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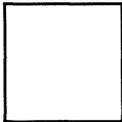
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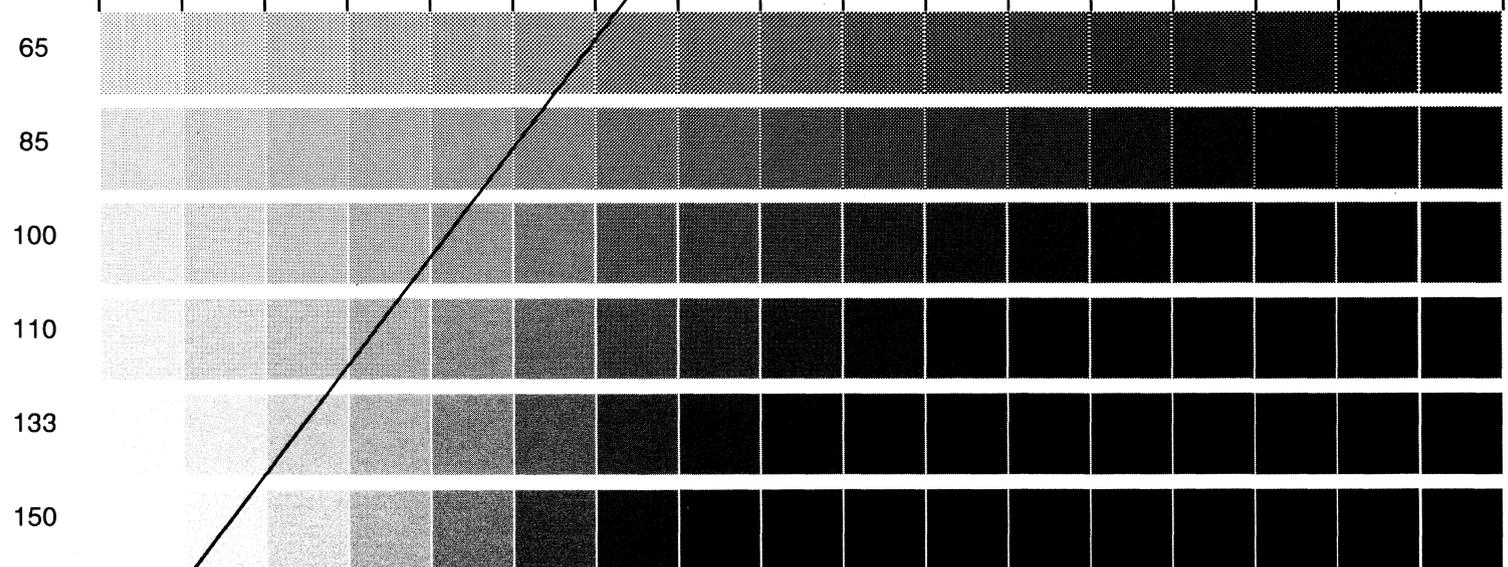
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*(Continuation of Contributions from the Museum of Geology)*

UNIVERSITY OF MICHIGAN

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REVISION OF ALEXANDER WINCHELL'S  
TYPES OF BRACHIOPODS FROM THE  
MIDDLE DEVONIAN TRAVERSE GROUP  
OF ROCKS OF MICHIGAN

BY

G. M. EHLERS AND VIRGINIA KLINE



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(Continuation of Contributions from the Museum of Geology)

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Editor: EUGENE S. McCARTNEY

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(Continued on inside of back cover)

## REVISION OF ALEXANDER WINCHELL'S TYPES OF BRACHIOPODS FROM THE MIDDLE DEVONIAN TRAVERSE GROUP OF ROCKS OF MICHIGAN

By G. M. EHLERS AND VIRGINIA KLINE

### INTRODUCTION

IN AN appendix to a report on the Grand Traverse region, which is available in only a few libraries, Alexander Winchell<sup>1</sup> described sixty-one species and two varieties of fossils from the Middle Devonian Traverse group of rocks exposed along the southern shore of Little Traverse Bay.

Winchell's descriptions of these fossils are very brief and are not accompanied by illustrations. Since these fossils, with few exceptions, were never subsequently illustrated and adequately described, recognition of the various species is practically impossible.

In order to determine the morphology of Winchell's species and to lay the foundation for a study of the faunas of the Traverse group the present writers are undertaking a revision of his types. In this study they have been fortunate in finding most of the basic types and numerous metatypes of Winchell's species, which are preserved in the Museum of Paleontology of the University of Michigan, the Hood Museum of Natural History at Alma College, Alma, Michigan, and the Peabody Museum of Natural History at Yale University. They have been aided in finding several types by Winchell's unpublished drawings of them preserved in the library of the University of Michigan.

<sup>1</sup> Winchell, A., *The Grand Traverse Region, a Report on the Geological and Industrial Resources of the Counties of Antrim, Grand Traverse, Benzie and Leelanaw in the Lower Peninsula of Michigan* (main part of report, pp. 1-82; Appendix, pp. 83-97), Ann Arbor, Mich., Dr. Chase's Steam Printing House, 1866.

The present paper deals with a revision of Winchell's species and varieties of brachiopods. His species of other invertebrates of the Traverse rocks will be described in subsequent papers.

Before presenting the revised descriptions of Winchell's species it is essential to give a brief discussion of the localities and strata from which this paleontologist obtained his fossil material.

In the list below numbers 855 to 884 refer to the localities at which Winchell studied outcrops (see Map 1). Some of them were visited by E. R. Pohl<sup>2</sup> also, who described the strata exposed at these places in a recent paper on the Traverse group of Michigan. Pohl's numbers for these localities are also listed below (see Map 1).

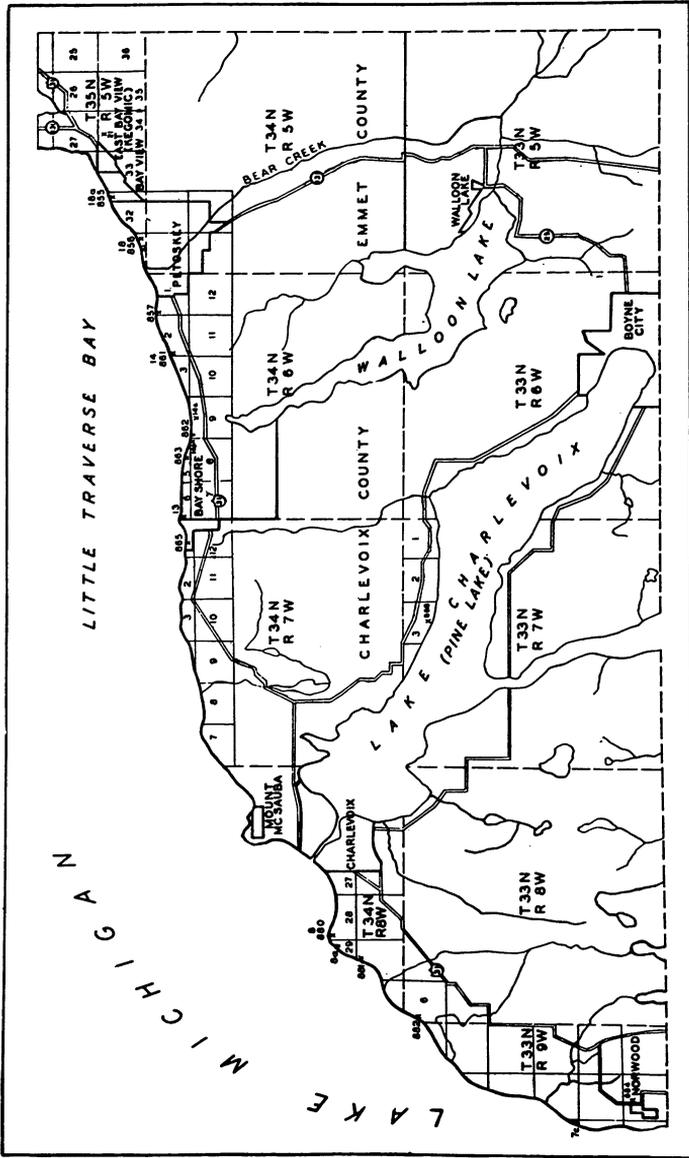
#### LIST OF WINCHELL'S LOCALITIES

LOCALITY	
884	NE. $\frac{1}{4}$ Sec. 34, T. 33 N., R. 9 W., Charlevoix County.
882	W. $\frac{1}{2}$ Sec. 8, T. 33 N., R. 8 W., Charlevoix County.
881	Section line between Secs. 29 and 32, T. 34 N., R. 8 W., Charlevoix County.
880	NW. $\frac{1}{4}$ Sec. 28, T. 34 N., R. 8 W., Charlevoix County. Approximately Pohl's locality 8.
865	Sec. 1, T. 34 N., R. 7 W., Charlevoix County. A little west of Pohl's locality 13.
863	$\frac{1}{2}$ mile west of locality 862.
862	NW. $\frac{1}{4}$ Sec. 9, T. 34 N., R. 6 W., Emmet County. Approximately Pohl's locality 14e.
861	SW. $\frac{1}{4}$ Sec. 2, T. 34 N., R. 6 W., Emmet County. Approximately Pohl's locality 14.
857	NW. $\frac{1}{4}$ Sec. 1, T. 34 N., R. 6 W., Emmet County. One mile west of Bear Creek.
856	An escarpment extending for a distance of $\frac{3}{4}$ mile west from a point 20 rods west of locality 855. West end is Pohl's locality 18.
855	East side of Sec. 32, T. 35 N., R. 5 W., Emmet County. Near Pohl's locality 18a.

Winchell (p. 88) subdivided the Traverse group (Hamilton group of Winchell, p. 83) of the Little Traverse Bay region as follows:

- IV. Chert Beds
- III. Buff, vesicular Magnesian Limestone
- II. Bituminous Shales and Limestones { Acervularia Beds  
Bryozoa Beds
- I. Pale buff, massive Limestone { Stromatopora Beds  
Pleurotomaria Beds

<sup>2</sup> Pohl, E. R., "The Middle Devonian Traverse Group of Rocks in Michigan, A Summary of Existing Knowledge," *Proc. U. S. Nat. Mus.*, Vol. 76, Art. 14, pp. 1-34, pls. 1-2, 1929.



