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The Late Ordovician and Silurian of The Eastern Great Basin, Part 3. Brachiopods of the Tony Grove Lake Member of the Laketown Dolomite

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Abstract: The Tony Grove Lake Member of the Laketown Dolomite in eastern Nevada and western Utah contains two distinct brachiopod assemblages which are described in this contribution. Both assemblages are dominated by pentamerid brachiopods and have low diversity as is characteristic of Silurian shallow-water communities in Benthic Assemblages 2-3. The stratigraphically lower assemblage is dominated by the new species *Virgiana utahensis*. Associated brachiopods are both small and scarce. The lower assemblage is late Early or Middle Llandovery in age. The stratigraphically higher assemblage is dominated by *Pentamerus* sp., and associated brachiopods are also small and scarce. The upper assemblage is Late Llandovery in age. Since the top of the Tony Grove Lake Member has the *Virgiana* assemblage in some sections and the *Pentamerus* assemblage in other sections, the top of the Tony Grove Lake Member is demonstrably diachronous.

INTRODUCTION

The Tony Grove Lake Member of the Laketown Dolomite was named by Budge and Sheehan (1979a). The member is the basal unit of the Laketown and is the formation's most widely distributed member. The location of sections, detailed descriptions of lithology, and location of fossil collections are given in Budge and Sheehan (1979b).

Two distinct brachiopod assemblages are found in the member. The assemblages are dominated by pentamerids with associated species both small and scarce. The lower assemblage, dominated by a new species of *Virgiana*, is present in all sections and may range into the overlying High Lake Member in the Hyrum Dry Canyon section. The second assemblage is dominated by *Pentamerus* sp. It is found in the upper part of the Tony Grove Lake Member in the Tony Grove Lake, Spors Mountain, and Barn Hills sections, and commonly extends into the overlying High Lake Member.

The *Virgiana* fauna underlies the *Pentamerus* fauna and the two genera have not been found together. Early reports suggested the two genera might occur together at Big Limestone Mountain, northern Michigan (see Berry and Boucot, 1970), but recent field work by the author revealed that the two genera occur there at separate levels. *Virgiana* is confined to the Late Early through Middle Llandovery, and *Pentamerus* first appeared at the base of the Upper Llandovery (Berry and Boucot, 1970). The presence of *Virgiana* at the top of the Tony Grove Lake member in most sections, but *Pentamerus* at the top in some other sections, establishes that the top of the Tony Grove Lake Member is diachronous.

Lithologic and faunal evidence (Budge and Sheehan, 1979a) indicate the depositional environment was shallow. Both the *Virgiana* and *Pentamerus* Communities lived in shallow water (Ziegler and Boucot, in Berry and Boucot, 1970; Boucot, 1975). Laterally, associated biotas are dominated by shallow water coral assemblages and intertidal stromatolitic algae.

Virgiana occurs in coquina beds, and the new species commonly occurs in great abundance at numerous horizons through the member. This contrasts with occurences of *Virgiana* in some areas of the mid-west where it is confined to one or a few horizons (e.g. the Mayville Dolomite of Wisconsin).

Illustrated specimens will be placed in the U.S. National Museum, (designated with 5 digit USNM catalogue numbers) with the exception of the specimen figured on Plate 2, figs. 1-4 which is from the University of California Museum of Paleontology. In the following section the number of shells recovered at each horizon are given in parenthesis after the locality number.

Systematic Paleontology

Phylum BRACHIOPODA
Order ORTHIDA
Superfamily ORTHACEA Woodward
Family PLECTORTHIDAE Schuchert & Cooper
Subfamily PLATYSTROPHIINAE Schuchert & LeVene
Genus PLATYSTROPHIA King
Platystrophia sp.
Pl. 1, figs. 1-3

Exterior: The shells are transverse, with a narrow, very high, well defined fold which has three costae. The ventral sulcus is narrow, deep and has two costae. The front of the sulcus is linguiform. The costae are high and angular. The individual from USNM loc. 19172 has 7 costae on the ventral flanks, whereas the one from USNM loc. 19515 has only four.

Occurrence: Southern Egan Range, Nevada—USNM loc. 19172 (1). Age: Late Early or Middle Llandovery.

Identified as *Platystrophia* sp.?. High Lake Member of the laketown

Dolomite. Delamar Range, Nevada—USNM loc. 19515 (1), 19523 (1). Age: probably Late Llandovery, possibly Wenlock.

Superfamily DALMANELLACEA Schuchert
Family DALMANELLIDAE Schuchert
DALMANELLID sp.
Pl. 1, figs. 4-5

Description: The valves are ventri-biconvex. The hinge line is wide. The surface is costellate, and there is a weak dorsal sulcus. The shells are about 4 mm long and 3 mm wide.

The dental plates are large and sub-parallel. The muscle field is impressed posteriorly. There is a very low adductor muscle platform.

The stout brachipohores are anteriorly divergent. The cardinal process is small, and there is a low median ridge in the posterior third of the valve.

Occurrence: Lakeside Mountains, Utah—USNM loc. 19042 (8). Age: Late Early or Middle Llandovery.

Order PENTAMERIDA
Superfamily PENTAMERACEA M'Coy
Subfamily VIRGIANINAE Boucot & Amsden
Genus VIRGIANA Twenhofel
***Virgiana utahensis* n. sp.**
Pl. 1, figs. 15-17, pl. 2, figs. 1-10

Virgiana cf. *decussatus* (Whiteaves). Boucot, Johnson, & Rubel, 1971, pl. 2, figs. 1-9, pl. 3, fig. 14.

Variation: This group of shells has considerable variation in many of the characters from collection to collection and equally among individuals in the same collection. Few consistent differences could be recognized among localities.

Exterior: The lateral profile is ventri-biconvex. All ventral valves are arched, and in adult shells the greatest curvature occurs in the posterior third of the valve. Most dorsal valves are gently convex, rarely strongly so, though none approaches the convexity of the ventral valve. The ventral beak is strongly incurved and touches the apex of the dorsal valve.

