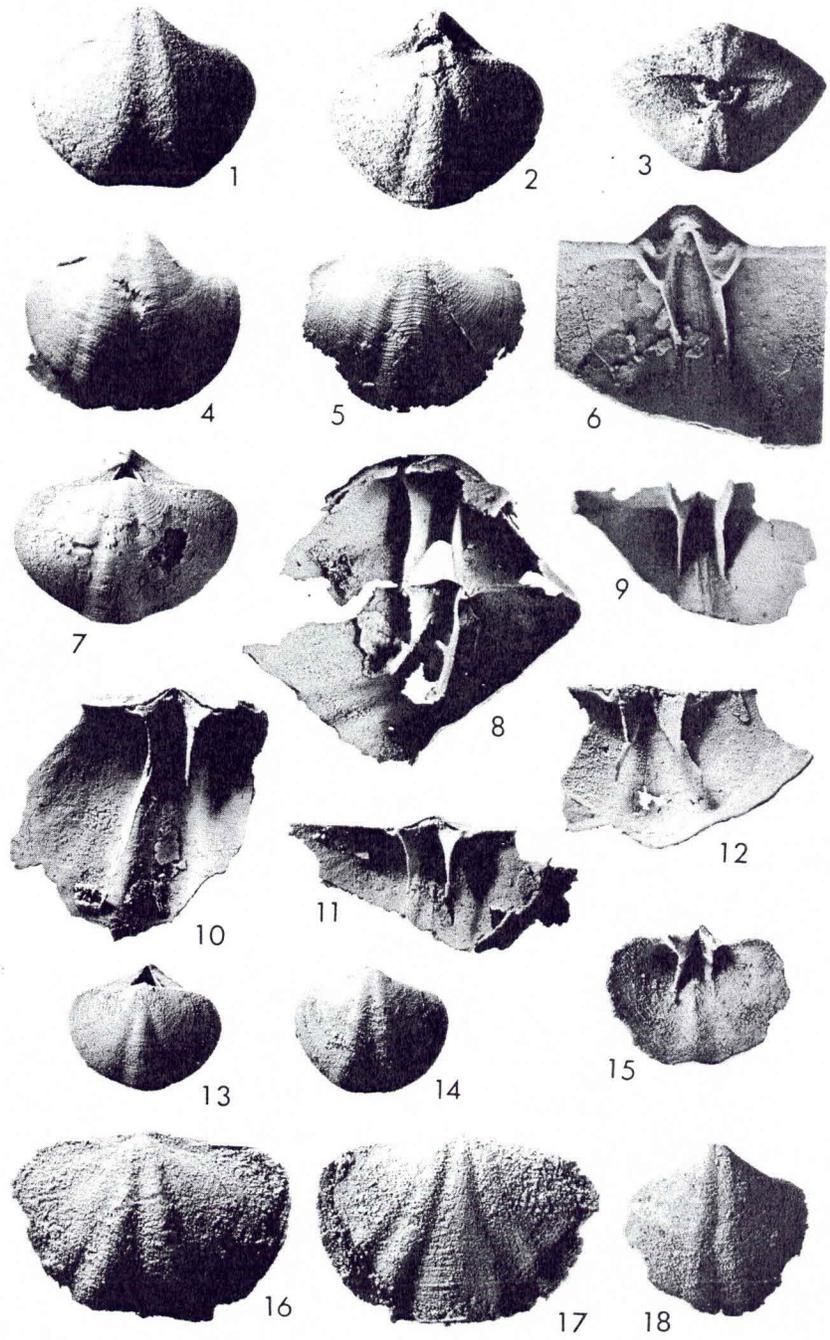


PLATE 13

Figures 1-13. *Atrypina erugata* Amsden, 1968

Jack Valley Member, Laketown Dolomite, southern Egan Range, Nevada, fig. 1, 4-13,
USNM loc. 19206; figs. 2, 3, USNM loc. 19209.

1, Dorsal exterior, X5.0. USNM 219744.

2,3, Ventral, dorsal exterior, X5.0. USNM 219745.

4-6, Ventral, dorsal, posterior exterior, X5.0. USNM 219746.

7, Dorsal interior, X5.0. USNM 219747.

8,9, Ventral, dorsal exterior, X5.0. USNM 219748.

10, Ventral exterior, X5.0. USNM 219749.

11,12, Ventral, dorsal exterior, X5.0. USNM 219750.

13, Dorsal exterior, X5.0. USNM 219751.



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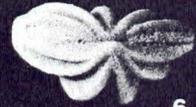
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