MAP 1. Little Traverse Bay region, showing Alexander Winchell's localities (numbers 855 to 884) and E. R. Pohl's (numbers 7 to 21)

A comparison of the sections made by Winchell and Pohl at the same localities indicates that Winchell was in error in interpreting the succession of strata of the Traverse group. This conclusion is supported by field observations of the senior writer of this paper and by information gained from the writers' study of Winchell's fossils in the Museum of Paleontology of the University of Michigan.

In correlating his sections Winchell (pp. 47 and 84) considered that the strata outcropping at localities 880 and 857 occupy the same stratigraphic position. He originally (pp. 42-43) assigned all the strata at 857 to his "Tropidoleptus Beds," which he subsequently (p. 84) designated as "Bryozoa Beds." Later (p. 84) he assigned only beds "A" and "B" at localities 857 and 880 to his "Bryozoa Beds," and placed the higher strata at each locality in the "Acervularia Beds." Beds "A" and "B" at 880 are among the lowest exposed strata in the Traverse group of the Little Traverse Bay region. All the strata at locality 857 should be included in the "Acervularia Beds." The term "Bryozoa Beds," as used in the present paper, is restricted to beds "A" and "B" at locality 880.

Immediately above these "Bryozoa Beds" are the "Acervularia Beds," which are especially well shown at localities 862, 861, and 857 (see chart, Fig. 1). The "Acervularia Beds" are highly fossiliferous, containing about three fourths of the species of brachiopods described by Winchell.

The next highest strata are the "Pleurotomaria Beds," which Winchell erroneously considered to be the lowest strata in the Traverse group. No brachiopods belonging to Winchell's species are known to occur in the "Pleurotomaria Beds," which outcrop at localities 855 and 856 (see chart, Fig. 1).

The "Magnesian Limestone Beds," which outcrop at locality 865, overlie the "Acervularia Beds" as noted by Winchell. They occupy approximately the same stratigraphic position as the "Pleurotomaria Beds" and, according to Winchell (pp. 85-86), contain some of the species of gastropods and pelecypods which are characteristic of the "Pleurotomaria Beds." It is evident that Winchell failed to recognize that the "Magnesian Limestone Beds" were practically equivalent to his "Pleurotomaria Beds."



Winchell's "Stromatopora Beds," which appear at locality 856, occupy a position above the "Pleurotomaria Beds" (see chart, Fig. 1). A few of his species of brachiopods are present in the "Stromatopora Beds."

The "Chert Beds," which are above the "Stromatopora Beds," outcrop at locality 884 and are the highest beds noted by Winchell. No fossils are reported by him as occurring in these beds.

The following table shows the correct order of succession of Winchell's stratigraphic divisions and the probable positions of these divisions in E. R. Pohl's classification of the Traverse group. The distribution of Winchell's species of brachiopods is also shown in this table.

TABLE SHOWING CORRECT POSITIONS OF WINCHELL'S  
STRATIGRAPHIC DIVISIONS AND THE OCCURRENCE  
OF WINCHELL'S SPECIES OF BRACHIOPODS

Petoskey formation	
Chert Beds	
Stromatopora Beds	
Pentamerella athyroides (Winchell)	
Athyris lens (Winchell)	
Spirifer consors Winchell	
Reticularia filicosta (Winchell)	
Charlevoix stage	
Pleurotomaria Beds	
Gravel Point stage	
Acervularia Beds	
Stropheodonta cincta Winchell	
Stropheodonta erratica Winchell	
Stropheodonta erratica var. fissicosta Winchell	
Stropheodonta erratica var. solidicosta Winchell	
* Stropheodonta imitata Winchell	
Leptalosia radicans (Winchell)	
Schuchertella anomala (Winchell)	
Stuartella traversensis (Winchell)	
Athyris eborea (Winchell)	
Athyris sesquiplicata (Winchell)	
Spirifer bidorsalis Winchell	
Reticularia filicosta (Winchell)	
Bryozoa Beds	
Stropheodonta cincta Winchell	
Chonetes emmetensis Winchell	

\* No specimens of *Stropheodonta imitata* Winchell have been found in Winchell's collections. According to him (p. 85), this species should occur in the "Acervularia Beds."

ACKNOWLEDGMENTS

The writers are greatly indebted to Professor H. M. MacCurdy, director of the Hood Museum of Natural History at Alma College, Alma, Michigan, for the loan of a large number of types which were essential to a revision of Winchell's species.

To Professors Charles Schuchert and Carl Dunbar of Yale University they are under great obligation for the loan of specimens of *Leptalosia radicans* (Winchell) and for helpful information regarding the generic relationships of this species.

DESCRIPTION OF SPECIES

*Stropheodonta cincta* Winchell

(Plate I, Figs. 1-3)

1866. *Stropheodonta cincta* Winchell, The Grand Traverse Region, p. 93, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1897. *Stropheodonta cincta* Schuchert, U. S. Geol. Surv., Bull. 87, p. 420.

*Original description.* — "Size and general appearance of *S. inaequistriata*. Hinge-line less than greatest width. hinge-angles rounded. Inside of ventral valve minutely pustulose in all parts, and marked by a prominent ridge all around near the border. Divaricator scars diverging, reaching two-thirds the distance to the anterior border; retractor scars nearly as long."

*Remarks.* — The writers have been able to obtain only two poorly preserved metatypes of this species, and they do not show characters sufficiently marked to be of specific value. The shell is moderately large, with a strongly convex ventral valve and somewhat less concave dorsal. The hinge line is a little shorter than the greatest width of the shell, with rounded extremities. The external surface is coarsely plicated, and the internal surface is covered with closely spaced minute pustules. The margin of the dorsal valve is raised in a prominent ridge on the interior. Other characteristics described by Winchell are not shown by either metatype.

Although *Stropheodonta cincta* may be a valid species, it will be impossible to determine this or to describe it adequately until better specimens identified by Winchell are found.

*Occurrence.* — One of the metatypes of *S. cincta* (preserved in the Hood Museum of Natural History at Alma College, No. 2769) was collected from bed "A" at Winchell's locality 857. The second metatype (preserved in the Museum of Paleontology of the University of Michigan, No. 4070) was collected from bed "B" at Winchell's locality 880.

Winchell (p. 84) correlates bed "B," locality 880, with bed "A," locality 857, and places them in his "Bryozoa Beds." This correlation is incorrect because bed "A" is higher than bed "B." Bed "B" at 880 occupies a position in the lower part and bed "A" at 857 in the upper part of the Gravel Point stage of Pohl.

*Stropheodonta erratica* Winchell

(Plate I, Figs. 4-9)

1866. *Stropheodonta erratica* Winchell, The Grand Traverse Region, p. 93, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1897. *Stropheodonta erratica* Schuchert, U. S. Geol. Surv., Bull. 87, p. 422.

*Original description.* — "Resembles *S. arcuata* Hall in hinge structure, but central cardinal process of ventral valve is narrower, and dental lamellae denticulated. Divaricator scars drawn to a point on median line; hinge-line abruptly acuminate. Ribs few and large on the umbo, increasing by implantation, and diminishing in size toward the margin. In variety *solidicosta*, about nine large nearly undivided ribs; in variety *fissicosta*, ribs fimbriated till they number fifty to eighty around the margin. The last variety, except in the ears, resembles *S. subdemissa* Hall. Comp. also with *S. plicata* Hall, (XIII Reg. Rep., p. 90) and *S. ? costata* Owen, (Surv. Wis. Minn. & Io.: Tab. III, Fig. 11)."

*Revised description.* — Shell rather small, broader than long, greatest width along hinge line, cardinal extremities acuminate. Dimensions of cotypes: 1, length 12.6 mm., width 16.9 mm., thickness 3.2 mm.; 2, length 12.2 mm., width 16.9 mm. (estimated).

Ventral valve moderately convex, becoming flattened to the short, acuminate cardinal extremities. Beak small, projecting slightly beyond cardinal margin. Cardinal area moderately wide, concave, lying almost in the plane of the valve. Hinge surface denticulate. Delthyrium not distinctly shown, filled by flat

deltidium, which is not sharply differentiated from the surface of the cardinal area.

Dorsal valve nearly flat to moderately concave. Cardinal area narrower than that of ventral valve, the two areas meeting at an angle of about 120 degrees. Hinge surface denticulate.

Surfaces of both valves covered with strong, sharply angular plications which increase by intercalation and bifurcation. Plications about ten or eleven near the beak increasing to twenty to forty along the anterior margin, the number varying with the size of the shell. Intercalated and bifurcated plications increasing rapidly in size and within a short distance having widths nearly equal to those of the original plications.

*Remarks.* — This species may be readily recognized by its short acuminate cardinal extremities and its strong, angular, bifurcating and intercalating plications.

*Types.* — Two cotypes of *Stropheodonta erratica* Winchell are preserved in the Hood Museum of Natural History at Alma College under number 2704. (Plastocotypes Nos. 14923 and 14924, Mus. Pal., U.M.) Drawings of the cotypes made by Winchell are preserved in the library of the University of Michigan.

*Occurrence.* — The cotypes bear no information concerning the exact place on the shore of Little Traverse Bay or stratum of the Traverse group from which they were collected. Some of the metatypes have become mixed; specimens which are obviously from different strata are labeled as coming from the same bed. The species is probably confined to the Gravel Point stage of the Traverse, although a field study must be made to determine its exact stratigraphic range.

*Stropheodonta erratica* var. *fissicosta* Winchell

(Plate I, Figs. 10-13)

1866. *Stropheodonta erratica* var. *fissicosta* Winchell, The Grand Traverse Region, p. 93, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1897. *Stropheodonta erratica* Schuchert, U. S. Geol. Surv., Bull. 87, p. 422.

*Original description.* — See under *S. erratica*.

*Revised description.* — Shell rather small, wider than long, greatest width along hinge line. Dimensions of cotypes (broken

at cardinal extremities): 1, length 16 mm., width 18.9 mm., estimated width along hinge line 23.6 mm.; 2, length 12.6 mm., width 15.4 mm., estimated width along hinge line 18.8 mm.

Ventral valve moderately convex, becoming flattened toward cardinal extremities. Beak small, projecting slightly beyond cardinal margin. Cardinal area moderately wide, concave, lying almost in the plane of the valve. Hinge surface denticulate. Delthyrium not distinctly shown, filled by flat deltidium, which is not sharply differentiated from the surface of the cardinal area.