Many ventral valves have a shallow, poorly defined, apical sulcus, though this is not present on all specimens; the individual from UCMP loc. A-9342 has a very slight apical fold. The shallow sulcus extends at least 20 mm forward on a few individuals from USNM loc. 19064. Many specimens have a broad, very low, flat-topped fold at the back of the dorsal valve. However, the specimen from UCMP A-9342 (pl. 2, figs. 1-4) has a very shallow sulcus in front of the fold; an anterior sulcus is also present on one valve from USNM loc. 19064. In one valve from USNM loc. 19172 the fold, though low, is rather well defined and extends forward nearly 30 mm, to the point where the shell is broken.

The individuals from USNM locs. 19510, 19511, and 19512, differ from the others in having a distinct, narrow ventral sulcus, and a more or less prominent dorsal fold, which has a greater width than the sulcus. Because the dorsal plate structure resembles that of the other collections, these specimens are retained in *V. utahensis*. Although preservation is too poor to be certain, the ventral sulcus does not seem to be present on individuals from USNM loc. 19513, which stratigraphically overlies the previous three localities by about 160 feet in the same section.

The shell width is about 3/4 of the length. Maximum width occurs about 2/3 of the distance to the anterior margin.

The external ornament is costate, with new costae originating by bifurcation. Newly bifurcated costae are fine and during growth gradually increased in strength toward the front, so that at any position on the valve adjacent costae are of many different sizes. The posterolateral sides of the ventral valves are smooth. The strength of costae, both in terms of height and width, is variable. On some valves, the largest costae are 2 mm in diameter; whereas in other they are about 1 mm in diameter. Some localities seem to have more coarsely costate shells than do other localities, but I could discern no consistent geographic or stratigraphic pattern. Many localities have individuals which exhibit both extremes.

USNM loc. 19171 and 19172 have some individuals with markedly reduced radical ornament, especially on the sides and in front where it is nearly imperceptible. Specimens range from strongly to very weakly costate.

Concentric ornament is generally lacking with the exception of some individuals from USNM locs. 19171 and 19172, again, where most valves have prominent growth lines, especially on the front of the valves. One valve from USNM loc. 19303, identified as ?*Virgiana utahensis*, also has prominent growth lines.

Most individuals are 30 to 40 mm in length. The largest valve, from USNM loc. 19172, was at least 60 mm in length, before it was broken.

Some valves have marked asymmetry which was due to growth in space confined by other shells.

Ventral Interior: The ventral valve is very thick, especially in the posterior third. An interarea is not present, but the palintrope is strongly incurved to accommodate the apex of the dorsal valve which touches it. Though the spondylium is robust, few specimens are present which have it completely preserved. In large shells the length of the spondylium is about 1/4 of the valve length. The sides of the spondylium join at an agle of

45° to 60°. A long median septum supports the spondylium for most of its length. In large valves the spondylium appears to be unsupported at its front. The base of the median septum extends to about midlength. The anterior edge of the median septum is concave.

Dorsal Interior: There are strong plane areas with a length of 5 mm or more in large valves. The lateral margins of the plane areas have an angular junction with the sides of the valve; on many specimens there is a dorsally directed flange along this line of join. When the valves are in articulation the entire plane area is covered by the ventral valve. The flange on the margins served as a seal between the valves. Faint to well developed tooth ridges are commonly present at the junctions of the plane area and the inner plates. Brachial process bases range in strength from very weak to very strong.

The inner plates are gently to strongly inclined. In relatively large valves, the outer plates attain a length of 10 to 15 mm. The outer plates are nearly vertical and are parallel or slightly divergent anteriorly; they are well separated at the posterior of the shell. They usually extend farther anteriorly than the inner plates, but this may be an artifact of preservation. The best preserved specimen, which has inner plates 10 mm long, has unsupported brachial processes which extend forward 5 mm from the brachial process bases. The brachial processes are sub-parallel to the floor of the brachial valve. The poor preservation does not allow the presence of a cardinal process to be precluded, though none was seen.

Discussion: When present, the species commonly occurs in great abundance, often forming shell coquinas. *Virgiana* lived in rough water environments, and the collections are very strongly biased toward ventral valves, because of their relative robustness. Ventral valves are thickened, especially in the beak by secondary shell deposition. The dorsal valves are thinner and more fragile.

Comparison: Most species of *Virgiana* have very short outer plates, but *Virgiana utahensis* is characterized by long plates, which attain a length of 10 to 15 mm. By comparison, outer plates are less than 3.3 mm long in *V. barrandei* figured by Amsden (1965, fig. 409, 4b-d, see text p. 547 for measurements); they are 6 mm in length on a 3 cm long dorsal valve of *V. decussatum* figured by Kindle (1915, p. 3, fig. 3). Specimens of *V. mayvillensis* in the Milwaukee Public Museum from Mayville Quarry, Wisconsin, have outer plates that attain a maximum length of about 6 mm (individuals to 49 mm long). The prominent beak in *V. mayvillensis* extends farther posteriorly than in *V. utahensis.*

Virgiana norfordi Boucot and Chiang (1974) also has long outer plates. It can be distinguished from *V. utahensis* by much weaker costae which are absent posteriorly.

The spondylium in *V. utahensis* is longer than that described in other species, and the median septum extends as far forward as midlength, which is uncommon for other species of the genus (see Amsden, 1965, fig. 407, 2a, and Kindle, 1915, pl. 2, figs. 3-6 and pl. 3, fig. 4).

Because the strength of the external ornament of *V. utahensis* is highly variable, comparison of this feature with other species is difficult. The ribbing of some specimens of both *V. decussatum* and *V. mayvillensis* is similar to that found in this species. Stearn (1956, p. 95) suggested that *V. mayvillensis* may be conspecific with *V. decussatum*. However, Boucot and Chiang (1974, p. 66) imply that *V. decussatum* has much finer costae than *V. mayvillensis*. In addition *V. mayvillensis* has a more prominent, erect beak that extends posteriorly more than in *V. decussatum*.

The reduced external ornament on some individuals from USNM loc. 19172 is similar to that found on some specimens of *V. barrandei* (see Bolton, 1972, pl. 7, figs. 15, 16 19, 20) and *V. barrandei* var. *anticostiensis* (Twenhofel, 1928, pl. 19, figs. 1-3) from Anticosti island *V. decussatum* from Manitoba (see Kindle, 1915, p. 16, pl. 3, fig. 6), and *V. norfordi* from British Columbia (Boucot and Chiang, 1974).