Dorsal valve moderately concave, becoming flat to slightly convex at cardinal extremities. Cardinal area a little narrower than that of ventral valve and meeting it at an angle of about 120 degrees. Hinge surface denticulate.

Surfaces of valves near beaks marked with about ten to twelve strong, sharply angular plications, which bifurcate repeatedly and decrease in size. Some plications intercalated. Plications becoming nearly uniform in size along the anterior and lateral margins and ranging from about thirty-five on small specimens to sixty on large ones.

*Remarks.* — This variety differs from *Stropheodonta erratica* in having finer and more plications, which are nearly uniform in size along the margins of the shell.

*Types.* — Two cotypes of *Stropheodonta erratica* var. *fissicosta* are preserved in the Hood Museum of Natural History at Alma College under number 2704. (Plastocotypes Nos. 14925 and 14926, Mus. Pal., U.M.) Drawings of the cotypes made by Winchell are preserved in the library of the University of Michigan.

*Occurrence.* — In a faunal list E. R. Pohl (p. 22) notes the occurrence of this variety in the Petoskey formation. However, the lithology and faunal associations of the cotypes and metatypes in the Museum of Paleontology of the University of Michigan indicate that these specimens belong to the Gravel Point stage and that the variety is probably confined to this stage of the Traverse.

*Stropheodonta erratica* var. *solidicosta* Winchell

(Plate I, Figs. 14-19)

1866. *Stropheodonta erratica* var. *solidicosta* Winchell, The Grand Traverse Region, p. 93, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1897. *Stropheodonta erratica* Schuchert, U. S. Geol. Surv., Bull. 87, p. 422.

*Original description.* — See under *S. erratica*.

*Revised description.* — Shell rather small, width a little greater than length, greatest width along hinge line; cardinal extremities acuminate. Dimensions of cotypes: 1, length 9.9 mm., width 11.2 mm., thickness 2.1 mm.; 2, length 12 mm., width 12.1 mm. (extremities broken), thickness 2.7 mm.

Ventral valve moderately convex, becoming flattened to the short, acuminate cardinal extremities. Beak small, projecting slightly beyond cardinal margin. Cardinal area moderately wide, concave, lying almost in the plane of the valve. Hinge surface denticulate. Delthyrium not distinctly shown, filled by flat deltidium, which is not sharply differentiated from the surface of the cardinal area.

Dorsal valve moderately concave. Cardinal area nearly as wide as that of ventral valve, the two areas meeting at an angle of about 120 degrees. Hinge surface denticulate.

Surfaces of both valves covered by eight to eleven strong, sharply angular plications, with a few fine plications originating by intercalation or bifurcation and with the number of fine plications increasing with the size of the shell.

*Remarks.* — This variety differs from *Stropheodonta erratica* in having a smaller number of prominent plications. The spaces between the prominent plications are occupied by much narrower plications in this variety than in the species.

*Types.* — Two cotypes of *Stropheodonta erratica* var. *solidicosta* Winchell are preserved in the Hood Museum of Natural History at Alma College under number 2705. (Plastocotypes Nos. 14927 and 14930, Mus. Pal., U.M.) Drawings of the cotypes made by Winchell are preserved in the library of the University of Michigan.

*Occurrence.* — *Stropheodonta erratica* var. *solidicosta* Winchell

is probably confined to the Gravel Point stage of the Traverse. Further field study is necessary, however, to determine the exact stratigraphic range of the variety.

*Stropheodonta imitata* Winchell

1866. *Stropheodonta imitata* Winchell, The Grand Traverse Region, p. 93, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1897. *Stropheodonta demissa imitata* Schuchert, U. S. Geol. Surv., Bull. 87, p. 421.

*Original description.* — "Adductor bosses prominent, bicrescentic, with a short, stout, median ridge issuing from between them forwards. Otherwise resembles *S. inaequistriata*, except that the striae are nearly equal, and the shell is relatively shorter and only 12.7 mm. (.5) to 17.8 mm. (.7) broad."

*Remarks.* — One or more specimens of this species are supposed to be in the collection of the Museum of Paleontology of the University of Michigan, being recorded in an old catalogue under number 4134. Specimens are also noted as being present in the Hood Museum of Natural History by the Winchell catalogue at Alma College.

The writers have not succeeded in finding these or any other specimens of this species and are therefore unable to make additions to Winchell's description. Unless specimens are found which have been identified by Winchell, it will be impossible to determine the structure of the species and to retain *Stropheodonta imitata* as a good species.

*Occurrence.* — According to the old catalogue in the Museum of Paleontology of the University of Michigan, the specimens numbered 4134 were collected from bed "B" of Winchell's "Acervularia Beds" at his locality 861. Gravel Point stage.

*Schuchertella anomala* (Winchell)

(Plate I, Figs. 20-27; Plate III, Figs. 1-2)

1866. *Crania (Pseudocrania) anomala* Winchell, The Grand Traverse Region, p. 92, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1892. *Streptorhynchus anomala* Hall and Clarke, Pal. New York, VIII, pt. I, p. 152.

1897. *Orthotheses anomalus* Schuchert, U. S. Geol. Surv., Bull. 87, p. 295.

*Original description.* — “Shell free or attached, irregular, thick; hinge line nearly equal to greatest width. Ventral valve with three or four pairs of muscular impressions, a broad, striated area, arched false deltidium nearly filling the very broad triangular fissure and fusing with cardinal processes to form a spoon-shaped orthidoid appendage. Exterior with many fine radial striae. Transverse diameter 28 mm. (1.1); length 20 mm. (.8).”

*Revised description.* — Shell about medium size, biconvex, broader than long, greatest width a little posterior to middle of the shell; cardinal extremities angular to rounded. Dimensions of holotype (dorsal valve): length 20 mm., maximum width 28 mm., length along hinge line 24.7 mm., depth 10 mm.; approximate dimensions of metatype (imperfect ventral valve): length 19.1 mm., maximum width 21 mm., length along hinge line 15.5 mm., depth 7.7 mm., height of cardinal area 5.5 mm.

Ventral valve strongly convex in the anterior part and almost equally concave immediately anterior to the beak, slightly convex at cardinal extremities. Mesial sinus obsolete. Beak blunt. Cardinal area wide, nearly flat, lying in a plane almost at right angles to the plane of the valve. Delthyrium higher than wide, closed by a convex deltidium which is divided by three distinct furrows, the median one being the most prominent. Perideltidial area distinct.

Dorsal valve moderately to strongly convex, greatest convexity near the middle, becoming somewhat flattened toward the cardinal extremities. Umbo not protuberant beyond the cardinal margin; cardinal area narrow but distinct. Cardinal process short, bifid, each half divided by a distinct groove. Chilidium present. Crural plates diverging widely on each side, recurving toward hinge line to form dental sockets. Muscle scars reaching nearly to the middle of the valve, deeply impressed, divided longitudinally by a moderately prominent median ridge originating at the base of the cardinal process.

Surfaces of both valves covered by coarse radiating striae, which are crossed by extremely fine and closely spaced concentric striae and very coarse, distantly spaced growth lines.

*Remarks.* — This species may be distinguished by the shape of the ventral valve, which is deeply concave just anterior to the

beak. A few individuals of *Schuchertella anomala* have been found associated with specimens of *Prismatophyllum* in such a manner as to suggest that they may have possessed the ability to attach themselves by the beak of the ventral valve. However, no individuals that show scars of attachment have been found.

*Types.* — The holotype and a paratype (dorsal valves) are preserved in the Hood Museum of Natural History at Alma College under number 2710. (Plastoholotype No. 14740, Mus. Pal., U.M.)

Metatypes are preserved in the Museum of Paleontology of the University of Michigan, where they bear the numbers 4116, 14741, 14742, and 14743.

*Occurrence.* — The types were collected from Winchell's "Acerularia Beds" at locality 861. Gravel Point stage.

*Chonetes emmetensis* Winchell

(Plate II, Figs. 2-3, 6, 8-13)

1866. *Chonetes Emmetensis* Winchell, The Grand Traverse Region, pp. 92-93, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1897. *Chonetes emmetensis* Schuchert, U. S. Geol. Surv., Bull. 87, p. 173.

*Original description.* — "Small, semicircular; hinge-line equal to greatest width, or slightly greater or less, armed with two short spines near each extremity, which turn out at right angles to axis of shell, and a minute tubercle near the beak. Dorsal valve very concave. Area wide, formed equally from both valves, turned over into the plane of the shell, slightly hollowed. Triangular foramen occupied by dental process. Ribs ten or eleven around the margin, stout, convex, simple or with two or three bifurcated ones. Concentric striae sometimes conspicuous.

"Resembles *C. gibbosa* Hall and *C. koninckana* N. & P. in the direction of its spines, but differs from these and related species in the small number of its ribs."

*Revised description.* — Shell subsemicircular in outline, wider than long, length about four fifths of the width, the hinge line equal to about the greatest width, cardinal extremities angular, lateral margins a little sinuate or nearly straight in the posterior half, curving regularly into the anterior margin. Dimensions of cotypes:

1, length 7 mm., width 8.7 mm., depth 2.4 mm.; 2, length 7.4 mm., width 9.3 mm., depth 3.5 mm.; 3, length 8.7 mm., width 10.1 mm., depth 3.6 mm.; 4, length 9.2 mm., width 10.4 mm., depth 4 mm.

Ventral valve moderately to strongly convex, greatest convexity a little posterior to the middle, surface curving abruptly to the beak and becoming conspicuously flattened to concave at the postero-lateral margins. Mesial sinus obsolete. Beak inconspicuous, not extending beyond the cardinal margin. Cardinal area flat to very slightly curved, parallel to the plane of the valve; delthyrium broadly triangular, apical part covered by a deltidium and lower part occupied by the cardinal process; cardinal margin sloping gently from the beak to the extremities and bearing three or possibly four spines on each side of the beak; spines long, almost evenly spaced, and extended outward nearly parallel to the hinge line. Muscle scars large, extending anteriorly for about two thirds of the distance from the beak. Inner surface covered with papillae.

Dorsal valve moderately to strongly concave, the greatest concavity near or a little posterior to the middle, becoming flattened to slightly convex at the postero-lateral margins. Cardinal area very narrow, about one half of the width of that of the ventral valve. Bilobed cardinal process with external surface covered by chilidium. Muscle scars large. Inner surface covered with prominent papillae.

Surfaces of valves covered by ten to sixteen subangular to rounded plications, more convex valves having an average of about eleven plications and less convex ones about fifteen. Bifurcation and intercalation of plications occur to very limited extent on valves of some individuals. Plications crossed by concentric growth lines, some of which are very prominent.

*Types.* — The basic types of *Chonetes emmetensis* consist of four cotypes, which are preserved in the Hood Museum of Natural History at Alma College under number 2742. (Plastocotypes Nos. 14816 and 14819, Mus. Pal., U.M.)

Metatypes, which are also topotypes, are preserved in the Museum of Paleontology of the University of Michigan under numbers 14812, 14813, and 14931.

*Occurrence.*—The types were collected from bed "B" of Winchell's "Bryozoa Beds" at his locality 880. This bed is included within the "Emmetensis zone" of the Gravel Point stage by Pohl; the zone receives its name from the abundance of *Chonetes emmetensis*. Gravel Point stage.

*Leptalosia radicans* (Winchell)

(Plate II, Figs. 1, 4-5, 7)

1866. *Crania radicans* Winchell, The Grand Traverse Region, p. 92, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.
1890. *Strophalosia radicans* Beecher, Am. Journ. Sci., 3d Ser., 40, pp. 240, 243, pl. 9, figs. 14-17.
1892. *Strophalosia radicans* Hall and Clarke, Pal. New York, VIII, pt. I, p. 316, pl. 15B, figs. 27-30.
1897. *Strophalosia radicans* Schuchert, U. S. Geol. Surv., Bull. 87, p. 418.
1932. *Leptalosia radicans* Dunbar and Condra, Nebraska Geol. Surv., Bull. 5, 2d Ser., p. 260.

*Original description.*— "Attached valve very irregular, with distinct cardinal truncation, always presenting the appearance of area, triangular fissure and cardinal processes; central portion of valve often absorbed or wanting, leaving only the upturned border. Exterior furnished with radiceform, flexuous often bifurcate, hollow spines or appendages, sometimes as long as the shell. Diameter about 3.8 mm. (.15)."

*Revised description.*— Shell minute, subsemicircular in outline, usually wider than long, hinge line about equal to greatest width. Dimensions of shell of average size: length 5.2 mm., width 7.7 mm.

Ventral valve attached by nearly the entire surface to some foreign object, the markings of which often show through the thin central portion of the valve. Margins upturned, fringed with long, hollow, rugose, adnate spines. Distinct cardinal area. Deltidium with deltidium. Two oblique cardinal teeth. "Cardinal muscular impressions small, separated by a slight ridge or septum" (Beecher, p. 243, 1890).

Dorsal valve slightly concave, except at beak, where it is convex. Cardinal area very narrow. Surface marked by lamellose concentric growth lines. No spines present. Interior with con-

spicuous narrow bifid cardinal process extending beyond hinge line and apparently covered by chilidium. Deep dental sockets. Septum present in central part of valve. Muscle scars large and distinct. Inner surface of valve strongly pustulose.

*Remarks.* — Ventral valves are usually found attached to corals originally identified as *Zaphrentis traversensis* Winchell (a cyathophyllid rather than a zaphrentid) and *Acervularia davidsoni* Edwards and Haime (= *Prismatophyllum davidsoni michiganense* Grabau [chironym]). The dorsal valves, being unattached, are seldom found associated with the ventral valves.

According to Beecher (p. 243, 1890), "A small ventral valve growing in a cavity in the epitheca of a coral . . . attached only by the beak and by spines from the cardinal margin" shows "the surface marked by irregular lamellose striae and by infrequent short spines, which become stronger and more elongate near the surface of attachment." This small ventral valve has been lost, and the present writers have not seen another valve which shows such a small area of attachment.

*Types.* — The cotypes are preserved in the Museum of Paleontology of the University of Michigan under numbers 4156 (group of nine specimens) and 14933.

Two metatypes, illustrated in C. E. Beecher's paper by figures 14 and 16, plate 9, are preserved in the Peabody Museum of Natural History at Yale University. Casts of these metatypes are preserved in the Museum of Paleontology of the University of Michigan under numbers 14817 and 14818.

*Occurrence.* — The types were collected from Winchell's "Acervularia Beds" at his locality 861. Gravel Point stage.

*Pentamerella athyroides* (Winchell)

(Plate III, Figs. 3-5)

1866. *Martinia athyroides* Winchell, The Grand Traverse Region, p. 94, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1897. *Martinia athyroides* Schuchert, U. S. Geol. Surv., Bull. 87, p. 263.

*Original description.* — "Triangularly terebratuliform, without fold or sinus. Ventral valve nearly twice as deep as the other,

with a projecting, somewhat incurved beak. No true area, but a broad, triangular fissure extends to the apex of the beak. Shell-structure thin-lamellar — neither punctate nor fibrous. Incremental surface markings numerous, fine, regular. Length 14.22 mm. (.56); breadth 13.21 mm. (.52). Resembles *Charionella Circe* Billings, from Corniferous limestone, but the beak is not perforate."

*Revised description.* — Shell of medium size, subtriangular in outline, length greater than width, greatest width near middle of shell; hinge line a little less than the greatest width, hinge extremities rounded; anterior margin broadly rounded. Dimensions of holotype: length of ventral valve 13.9 mm., length of dorsal valve 12.7 mm., width of shell 13.0 mm., thickness 8.8 mm.

Ventral valve strongly convex, greatest convexity posterior to the middle, surface curving abruptly toward hinge line and more gently to the antero-lateral margins. Mesial sinus absent, a very slight flattening near the anterior margin indicating the possible presence of a shallow sinus in mature specimens. Beak rather large, strongly incurved; delthyrium large, equilaterally triangular, open. Internal septum very short.

Dorsal valve less convex than ventral valve, greatest convexity posterior to the middle, surface curving gently to margins. Mesial fold lacking, a very slight upward curvature at the anterior margin indicating the possible presence of a low fold in mature specimens. Beak small, incurved.

Surfaces of internal mold marked by fine, distant, radiating striae and a few low radiating ridges near the anterior margin, indicating the existence of plications. External shell markings not observed.

*Remarks.* — This species is based on a single specimen, an internal mold.

Although most of the internal structures are unknown, it is evident that the species must belong to *Gypidula*, *Sieberella* or *Pentamerella*. The absence of a distinct cardinal area, the existence of a single short septum in the ventral valve, and the indication of a fold in the dorsal valve lead the writers to assign the species to *Pentamerella*.

*Types.* — The holotype is preserved in the Museum of Paleontology of the University of Michigan under number 4833.

*Occurrence.* — The holotype was collected from bed "C" of Winchell's "Stromatopora Beds" at his locality 856. Petoskey formation.

*Stuartella traversensis* (Winchell)

(Plate III, Figs. 6-16)

1866. *Terebratula traversensis* Winchell, The Grand Traverse Region, p. 95, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1897. *Terebratula traversensis* Schuchert, U. S. Geol. Surv., Bull. 87, p. 450.

*Original description.* — "In form resembling *T. Linklaeni* Hall, but broader, with more of a false area on ventral valve, and no trace of sinus. Surface, also sub-lamellosely striate concentrically, and pores larger, more oval and more remote — their two diameters and their distances being as 4:7:6, while in *T. Linklaeni* the same dimensions are as 3:4:4. Smaller diameter of pores .0321 mm. (.00126); greater .0559 mm. (.00220); the intervening distance from end to nearest end of pore .048 mm. (.00189). In *T. Linklaeni* these dimensions are .0213 mm. (.00084), .0321 mm. (.00126) and .0359 mm. (.00141)."

*Revised description.* — Shell small to moderately large, ovate to subtrigonal in outline, longer than wide, greatest width near or anterior to the middle; anterior margin broadly rounded. Dimensions of metatypes: 1 (14845, Mus. Pal., U.M.), length of ventral valve 19.1 mm., length of dorsal valve 17.3 mm., width 18.6 mm., thickness 10 mm.; 2 (14848, Mus. Pal., U.M.), length of ventral valve 26.7 mm., length of dorsal valve 23.9 mm., width 22.4 mm., thickness 16.2 mm.

Ventral valve strongly convex, with the greatest depth a little posterior to the middle; surface curving abruptly to the posterolateral margins and less abruptly to the anterior margin. Sinus absent. Beak large, strongly incurved, marked apically by a comparatively large foramen, which is directed posteriorly at an angle of about 30 degrees to the plane of the valve. Rather large delthyrium with pseudodeltidium. Internally, pseudosyrinx small and short, resting upon the inner surface of the pseudodeltidium

and fused laterally with the dental lamellae. Latter nearly parallel posteriorly, becoming strongly divergent anteriorly, extending about one fifth of the distance to the anterior margin.

Dorsal valve slightly less convex than the ventral, with greatest depth posterior to the middle. Surface strongly convex in umbonal region, curving more gently toward the anterior margin. Fold absent. Internally, socket plates heavy, moderately concave, divided laterally into three well-marked divisions by the crural geniculations. Anterior half free from the floor of the valve. Entire brachidium about one seventh of the length of the valve.

Surfaces of both valves covered by numerous punctae and fine concentric growth lines. Distinct concentric bands colored light gray and yellowish gray present on some specimens.

*Remarks.* — This species differs from *S. devoniana* Belanski in being somewhat smaller, in lacking a sinus, and in having a more concave hinge plate. It differs from *S. vera* Belanski in being slightly smaller and having a larger, more nearly circular, foramen.

It differs distinctly in its internal structure from *Terebratulula Linklaeni* (= *Eunella linklaeni* (Hall)) of Winchell's description.

The generic identification of this species is based on the internal structure of metatypes. The metatypes were collected from a bed and locality different from those of the holotype, a ventral valve which shows no distinctive generic structure. It is possible that complete specimens may be obtained from the same bed as the holotype and that an examination of their internal structures may prove that these specimens and also the holotype belong to a different genus.

*Types.* — The holotype is preserved in the Hood Museum of Natural History at Alma College under the number 2762. (Plas-toholotype No. 14929, Mus. Pal., U.M.)