Virgiana? sinanensis Wang (1974, pl. 94, figs. 5, 6, 10) is more coarsely plicate and has a more convex dorsal valve than *V. utahensis*.

Virgiana? fenggangensis Wang (1974, pl. 92, figs. 15-18) is a small species that is apparently characterized by a strong, wide ventral fold that is flat topped and has steep margins (Wang, 1974, pl. 92, fig. 16).

The variation described in the ventral fold and sulcus of *V. utahensis* is similar to that found by Kindle (1915, p. 16, pl. 2) in *V. decussatum* from Manitoba. Most ventral valves have a depressed venter apically. In some individuals from USNM 19064 this extends well forward; these individuals resemble Kindle's var. C (1915, p. 16). The individual from UCMP A-9342 has a faint fold on the ventral valve and is similar to Kindle's var. A in this respect. However, most individuals have the venter faintly depreseed apically, resembling the intermediate var. B. of Kindle.

Holotype: The holotype is a specimen figured by Boucot *et al.* (1971, pl. 2, fig. 7) from USNM loc. 12886 in the Tony Grove Lake Member, southern Egan Range, near Sunnyside, Nevada.

Occurrence: Tony Grove Lake Member, Laketown Dolomite. Tony Grove Lake, Utah—USNM locs. 19078 (1), 19305 (10). Lakeside Mountains, Utah—USNM LOC. 19042 (204). Ibex Hills, Utah—USNM loc. 19064 (84). Southern Egan Range, Nevada—USNM locs. 19170 (5), 19171 (32), 19172 (125). Cherry Creek Range, Nevada—USNM loc. 19265 (38). Delamar Range, Nevada—USNM locs. 19510 (27), 19511 (75), 19512 (28), 19513 (138). Bald Mountain, Nevada—USNM loc. 19525 (22). Blacksmith Fork Canyon, Utah—UCMP loc. 9342 (1).

?High Lake Member, Laketown Dolomite. Hyrum Dry Canyon, Utah—USNM Loc. 19072 (664).

Age: Late Early to Middle Llandovery.

Identified as *Virgiana utahensis?*. Tony Grove Lake, Utah—USNM locs. 19303 (2), 19307 (8). Eureka, Utah—USNM loc. 19574 (2). Southern Egan Range, Nevada—USNM loc. 19169 (1). Delamar Range, Nevada—USNM loc. 19518 (100). Pancake Range, Nevada—USNM locs. 19213 (4), 19483 (7). Bald Mountain, Nevada—USNM loc. 19526 (13). Mahogany Hills, Nevada—USNM Loc. 19528 (4).

Identified as Pentameracea, possibly *Virgiana utahensis*. Tony Grove Lake Member. Tony Grove Lake, Utah—USNM locs. 19301 (2), 19304 (2). Southern Egan Range, Nevada—USNM locs. 19163 (1), 19164 (4), 19174 (49), 19176 (6). Cherry Creek Range, Nevada—USNM locs. 19262 (2), 19264 (1). Delamar Range, Nevada—USNM loc. 19507 (13).

Subfamily PENTAMERINAE M'Coy 1894
Genus *Pentamerus* M'Coy, 1894
Pentamerus sp.

Pl. 3, figs. 1-7, figs. 1-4

Apopentamerus? sp. Boucot & Johnson, 1979, p. 105.

Exterior: The valves are ventri-biconvex. The erect ventral beak is incurved with the greatest convexity in the posterior third of the valve in large shells. The beak of the dorsal valve extends slightly into the deltyhrium, at a point well in front of the apex of the delthyrium. That portion of the delthyrium behind the dorsal valve is filled by a thin, concave pseudodeltidium which often is not preserved. The margins of the delthyrium are very angular and usually have slight, medially directed flanges. Similar structures illustrated by Gauri and Boucot (1970, p. 90-91, text fig. 30) are composed of the hinge teeth and extensions of the lamellar layer of the plane area. The dorsal plane area, which is covered by the ventral valve, is gently concave and conforms to the gently convex sides of the ventral valve which lie lateral to the delthyrium. The lateral margins of the dorsal plane area are marked by ventrally directed flanges. The flanges must have touched or nearly touched the ventral valve, and together with the pseudodeltidium, served to seal off the interior of the valves from the outside.

The front of the ventral valve is distinctly trilobate in cross section. The lobation is formed by one median and two lateral convex undulations of the shell which begin 10 to 20 mm from the beak. Commonly these undulations are rather low, but in all large valves they are distinct. This lobation cannot be seen well in short valves (either young valves or valves which do not have their anterior preserved). The surface lacks radial ornament but has strong, widely spaced growth lines.

Most shells are broken and only the beaks are preserved. The largest shells approach 5 cm in length, but even these shells are broken.

In most collections some of the individuals are distinctly asymmetrical with various protrusions and indentations. In some valves the ventral median septum and spondylium are also deflected to one side or the other. These irregularities were most likely produced by growth in confined space (Ziegler, Boucot, and Sheldon, 1966, p. 1032-33).

Ventral Interior: The long spondylium is prominent. Laterally, the sides of the spondylium are gently convex. Near the midline, however, the strength of curvature of the sides increases abruptly, and the sides are closely spaced, sub-parallel, and nearly perpendicular to the floor of the valve. Where the lateral walls meet, at the base of the spondylium, they are curved abruptly toward each other. Thus the floor of the spondylium is flat or gently concave and very narrow. The spondylium is supported along most or all of its length by a median septum. The apical portions of the valve are greatly thickened in larger valves, as is the median septum.

In many silicified valves the outer parts of the valves are not preserved and there is often an indentation of the exterior surface of the valve along the midline. In these specimens the inner prismatic layer may have been more easily silicified than the outer lamellar layer and the lamellar layer that lies in the middle of the septum. Differential silicification of the prismatic layer would result in a specimen with a median indentation.