Metatypes, including specimens from which serial sections were made, are preserved in the Museum of Paleontology of the University of Michigan under numbers 14845 to 14850.

*Occurrence.* — According to Winchell (p. 86), this species has a considerable vertical range, being found in his "Bryozoa," "Acervularia," "Pleurotomaria," and "Stromatopora" beds.

The holotype was collected from a buff limestone of the "Acer-

ularia Beds" at locality 862. Metatypes, Nos. 14845, 14846, 14847, 14848, and 14850, were collected from a bluish gray shale of Winchell's "Acervularia Beds" at locality 861.

Three metatypes (No. 14849, Mus. Pal., U.M.) were collected from strata at locality 857 which Winchell assigned to his "Bryozoa Beds." The "Bryozoa Beds" at this locality are a part of the "Acervularia Beds." Gravel Point stage.

Winchell's collection contains no specimens unquestionably belonging to this species which were collected from his "Pleurotomaria" and "Stromatopora" beds.

*Athyris eborea* (Winchell)

(Plate IV, Figs. 1-6)

1866. *Spirigera eborea* Winchell, The Grand Traverse Region, p. 94, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.
1889. *Athyris eborea* S. A. Miller, North Am. Geol. and Pal., p. 377, Cincinnati, Ohio, Press of Western Methodist Book Concern.
1897. *Athyris fultonensis* Schuchert, U. S. Geol. Surv., Bull. 87, p. 413.

*Original description.* — "General appearance of small specimens of *S. concentrica*, but more ventricose, with a fuller and more produced ventral beak. Shell substance extremely solid and ivory-like, but not punctate; surface polished, with numerous extremely delicate concentric striae. Length 9.4 mm. (.37); breadth 9.14 mm. (.36); depth of ventral valve 4.06 mm. (.16)."

*Revised description.* — Shell small, subcircular to subelliptical in outline, length slightly greater than width; valves strongly and subequally convex; hinge line about equal to one half of the greatest width of the shell; cardinal extremities rounded; greatest width near or a little anterior to the middle of the shell. Dimensions of holotype (a ventral valve) in present imperfect condition: length 9.4 mm., width 9.14 mm., depth 4.06 mm.; probable dimensions of holotype in perfect state: length 10.5 mm., width 10 mm., depth 4.06 mm. Dimensions of paratype (posterior part of both valves missing): length 9.2 mm., width 9.3 mm., thickness 6.5 mm.; probable dimensions of paratype in perfect state: length 10 mm., width 9.3 mm., thickness 6.5 mm.

Ventral valve moderately to strongly convex, the greatest con-

vexity posterior to the middle; surface curving abruptly from the umbonal region to the cardinal extremities and more gently to the anterior and lateral margins. Mesial sinus nearly obsolete, being shown only at the anterior margin as a broad, shallow depression. Beak small, pierced by a small circular foramen. Cardinal area narrow and inconspicuous, lateral margins not well defined. Delthyrium not visible.

Dorsal valve slightly less convex than ventral, greatest convexity posterior to the middle; surface curving rather abruptly to the cardinal margin and more gently to the anterior and lateral margins. Mesial fold obscure, appearing only as a slight elevation at the anterior margin. Beak incurved beneath that of the opposite valve.

Surfaces of both valves marked by closely spaced fine concentric lamellae of unequal strength.

*Remarks.* — *A. eborea* differs from *A. fultonensis* (Swallow) in its greater convexity, its development of a slight fold and sinus, and its more nearly circular outline, the length and width being more nearly equal in *A. eborea* than in *A. fultonensis*. *A. eborea* differs from *A. spiriferoides* (Eaton) (*Spirigera concentrica* of Winchell's description) in being smaller and having a much less prominent fold and sinus. *A. eborea* resembles *A. parvula* Whiteaves (*Contrib. Canadian Pal.*, Vol. 1, pt. 3, pp. 228-229, pl. 32, figs. 4-5, 5a, 1891), but differs from this species in having a less pronounced fold and sinus.

*Types.* — The holotype and paratype of *A. eborea* are preserved in the Hood Museum of Natural History at Alma College, number 2770. (Plastoholotype No. 14725, plastoparatype No. 14726, Mus. Pal., U.M.)

A fairly well preserved plesiotype is in the Museum of Paleontology of the University of Michigan under number 14730.

*Occurrence.* — The types were collected from beds "A" and "C" of Winchell's section at locality 857. These beds, although included by Winchell in the "Bryozoa Beds," really occupy a higher position in the "Acervularia Beds." Gravel Point stage.

*Athyris lens* (Winchell)

(Plate IV, Figs. 7-11)

1866. *Merista lens* Winchell, The Grand Traverse Region, p. 94, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1893. *Meristella lens* Hall and Clarke, Pal. New York, VIII, pt. II, p. 78.

1897. *Meristella lens* Schuchert, U. S. Geol. Surv., Bull. 87, p. 268.

*Original description.* — "Quadrato-rotund, lenticular, both valves equally convex, the ventral having the beak closely incurved over its opposite. Ventral sinus only represented by a slight anterior projection; dorsal fold only a broad angulation of the valve, except anteriorly. Surface of casts marked by six narrow, remote, radiating ridges around the middle of each valve, bifurcated nearer the margins (vascular markings?). Occlusor scars lingulate, deep. Shell thick, fibrous. Spires present. Length and breadth 19.81 mm. (.78)."

*Revised description.* — Shell of medium size, subcircular in outline, valves moderately convex, the length about equal to the width, greatest width near or a little posterior to the middle of the shell; hinge line equal to a little more than one half of the greatest width of the shell; cardinal extremities rounded. Dimensions of cotype (Mus. Pal., U.M.) measured by Winchell: length 19.7 mm., width 19.8 mm., thickness 10.3 mm.; dimensions of cotype (Alma College) drawn by Winchell: length 17.1 mm., width 16.5 mm., thickness 9.4 mm.; dimensions of third cotype (Alma College): length 17.8 mm., width 19.2 mm., thickness 10.4 mm.

Ventral valve moderately convex, greatest convexity a little posterior to the middle, surface curving abruptly from the umbonal region to the cardinal margin and gently to the lateral and anterior margins, somewhat compressed toward cardinal extremities. Sinus shown only as a gentle curvature at the anterior margin. Beak small, contiguous with that of dorsal valve, pierced by a subcircular foramen. Cardinal area very narrow and inconspicuous. Delthyrium concealed by beak of dorsal valve.

Dorsal valve a little less convex than the ventral valve, greatest convexity posterior to the middle, surface curving rather abruptly

to the cardinal margin and more gently to the antero-lateral margins, becoming flattened to slightly concave at the cardinal extremities. Mesial fold obsolete or shown only as a slight undefined elevation at the anterior margin of the valve. Beak strongly incurved below that of ventral valve.

Outer surface of each valve marked by strong concentric lamellae about 1 to 2 mm. apart on the central part of the shell. Inner surface of each valve shows deep elongate muscle scars and ten to twelve distinct pallial sinuses, which bifurcate several times toward the anterior and lateral margins.

*Remarks.* — The cotypes are internal molds, some of which have fragments of shell showing their relationship to topotypes with well-preserved shells.

*Types.* — Two cotypes are preserved in the Hood Museum of Natural History at Alma College under number 2806. A drawing of one of these specimens was made by Winchell (Plastocotype No. 14734, Mus. Pal., U.M.) Seven other cotypes are preserved in the Museum of Paleontology of the University of Michigan under number 4443. The dimensions of one of these specimens correspond with those given by Winchell in his description of the species.

A plesiotype (also a topotype), which Winchell erroneously identified as *Spirigera concentrica* Bronn, is preserved in the Museum of Paleontology of the University of Michigan under number 14733.

*Occurrence.* — The types were collected from bed "C" of Winchell's "Stromatopora Beds" at locality 856. Petoskey formation.

*Athyris sesquiplicata* (Winchell)

(Plate IV, Figs. 12-23)

1866. *Leiorhynchus sesquiplicatus* Winchell, The Grand Traverse Region, p. 95, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1897. *Leiorhynchus sesquiplicatum* Schuchert, U. S. Geol. Surv., Bull. 87. p. 238.

*Original description.* — "Shell having the form of *Spirigera concentrica*, with a more abrupt sinus and fold which, with the faint plications, extend only half way to the beak. About four

plications on the fold, and as many on each side. Concentric lines fine and indistinct. Length 8.38 mm. (.33); breadth 9.65 mm. (.38)."

*Revised description.*—Shell small, subcircular in outline, strongly convex, greatest width near the middle of the shell; hinge line equal to about two thirds of the greatest width of the shell; cardinal extremities rounded. Dimensions of holotype: length 9.4 mm., maximum width 9.6 mm., thickness 6.5 mm.

Ventral valve strongly convex, greatest convexity a little posterior to the middle; surface curving strongly in all directions from the umbo. Sinus broad and relatively shallow, originating in the umbonal region and increasing in depth toward the anterior margin, where it may be produced in a rounded extension of the valve; lateral margins of sinus toward the front defined by ridges. Beak moderately large, pierced by large foramen.

Dorsal valve also strongly convex, greatest convexity near middle, surface curving strongly to margins. Mesial fold present only on the anterior half of valve, broad, greatly elevated; surface of valve at anterior margin depressed on each side of fold. Beak incurved below that of ventral valve.

Outer surface of valves marked by strong closely spaced concentric lamellae. Internal molds show very faint irregularities simulating plications.

*Remarks.*—The holotype is an internal mold with some shell material adhering to it. The "faint plications" noted by Winchell are not true plications, but may be pallial markings.

The description of the exterior of the shell is based on well-preserved plesiotypes.

This species is related to *Athyris vittata* Hall, but is smaller, with a less prominent sinus and a flatter fold. It is more closely related to *Athyris parvula* Whiteaves (*Contrib. Canadian Pal.*, Vol. 1, pt. 3, pp. 228–229, pl. 32, figs. 4–5 and 5a, 1891) and *A. angelica* var. *occidentalis* Whiteaves (*ibid.*, p. 227, pl. 32, figs. 3, 3a, 3b), differing from the former in having the fold set off by furrows and the sinus bounded by slight elevations of the shell, and from the latter in having a shallower sinus and in lacking a divergent fold on each side of the median fold.