Dorsal Interior: As previously described, the plane areas of the dorsal valve are flat to gently concave. Medially, the plane areas bound the hinge grooves. (Boucot and Johnson, 1971). Faint dorsal hinge processes (Jaanusson, 1971) define the boundary between the margins of the hinge grooves and the brachial lamellae. In cross section the brachial lamellae are gently curved near the dorsal hinge processes, but the curvature increases distally where they lie nearly perpendicular to the floor of the valve. In cross section the ventral parts of the brachial lamellae (inner plates) are gently curved toward the dorsal hinge processes, but distally the curvature increases and the outer plates are closely spaced, nearly parallel, and perpendicular to the floor of the valve. Near the floor of the valve they are curved away from each other rather sharply, and, at the point of curvature, there is a faint medial carinae (Gauri and Boucot, 1970, fig. 7, and illustrated but not labeled on fig. 8). Distally from the carinae the outer plates are flat and lie nearly perpendicular to the floor of the valve. The outer plates are long and sub-parallel anteriorly. Commonly there is a low myophragm on the floor of the valve between the outer plates. The dorsal valves are not thickened by secondary shell deposition.

Variation: Several individuals from USNM loc. 19537 are characterized by unusually deep and narrow ventral valves which have a high, narrow ventral fold. They are trilobate. USNM loc. 19537 is overlain stratigraphically by USNM loc. 19538 from which typical members of *Pentamerus* sp. have been obtained.

Comparison: Boucot and Johnson (1979) tentatively included this species in *Apopentamerus*, because of the prominent ventral beak and umbo. However, *Apopentamerus* lacks trilobation, which is well developed in this species and which characterizes *Pentamerus*. A prominent beak and thickened ventral septum also characterizes *Harpidium (Isovella)*, but again this genus lacks trilobation, although Boucot and Johnson (1979 p. 110) qualify this somewhat. The smooth, trilobate exterior requires placement of the species in *Pentamerus*. The unusually promenent beak makes this species a possible ancestor of *Apopentamerus* and *Harpidium (Isovella)*. This raises the possibility that these genera were derived directly from *Pentamerus* rather than from an unspecified virgianinid ancestor as suggested by Boucot and Johnson (1979, Text Fig. 1).

This species differs from the European *Pentamerus oblongus* Sowerby in having a more prominent beak and a thickened ventral valve (see St. Joseph, 1938, p. 280).

This species resembles the American species commonly referred to as *P. oblongus* but again this species has a more prominent ventral beak.

The small, possibly juvenile, *P. divergens* (Foerste, 1909, p. 28-29, pl. 1, fig. 5A; pl. 2, figs. 17 A-B) differs from this species in having a ventral median ridge that extends nearly to the anterior margin. The relatively large spondylium indicates that *P. divergens* may be a young shell because young pentameraceans tend to have relatively larger spondyliums than the adults.

Discussion: The large predominence of ventral over dorsal valves can best be explained as a proportionally larger number of dorsal valves having been broken prior to deposition. The ventral valves are usually thickened by secondary shell deposition whereas the dorsal valves have little secondary shell deposition. The secondary shell probably strengthens the ventral valve and is at least in part responsible for the larger number of ventral valves collected.

Shells identified as *Pentamerus* sp. minimally exhibit a trilobate ventral valve, disjunct, sub-parallel outer plates, and the typical cross section of the spondylium. Shells identified below as *Pentamerus*? sp. exhibit the latter two characters cited above, but a trilobate shape was not visible, due to poor preservation.

Occurrence: Tony Grove Lake Member of Laketown Dolomite. Tony Grove Lake, Utah—USNM loc. 19309 (30). Spors Mountain, Utah—

USNM loc. 19570 (214), talus at 19570 (61). Barn Hills, Utah—USNM loc. 19537 (19), 19538 (17).

High Lake Member of Laketown Dolomite. Laketown Canyon (Type Section), Utah—USNM loc. 19079 (38). Tony Grove Lake, Utah—USNM loc. 19314 (9). Hyrym Dry Canyon, Utah—USNM loc. 19073 (24). Deep Creek Range, Utah—USNM loc. 19277 (267). Age: Late Llandovery.

Member C of Poole (1965) unnamed Silurian formation, Ranger Mountains, Nevada—USNM loc. 19419 (112). Age: Late Llandovery.

Identified as *Pentamerus*? sp. Tony Grove Lake Member, Laketown Dolomite. Tony Grove Lake, Utah—USNM locs. 19308 (12), 19310 (5). Ibex Hills, Utah—USNM loc. 19538 + 10′ (22). High Lake Member, Laketown Dolomite. Tony Grove Lake, Utah—USNM locs. 19312 (6), 19313 (2), 19315 (12). Four Mile Canyon, Utah—USNM Loc. 19069 (9). Delamar Range, Nevada—USNM locs. 19516 (27), 19517 (40).

Order RHYNCHONELLIDA
RHYNCHONELLID sp. A
Pl. 1, figs. 6-10.

Exterior: The lateral profile is biconvex with the dorsal valve somewhat more strongly convex than the ventral. The oval outline is transverse, and the margins are evenly rounded. Maximum width is in front of midlength. The shells occur in tightly packed groupings and the surfaces of many valves are irregular, probably as a result of confined growth in space which was limited by other shells. The costae and interspaces are rounded in cross section. The dorsal fold and ventral sulcus most commonly have five costae, and each flank has seven costae. The high, well-defined fold originates about 3 mm from the beak. Commonly the fold is flat-topped with three costae on the summit and one costa on each side of the fold. The sulcus, which originates about 3 mm from the beak, is of moderate strength and is not as well defined as the fold. The largest valve is about 10 mm long and 11 mm wide; most are smaller.

Interior: Short dental plates are present in a cross section of one valve. The dorsal interior was not observed.

Comparison: The absence of preserved internal structures precludes even generic identification.