*Types.* — The holotype and two plesiotypes are preserved in the Museum of Paleontology of the University of Michigan, where they bear respectively the numbers 4836, 14814, and 14815.

*Occurrence.* — The holotype was collected from bed "C" of Winchell's section at locality 857. Although assigned by Winchell to his "Bryozoa Beds," bed "C" actually occupies a position within the "Acervularia Beds." Gravel Point stage.

The plesiotypes were collected from Winchell's "Acervularia Beds" (probably bed "B") at locality 861. Gravel Point stage.

*Spirifer bidorsalis* Winchell

(Plate IV, Figs. 24–31)

1866. *Spirifera bidorsalis* Winchell, The Grand Traverse Region, p. 93, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1897. *Spirifer bidorsalis* Schuchert, U. S. Geol. Surv., Bull. 87, p. 383.

*Original description.* — "Resembles *S. biplicata* and *bimesialis*, but is not produced at hinge extremities; has a high incurved ventral beak, and delicate, regular imbricating lamellae. Length 8.88 mm. (.35); breadth 12.7 mm. (.5). Very commonly parasitic on corals."

*Revised description.* — Shell small, wider than long, greatest width along hinge line, cardinal extremities angular. Dimensions of holotype (specimen measured by Winchell): length 8.9 mm., width 12.5 mm., thickness 7.3 mm.

Ventral valve moderately convex, greatest convexity posterior to the middle, flattening out to the cardinal extremities. Mesial sinus broad, moderately deep, curving sharply in the umbonal region, the curvature decreasing toward the anterior margin; marked by a single low median plication extending from the umbonal region to the anterior margin. Beak small, slightly incurved, turned to one side. Cardinal area high, concave; lateral margins distinct. Delthyrium twice as high as wide. Lateral slopes marked by seven to nine simple, rounded to angular plications.

Dorsal valve a little less convex than ventral, becoming flattened to slightly concave at the cardinal extremities. Lateral slopes marked by seven to nine simple, rounded to angular plica-

tions. Mesial fold moderately wide, well defined, but little elevated above the surface of the valve except anteriorly; divided by a median furrow, less prominent than those between the other plications, originating near the beak; axis of fold curved.

Surfaces of both valves covered by closely spaced imbricating growth lines.

*Remarks.* — This species may be readily identified by its small size, conspicuous imbricating growth lines, relatively high cardinal area, and curved fold with median groove and plicated sinus.

Single valves of *S. bidorsalis* are frequently found adhering to corals, which led to Winchell's erroneous statement that this species is parasitic on corals.

*Types.* — The holotype and two paratypes are preserved in the Hood Museum of Natural History at Alma College under number 2722 (Plastoholotype No. 14928 and plastoparatypes Nos. 15063 and 15064, Mus. Pal., U.M.). A drawing of the holotype made by Winchell is preserved in the library of the University of Michigan.

The metatype illustrated by Figures 28-31 of Plate IV is preserved in the Museum of Paleontology of the University of Michigan under number 14932.

*Occurrence.* — The types were collected from bed "C" of Winchell's "Acervularia Beds" at locality 861. Gravel Point stage.

*Spirifer consors* Winchell

(Plate IV, Figs. 32-37)

1866. *Spirifera consors* Winchell, The Grand Traverse Region, pp. 93-94, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.

1897. *Spirifer consors* Schuchert, U. S. Geol. Surv., Bull. 87, p. 386.

*Original description.* — "Semicircular, with salient hinge extremities, ventricose to the margin. Dorsal valve with little elevated but strongly isolated fold, having a median furrow throughout its whole length; ventral, most ventricose, especially near the incurved beak; having a broad, sharply-rounded, well-defined sinus reaching to the beak and destitute of a median

ridge. Dorsal area narrow; ventral elevated, arched and perforated by a triangular opening half as broad as high. Surface with about seven rounded plications each side of the middle, and crossed by feeble lines of growth. Length 11.68 mm. (.46); breadth 21.6 mm. (.85); depth of both valves 11.22 mm. (.44).

"Less mucronate, more ventricose, and with fewer plications than *S. subattenuata varicosa* and *bimesialis*. Much more ventricose than *S. bidorsalis*. Apparently identical with an undescribed species from Columbus, Ohio."

*Revised description.* — Shell small, subsemicircular in outline, with short mucronate cardinal extremities, wider than long, greatest width along the hinge line. Dimensions of holotype: length 14 mm., width 18.4 mm., thickness 11.6 mm.

Ventral valve strongly convex, greatest convexity a little posterior to the middle, flattening out to postero-lateral margins. Mesial sinus moderately wide and deep, rounded in the bottom, well defined throughout its length. Beak small, incurved; cardinal area of moderate height, concave, lateral margins well defined, sloping from the beak to the cardinal extremities with a gently convex curve. Delthyrium higher than wide; deltidial plates narrow. Each lateral slope marked by about eight to ten simple, rounded, radiating plications.

Dorsal valve slightly less convex than ventral, greatest convexity a little posterior to the middle, flattening out toward the cardinal extremities. Mesial fold scarcely elevated above the surface of the valve with indistinct furrow extending entire length; fold set off by a pair of furrows which are broader and deeper than those between the other plications. Surface marked by about eight to ten plications on each side of fold.

Surface of shell, when well preserved, marked by closely spaced imbricating lamellae.

*Remarks.* — These descriptions are based on specimens with shells largely or wholly exfoliated. Specimens with complete shells may show structures not conforming exactly with the types.

In his original description Winchell states that this species is "apparently identical with an undescribed species from Columbus, Ohio." So far as known, there is no brachiopod in the Devo-

nian of the region of Columbus, Ohio, which is identical with *Spirifer consors*. *Spirifer gregarius* Clapp or *Delthyris consorbina* (d'Orbigny) of the middle Devonian of the Columbus area may be the species which Winchell considered identical with *Spirifer consors*. Both species, however, are quite distinct from Winchell's species.

*Types*. — The holotype is preserved in the Hood Museum of Natural History at Alma College under number 2801. This specimen was drawn by Winchell (Plastoholotype No. 14720, Mus. Pal., U.M.).

A specimen in the Hood Museum, bearing the label "cotype," is numbered 2801a. In view of the fact that Winchell evidently considered this "cotype" a supplement to the "type" (holotype), the writers regard this specimen as a paratype.

The Museum of Paleontology of the University of Michigan has nine paratypes; six of these bear the number 4838; two, the numbers 4553 and 14719; and the ninth, a drawing of which was made by Winchell, the number 14452.

*Occurrence*. — The types were collected from Winchell's "Stromatopora Beds" at locality 856. Petoskey formation.

Winchell (table, p. 86) notes the occurrence of *Spirifer consors* in the "Pleurotomaria Bed," which occupies a position within the Charlevoix stage of Pohl. No specimens of the species have been found by the present writers in material collected by Winchell from this bed. It is possible that Winchell noted this occurrence in the field.

*Reticularia filicosta* (Winchell)

(Plate IV, Figs. 38-46)

1866. *Spirifera filicosta* Winchell, The Grand Traverse Region, p. 94, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.
1866. *Trematospira? liniuscula* Winchell, The Grand Traverse Region, p. 94, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.
1866. *Pentamerus intralineatus* Winchell, The Grand Traverse Region, p. 94, Ann Arbor, Michigan, Dr. Chase's Steam Printing House.
1897. *Spirifer filicosta* Schuchert, U. S. Geol. Surv., Bull. 87, p. 390.
1897. *Trematospira (?) liniuscula* Schuchert, U. S. Geol. Surv., Bull. 87, p. 454.
1897. *Pentamerella intralinea* Schuchert, U. S. Geol. Surv., Bull. 87, p. 303.

1932. *Pentamerella intralineata* Schuchert and Cooper, Genera of the Suborders Orthoidea and Pentameroidea, Mem. Peabody Mus. Nat. Hist., Yale Univ., 4, pt. 1, p. 176.

*Original description of Spirifera flicosta.* — "Form and two-thirds the size of *S. Parryana* Hall. Fold and sinus much less pronounced and, with the fewer plications, marked by numerous radial striae. Ventral beak much incurved; area not well defined."

*Original description of Trematospira? liniuscula.* — "Form and size of *T. perforata* Hall. Cast with numerous faint radiating lines. Ventral beak incurved, apparently imperforate. Dental lamellae two-fifths the length of the valve. Ocluser scars oval, deep. Dorsal valve with a transverse narrow area; false area of ventral valve with a triangular fissure extending to the beak. Fold and sinus reaching the beak, but very feeble."

*Original description of Pentamerus intralineatus.* — "Size of *P. occidentalis* Hall, but broader and more regularly (though faintly) costate on the anterior two-thirds, with shallow ventral sinus reaching to beak. Shell-fibres arranged concentrically. Exterior with numerous wavy, sub-lamellose, concentric grooves, and fine intervening striae; interior with numerous fine, radiating, grooved striae."

*Revised description.* — Shell large, transversely subelliptical in outline, with lateral margins symmetrically rounded, length of hinge line about three fourths of the width of shell, cardinal extremities rounded. Dimensions of imperfect ventral valve (holotype of *Pentamerus intralineatus*): length 27.6 mm., maximum width 28.5 mm., length along hinge line 17.5 mm., depth 9.0 mm. Dimensions of second imperfect ventral valve (cotype of *Spirifer flicosta* Winchell): length 22.0 mm., maximum width 25.7 mm., length along hinge line 22.5 mm., depth 10.0 mm. Dimensions of imperfect dorsal valve (cotype of *Spirifer flicosta*): length 19.5 mm., maximum width 26.0 mm., length along hinge line 18.2 mm., depth 7.0 mm. Dimensions of immature specimen (holotype of *Trematospira? liniuscula*): length of ventral valve 13.5 mm., length of dorsal valve 12.4 mm., maximum width of shell 16.2 mm., length along hinge line 11.3 mm., thickness 7.7 mm.

Ventral valve moderately convex, greatest convexity posterior to the middle, surface curving abruptly from umbonal region to cardinal margins, and much less abruptly to the anterior and lateral margins. Mesial sinus ill defined, shallow, narrow, originating in the umbonal region. Beak small, pointed, strongly incurved. Cardinal area high; lateral margins ill defined, curving into the lateral slopes with no marked differentiation. Delthyrium large, higher than wide, open. Internally, hinge teeth supported by a pair of strong dental lamellae extending at least two fifths of the length of valve, diverging at an angle of about 40 degrees; median septum slightly longer than lamellae. Muscle scars oval, elongate, nearly level with floor of valve, terminated anteriorly by a ridge connecting the anterior ends of lamellae and septum.

Dorsal valve slightly convex, greatest convexity near or posterior to the middle, surface curving gently to anterior and lateral margins, becoming flattened at the cardinal extremities. Mesial fold low, narrow, ill defined, extending from a point near the beak to the anterior margin. Beak small, scarcely projecting beyond the hinge line. Muscle scars narrow, indistinct, separated by a strong median septum.

Surfaces of valves covered by low, broad plications and concentric imbricating bands of minute spines. Some internal molds show a narrow, indistinct ridge in each furrow between plications. Inner surfaces of valves covered with fine radiating striae.

*Remarks.* — Specimens of this species were variously described by Winchell as *Spirifer filicosta*, *Pentamerus intralineatus*, and *Trematospira? liniuscula*. The cotypes of *S. filicosta* are internal molds, which retain a few fragments of shell that indicate their generic character. A single ventral valve, the holotype and only known specimen of *Pentamerus intralineatus*, unquestionably belongs to the same species. About one third of the shell material of this specimen is preserved. *Trematospira? liniuscula*, represented by a single specimen, is much smaller than the cotypes of *Reticularia filicosta*, but is undoubtedly a young specimen of this species.

*Types.* — Two cotypes are preserved in the Hood Museum of Natural History at Alma College under number 2802 (Plastocotypes Nos. 14761 and 14762, Mus. Pal., U.M.).

Six cotypes are preserved in the Museum of Paleontology of the University of Michigan under number 4840.

Two plesiotypes, the holotypes of *Pentamerus intralineatus* and *Trematospira? liniuscula*, are preserved in the same museum, where they bear the numbers 4835 and 4491 respectively.

*Occurrence.* — The six cotypes of *Reticularia filicosta* (No. 4840) and the holotype of *Trematospira? liniuscula* (No. 4491) were collected from bed "C" of Winchell's "Stromatopora Beds" at locality 856. Petoskey formation.

The two cotypes in the Hood Museum at Alma, Michigan, were collected from bed "B" of Winchell's section at the same locality. This bed is assigned by Winchell to his "Stromatopora Beds" on page 41 of his paper and to his "Pleurotomaria Beds" on page 84. The species is listed by Winchell (p. 86) as occurring only in the "Stromatopora Beds." In the opinion of the present writers it seems most probable that these cotypes were incorrectly labeled as coming from bed "B" and that they were obtained from bed "C."

The holotype of *Pentamerus intralineatus* was collected from bed "C" of Winchell's section at locality 857. This bed is included within the "Acervularia Beds," although assigned by Winchell to his "Bryozoa Beds."

*Spirifer consors* Winchell and *Athyris lens* Winchell occur in association with the cotypes of *Reticularia filicosta* (Winchell).

## PLATES AND EXPLANATIONS

All figures are of natural size unless otherwise indicated.

The museum in which each specimen used for illustration may be found has been indicated in the explanation of the plates. The abbreviations for these museums are as follows:

U.M. = Museum of Paleontology, University of Michigan.

H.M. = Hood Museum of Natural History, Alma College, Alma,  
Michigan.

Y.U. = Peabody Museum of Natural History, Yale University.

## EXPLANATION OF PLATE I

- Stropheodonta cincta* Winchell P. 149
1. Ventral view of a largely exfoliated metatype. (No. 2769, H.M.)
  2. Lateral view of same specimen, showing great convexity of ventral valve
  3. View of a partly exfoliated dorsal valve. Metatype. (No. 4070, U.M.)
- Stropheodonta erratica* Winchell P. 150
- 4-6. Ventral, dorsal, and lateral views of a cotype, showing shape of shell and character of plications. (No. 2704, H.M.)
  - 7-9. Ventral, dorsal, and lateral views of second cotype. (No. 2704, H.M.)
- Stropheodonta erratica* var. *fissicosta* Winchell P. 151
- 10-12. Ventral, dorsal, and lateral views of a cotype, showing character of plications and convexity of shell. (No. 2704, H.M.)
  13. Ventral view of second cotype. (No. 2704, H.M.)
- Stropheodonta erratica* var. *solidicosta* Winchell P. 153
- 14-16. Ventral, dorsal, and lateral views of a cotype showing shape of shell and character of plications. (No. 2705, H.M.)
  - 17-19. Ventral, dorsal, and lateral views of second cotype. (No. 2705, H.M.)
- Schuchertella anomala* (Winchell) P. 154
20. Dorsal valve, encrusted with bryozoan and *Spirorbis*, showing shape. Holotype. (No. 2710, H.M.)
  21. Interior of holotype, showing cardinal process, crural plates, dental sockets, and muscle scars
  22. Lateral view of holotype, showing its convexity
  23. Fragment of ventral valve, showing surface markings. Metatype. (No. 14743, U.M.)
  - 24-25. Exterior and interior of ventral valve. Metatype. (No. 14741, U.M.)
  26. Lateral view of same specimen, showing attitude of cardinal area in relation to the plane of the valve
  27. Cardinal area of same specimen, showing deltidium and perideltidial area.  $\times 2$

PLATE I



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## EXPLANATION OF PLATE II

### *Chonetes emmetensis* Winchell

P. 156

2. Three ventral valves enlarged ( $\times 2$ ) to show spines and details of plications and growth lines. Metatypes (same specimens as three shown in upper part of Figure 3). (No. 14812, U.M.)
3. Group of seven metatypes, showing four ventral valves, two dorsal valve interiors, and one ventral valve interior. (No. 14812, U.M.)
6. Interior of a dorsal valve, showing cardinal process, muscle scars, and papillae.  $\times 2$ . Metatype. (No. 14813, U.M.)
- 8-10. Ventral, dorsal, and lateral views of cotype.  $\times 2$ . (No. 2742, H.M.)
- 11-13. Lateral, ventral, and dorsal views of metatype, showing prominent spine bases.  $\times 2$ . (No. 14931, U.M.)

### *Leptalosia radicans* (Winchell)

P. 158

1. View of cotype, showing concave, lamellose dorsal valve and cardinal area, and spines of ventral valve.  $\times 4$ . (No. 14933, U.M.)
4. View of interiors of two ventral valves illustrated by Beecher in fig. 14, pl. 9, *Am. Journ. Sci.*, Vol. 50, 1890.  $\times 2$ . Metatypes. (Y.U.)
5. Interior of a brachial valve, illustrated by Beecher in fig. 16, pl. 9, of same paper, showing cardinal process and muscle scars.  $\times 4$ . Metatype. (Y.U.)
7. Group of nine ventral valves on peritheca of *Prismatophyllum*.  $\times 4$ . Cotypes. (No. 4156, U.M.)

PLATE II



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2



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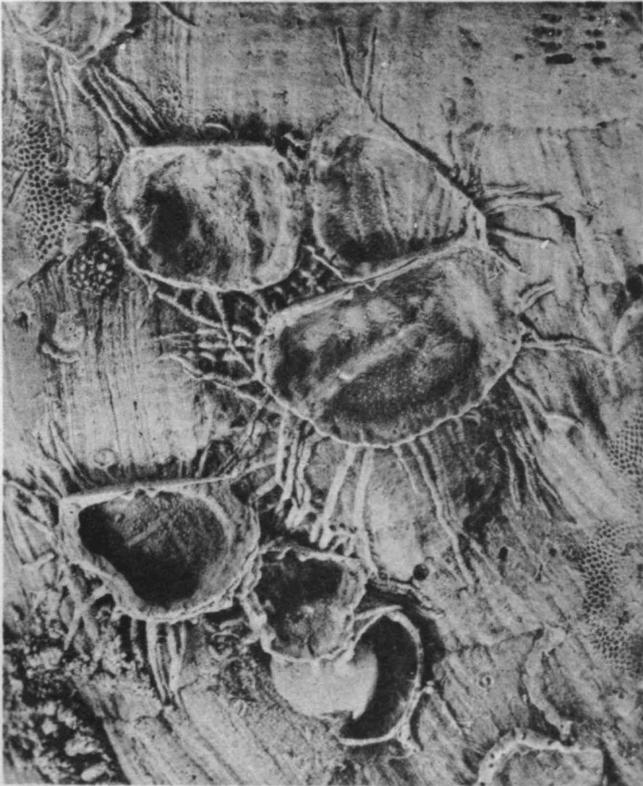
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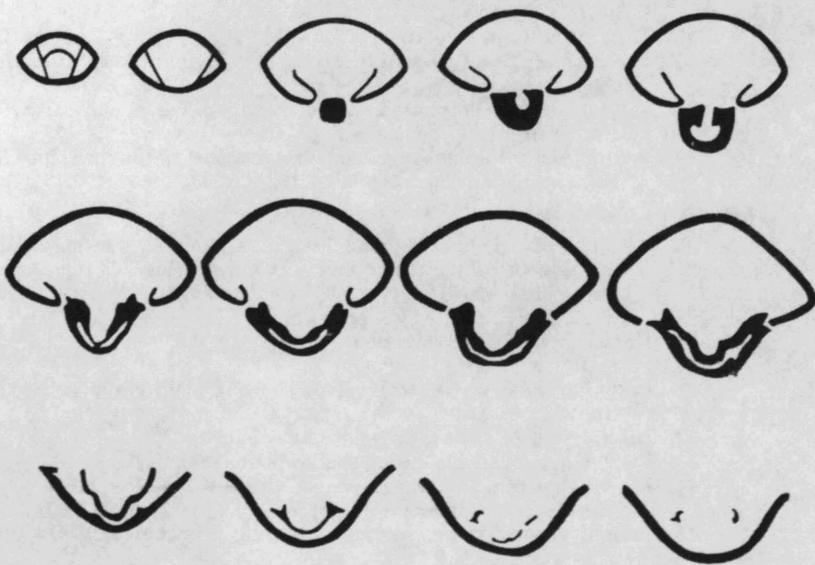
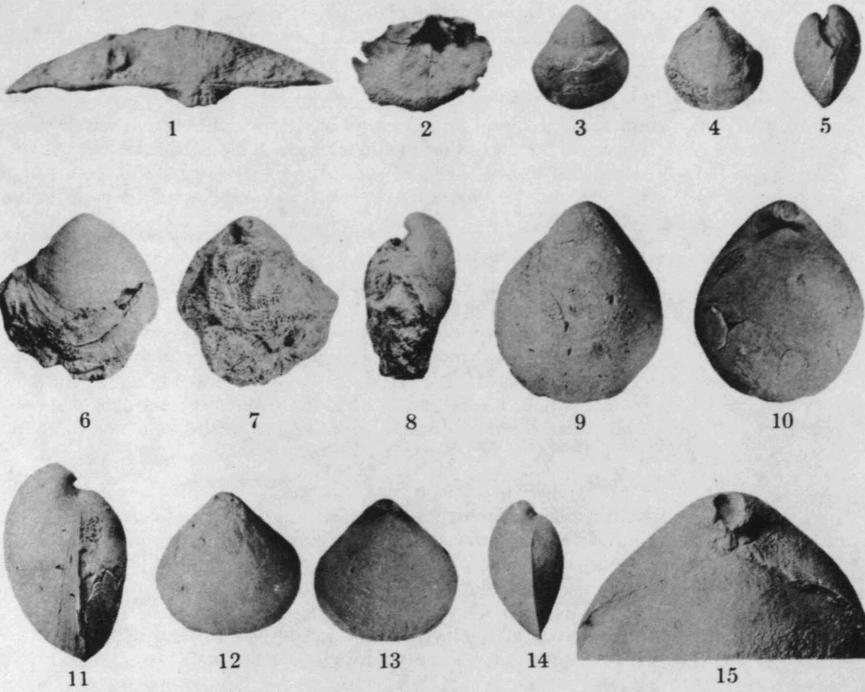