"Camarotoechia" winiskensis Whiteaves (see Ehlers & Kesling, 1957, pl. 6, figs. 23-26; Stearn, 1956, pl. 11, fig. 7) is less coarsely costate and has a stronger, better defined fold and sulcus than this species. However, Stearn noted that *"C". winiskensis* of Whiteaves (1906) is more coarsely costate than his specimens. Bolton and Copeland (1972) assigned both finely costate (pl. 1, figs. 16, 19, 20, 22, 25, 26, 28) and coarsely costate (pl. 1, figs. 21, 23, 24, 28) specimens to *"C". winiskensis.*

This species closely resembles specimens from the Fisher Brach Dolomite of Manitoba which Stearn (1956, p. 104, pl. 11, fig. 2) assigned to Hall's Waldron species *"Camarotoechia" indianensis.* Stearns noted that the Fisher Branch specimens were finer ribbed than typical *"C". indianensis* and might be a distinct subspecies. I believe it is a separate species, possibly identical to the species described herein.

Occurrence: Cherry Creek Range, Nevada—USNM loc. 19268 (several hundred specimens). Age: Middle or Late Llandovery.

RHYNCHONELLID sp. B
Pl. 1, figs. 11-14

Description: The ventral valve is strongly convex; the dorsal valve is gently convex. There are three, low, rounded costae in the shallow sulcus and 4 or 5 stronger costae on the flanks. Internally the teeth are supported by poorly preserved dental plates. The largest individual measures 5 by 5 mm. The dorsal interiors were not seen.

Occurrence: Lakeside Mountains, Utah—USNM loc. 19042 (7). Age: Late Early to Middle Llandovery.,

Order SPIRIFERIDA
Superfamily ATRYPACEA Gill
Family ATRYPIDAE Gill
Subfamily ATRYPINAE Gill
Genus PLECTATRYPA Schuchert & Cooper
***Plectatrypa* sp.**
Pl. 4, figs. 5-6

The outline is sub-circular. The high, narrow fold has three costae. The sulcus is well defined by strong costellae; the costellae on the flanks are weaker. Growth lines are strong and lamellose. The largest shell is 13 mm long and 13 mm wide.

Occurrence: Southern Egan Range, Nevada—USNM loc. 19171 (3). Age: Late Early to Middle Llandovery.

High Lake Member, Laketown Dolomite. Delamar Range, Nevada—USNM Loc. 19515 (1). Age: Middle, possibly Late Llandovery.

Atrypid sp.
Pl. 4, figs. 11-15.

Exterior: The plano-convex to dorsi-biconvex valves are slightly elongate or of equal length and width. The hinge line is short, and the margins of the valve are rounded. The costae and interspaces are rounded in cross section. The ventral valve is naviculate with 2 large, medial costae; the flanks have three weaker costae. In some of the larger valves one or both of the two prominent medial costae bifurcate anteriorly. The dorsal valve bears a median costae in a broad, poorly defined sulcus; each flank has 3 costae.

Ventral interior: The teeth are located on the margins of the valve and are supported by short dental plates. There is no raised muscle field on the floor of the valves.

Dorsal Interior: The socket ridges are small and divergent. A short, low median ridge is confined to the apex of the valve.

Discussion: The individual from USNM loc. 19264 has a flatter dorsal valve than is common for individuals from USNM loc. 19042. This species resembles *Alispira gracilis* Nikiforova (in Nikiforova and Andreeva, 1961) especially specimens assigned to the species by Lopushinskaya (1976, pl. 11, figs. 1-2). Unfortunately, poor preservation does not allow a confident assignment.

The naviculate ventral valve, with two strong medial costae, is suggestive of Silurian species of *Coelospira* (see Boucot and Johnson, 1967, p. 1228). The shells are too poorly preserved to determine whether the characteristic small median costa of *Coelospira* is present. This species can be distinguished from the species of *Coelspira* by the absence of a ventral muscle platform.

This species differs from *Zygatrypa paupera* (Twenhofel) in having fewer lateral costae and strong medial costae (see Boucot and Johnson, 1967, pl. 166, figs. 22-37; Cooper, 1977, pl. 37, figs. 21-29).

Occurence: Lakeside Mountains Utah—USNM loc. 19042 (106). Cherry Creek Range, Nevada—USNM loc. 19264 (1). Age: Late Early to Middle Llandovery.

Superfamily ATHYRIDACEA M'Coy
Family MERISTELLIDAE Waagen
Subfamily HYATTIDININAE Sheehan
***Hyattidina?* sp.**
Pl. 4, figs. 7-10

Exterior: The smooth shells are subequally biconvex. There is an angular ventral sulcus and a narrow dorsal fold, flanked by shallow sinuses. Maximum shell width is in front of midlength. The outline is rounded in front with an angular beak. The largest valve is 5 mm long and 6 mm wide.

The lack of interiors precludes confident identification, but there is a marked resemblance to the larger *Hyattidina congesta junea* (Billings) as illustrated by Twenhofel (1928, pl. 30, figs. 4-6).

Occurrence: Lakeside Mountains, Utah—USNM loc. 19042 (3). Age: Late Upper to Middle Llandovery.

Indeterminate Specimens

The following brachiopods were recovered from the Tony Grove Lake Member, but because of poor preservation identification was not possible. They are included here to document the diversity of the *Virgiana* Community.

Coarse ribbed orthid: Southern Egan Range, Nevada, USNM loc. 19172 (1); Delamar Range, Nevada USNM loc. 19510 (2).

Fine ribbed orthid: Tony Grove Lake, Utah, USNM loc. 19308 (2); Cherry Creek Range Nevada, USNM loc. 19268 (2); Spors Mountain, Utah, USNM lco. 19570T (3).

Rhynchonellid: Southern Egan Range, Nevada, USNM loc. 19172 (1).

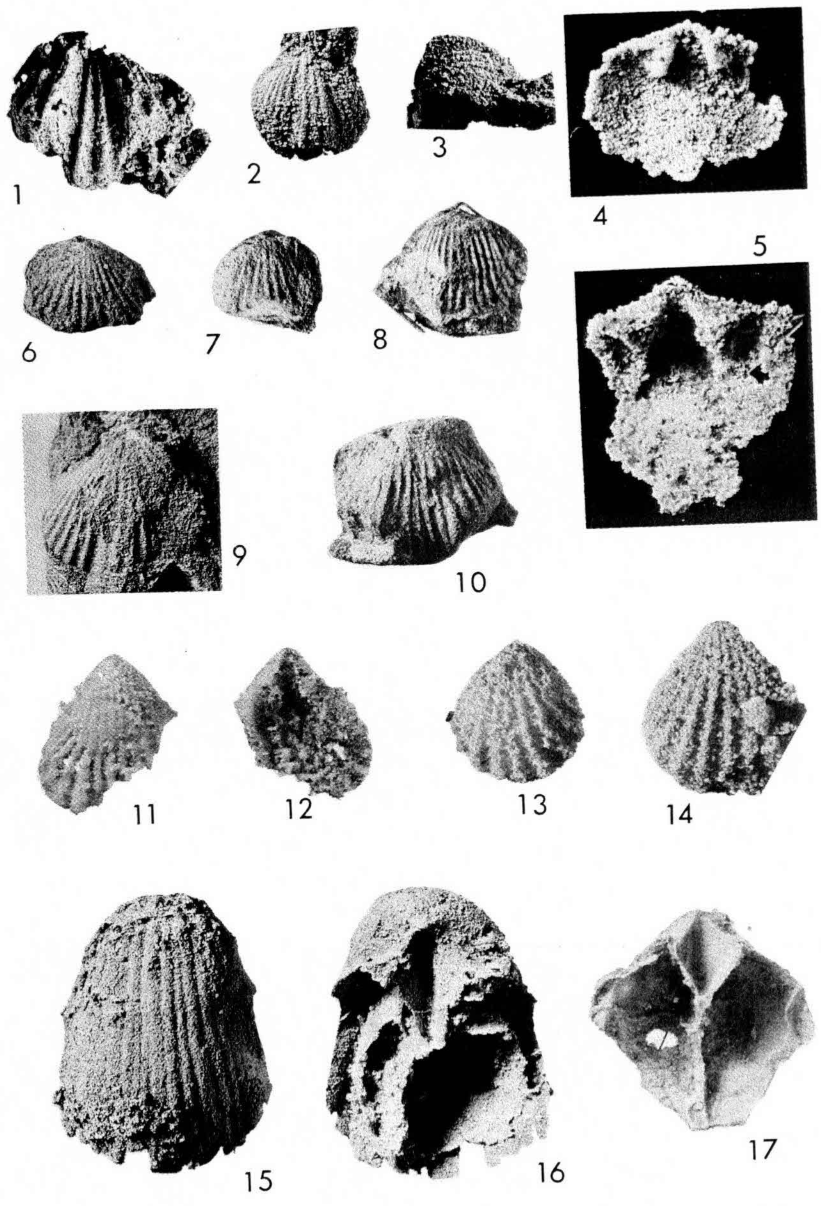
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Plate 1

Figs. 1-3. *Platystrophia* sp.

1, USNM loc. 19515, High Lake Member, Laketown Dolomite, Delamar Mountains, Nevada, *2-3,* USNM loc. 19172, Tony Grove Lake Member, Laketown Dolomite, southern Egan Range, Nevada.

1, ventral exterior, X1.5, questionably assigned to this species. USNM 219524

2-3, dorsal exterior and lateral view, X1.5. USNM 219525

Figs. 4-5. Dalmanellid sp.

USNM loc. 19042, Tony Grove Lake Member, Laketown Dolomite, Lakeside Mountains, Utah.

4, dorsal interior, X5.0. USNM 219526.

5, ventral interior, X5.0. USNM 219527.

Figs. 6-10. Rhynchonellid sp. A

USNM loc. 19268, Tony Grove Lake Member, Laketown Dolomite, Cherry Creek Mountains, Nevada.

6, ventral exterior, X2.5. USNM 219528.

7, dorsal exterior, X2.5. USNM 219529.

8, dorsal exterior, X1.8. USNM 219530.

9, dorsal exterior, X2.0. USNM 219531.

10, ventral exterior, X1.8. USNM 219532.

Figs. 11-14. Rhynchonellid sp. B

USNM loc. 19042, Tony Grove Lake Member, Laketown Dolomite, Lakeside Mountains, Utah.

11-12, ventral exterior, interior, X3.0. USNM 219533

13, dorsal exterior, X3.0 USNM 219534

14, ventral exterior, X3.0. USNM 219535

Figs. 15-17. *Virgiana utahensis* n. sp.

15-16, USNM 19042, Tony Grove Lake Member, Laketown Dolomite, Lakeside Mountains, Utah.

17, USNM 19072 High Lake Member, Laketown Dolomite, Hyrum Canyon, Utah.

15-16, ventral exterior, interior, X1.0. USNM 219536

17, ventral interior, X1.5. USNM 219537.

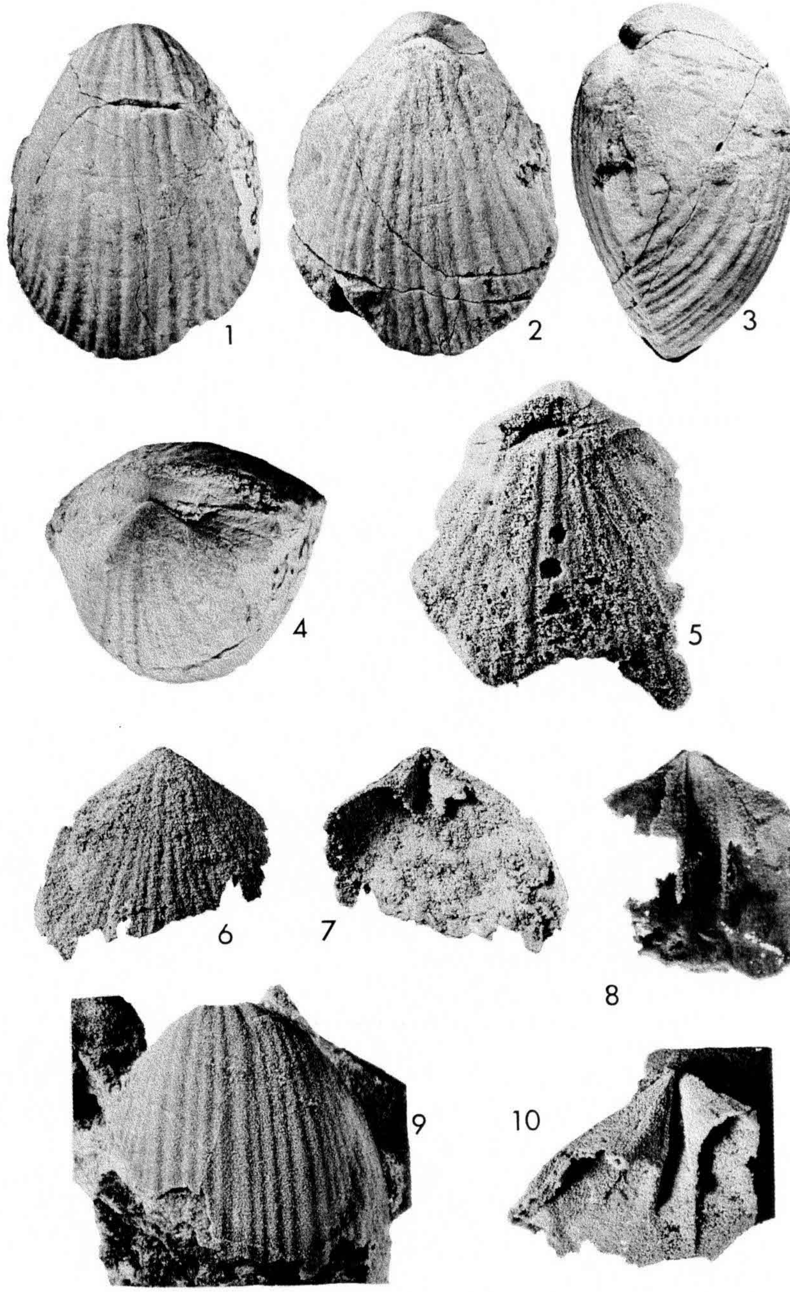
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Plate 2

Figs. 1-10. *Virgiana utahensis* n. sp.

1-4, University of California Museum of Paleontology loc. A-9342, Tony Grove Lake Member, Laketown Dolomite, Blacksmith Fork Canyon, Utah. *5, 9*, USNM loc. 19172, Tony Grove Lake Member, Laketown Dolomite, southern Egan Range, Nevada. *6-7*, USNM loc. 19042, Tony Grove Lake Member, Laketown Dolomite, Lakeside Mountains, Utah. *8-10*, USNM loc. 19171, Tony Grove Lake Member, Laketown Dolomite, southern Egan Range, Nevada.

1-4, ventral, dorsal, lateral, posterior views of a complete specimen, X1.1.

5, dorsal exterior, X1.0. USNM 219538.

6-7, dorsal exterior, interior, X1.0. USNM 219539.

8, dorsal interior, X1.5. USNM 219540.

9, ventral exterior, X1.0. USNM 219541.

10, dorsal interior, X1.5. USNM 219542.

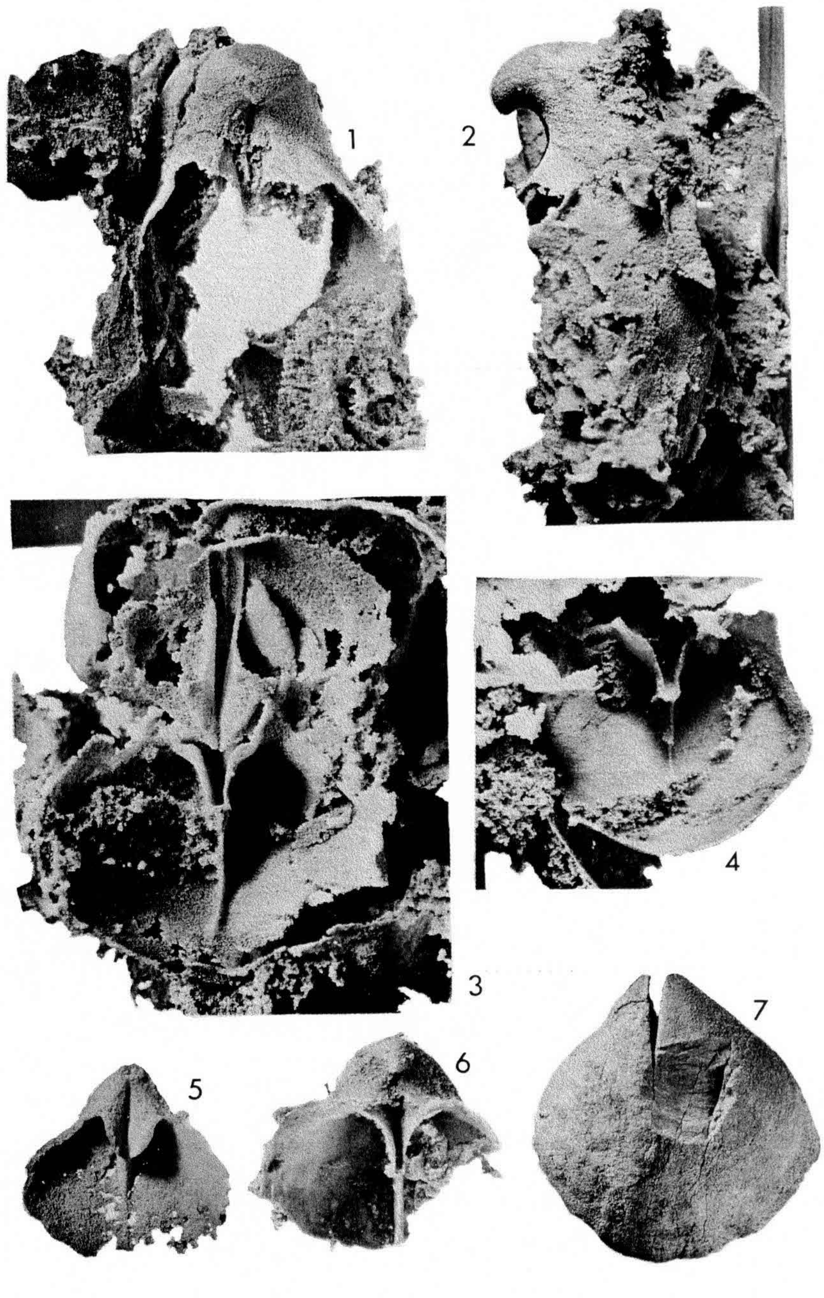
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Plate 3

Figs. 1-7. *Pentamerus* sp.

1-5, USNM loc. 19277, Portage Canyon Member, Laketown Dolomite, Deep Creek Mountains, Utah. *6-7*, USNM loc. 19309, Tony Grove Lake member, Laketown Dolomite, Tony Grove Lake, Utah.

1-2, interior and lateral views of a ventral valve, X1.0. USNM 219543.

3, interior view of articulated valves, X1.25. USNM 219544.

4, ventral interior, X1.25. USNM 219545.

5, ventral interior, X1.0. USNM 219546.

6, ventral interior, note pseudodeltidium, X1.25. USNM 219547.

7, mold of ventral interior, X1.0. (Note asymetrical valve with middle lobe along the off-center septum.) USNM 219548.

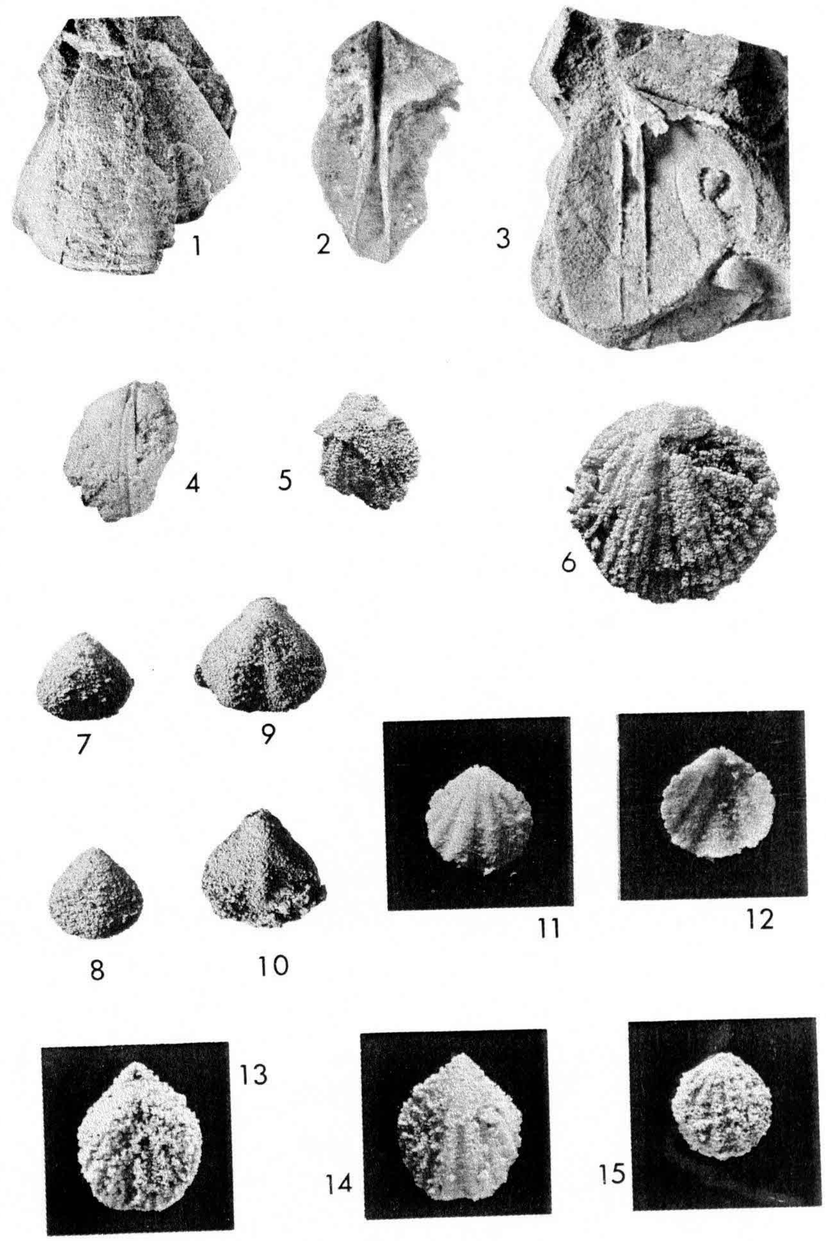
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Plate 4

Figs. ***1-4.*** *Pentamerus* sp.

1, USNM loc. 19537, Tony Grove Lake Member, Laketown Dolomite, Barn Hills, Utah. *2,* USNM loc. 19570, Harrisite Dolomite (= Tony Grove Lake Member, Laketown Dolomite), Spors Mountain, Utah. *3,* USNM loc. 19419, Member C of Poole (1965), Ranger Mountains, Nevada. *4,* USNM 19314, High Lake Member, Laketown Dolomite, Tony Grove Lake, Utah.

1, ventral exterior, X1.0. Note trilobation. USNM 219549.

2, dorsal interior, X1.5. USNM 219550.

3, dorsal interior, X1.5. USNM 219551.

4, mold of dorsal interior, X1.0. USNM 219552.

Figs. 5-6. *Plectatrypa* sp.

5, USNM loc. 19171, Tony Grove Lake Member, Laketown Dolomite, southern Egan Range, Nevada. *6,* USNM loc. 19515, High Lake Member, Laketown Dolomite, Delamar Mountains, Nevada.

5, ventral exterior, X2.0 USNM 219553.

6, ventral exterior, X2.0 USNM 219554.

Figs. ***7-10.*** *Hyattidina?* sp.

USNM loc. 19042, Tony Grove Lake Member, Laketown Dolomite, Lakeside Mountains, Utah.

7-8, ventral, dorsal exterior, X3.0. USNM 219555.

9-10, ventral, dorsal exterior, X3.0. USNM 219556.

Figs. ***11-15.*** Atrypid sp.

USNM loc. 19042, Tony Grove Lake Member, Laketown Dolomite, Lakeside Mountains, Utah.

11-12, ventral exterior, interior, X4.0 USNM 219557.

13-14, dorsal, ventral exteriors, X4.0. USNM 219558.

15, dorsal exterior, X4.0. USNM 219559.

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