13

### EXPLANATION OF PLATE III

- Schuchertella anomala* (Winchell) P. 154
1. View showing cardinal process.  $\times 2$ . Metatype. (No. 14742, U.M.)
  2. Interior of dorsal valve. Paratype. (No. 2710, H.M.)
- Pentamerella althyroides* (Winchell) P. 159
- 3-5. Ventral, dorsal, and lateral views of holotype. (No. 4833, U.M.)
- Stuartella traversensis* (Winchell) P. 161
- 6-8. Ventral, apertural, and lateral views of holotype. (No. 2762, H.M.)
  - 9-14. Ventral, dorsal, and lateral views of two metatypes, showing variation in shape. (Nos. 14848 and 14845, U.M.)
  15. A metatype showing pseudodeltidium.  $\times 2$ . (No. 14850, U.M.)
  16. A series of thirteen cross-sections, showing the dental lamellae and pseudosyrinx of ventral valve and crura, socket plates, and hinge plate of the dorsal valve.  $\times 2$ . Metatype. (No. 14847, U.M.)

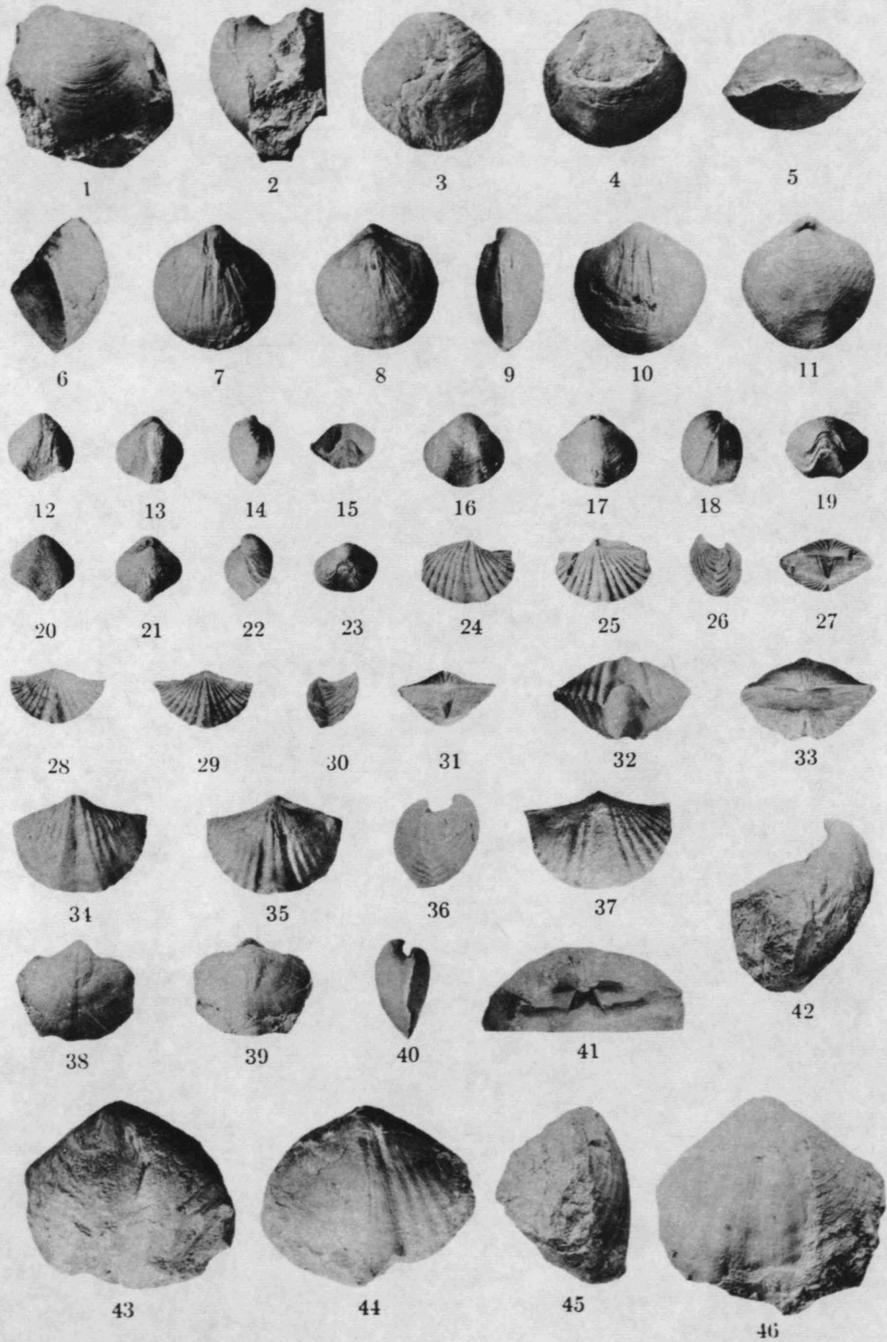
PLATE III



## EXPLANATION OF PLATE IV

- Athyris eborea* (Wincheli) P. 163  
 1-2. Ventral and lateral views of holotype.  $\times 2$ . (No. 2770, H.M.)  
 3-6. Ventral, dorsal, anterior, and lateral views of paratype.  $\times 2$ . (No. 2770, H.M.)
- Athyris lens* (Winchell) P. 165  
 7-9. Ventral, dorsal, and lateral views of cotype, an internal mold, showing vascular and muscular markings. (No. 2806, H.M.)  
 10-11. Ventral and dorsal views of plesiotype, showing vascular markings of ventral valve and concentric lamellae of dorsal valve. (No. 14733, U.M.)
- Athyris sesquiplicata* (Winchell) P. 166  
 12-15. Ventral, dorsal, lateral, and anterior views of holotype, an internal mold. (No. 4836, U.M.)  
 16-19. Ventral, dorsal, lateral, and anterior views of a plesiotype, a gerontic shell, showing character of sinus and fold and convexity of valves. (No. 14815, U.M.)  
 20-23. Ventral, dorsal, lateral, and anterior views of second plesiotype, an unexfoliated shell which is very similar to the holotype in shape. (No. 14814, U.M.)
- Spirifer bidorsalis* Winchell P. 168  
 24. Ventral view of holotype, showing angular plications, imbricating lamellae, and curved sinus with median plication. (No. 2722, H.M.)  
 25. Dorsal view of holotype, showing curved fold with median furrow  
 26. Lateral view of holotype, showing high cardinal area  
 27. Cardinal area of holotype, showing delthyrium and deltidial plates  
 28-31. Ventral, dorsal, lateral, and cardinal views of metatype. (No. 14932, U.M.)
- Spirifer consors* Winchell P. 169  
 32. Anterior view of holotype, an internal mold showing low fold and sinus. (No. 2801, H.M.)  
 33. Posterior view of holotype  
 34-35. Ventral and dorsal views of holotype, showing plications, sinus, and fold  
 36. Lateral view of holotype, showing convexity of valves and curvature of cardinal area of ventral valve  
 37. Ventral view of a metatype which retains part of the shell, showing imbricating lamellae. (No. 14719, U.M.)
- Reticularia filicosta* (Winchell) P. 171  
 38. Ventral valve of small individual, an internal mold, showing muscle scars, low broad plications, and very narrow ridges in furrows between plications. Holotype of *Trematospira? liniuscula* Winchell. (No. 4491, U.M.)  
 39. Dorsal view of same specimen  
 40. Lateral view of same specimen  
 41. Posterior view of ventral valve, showing delthyrium. Cotype. (No. 2802, H.M.)  
 42. Lateral view of same valve, showing convexity  
 43. View of same valve, showing shallow sinus indistinctly  
 44. Dorsal view of a second cotype, showing low fold, low broad plications, and striations on internal mold. (No. 2802, H.M.)  
 45. Lateral view of same specimen, showing low convexity of dorsal valve  
 46. View of ventral valve, showing concentric imbricating bands of spines on the right side and the striations on the internal mold on the left side. Holotype of *Pentamerus intralineatus* Winchell. (No. 4835, U.M.)

PLATE IV









(Continued from inside of front cover)

- of Michigan, by G. M. Ehlers and T. E. White. Pages 93-100, with 5 plates. Price, \$.20.
5. *Gypidula petoskeyensis*, Sp. Nov., a New Brachiopod from the Traverse Group of Michigan, by R. W. Imlay. Pages 101-103, with 1 plate. Price, \$.15.
  6. A Specimen of a Long-nosed Dolphin from the Bone Valley Gravels of Polk County, Florida, by E. C. Case. Pages 105-113, with 2 plates. Price, \$.20.
  7. Description of a Skull of *Kannemeyeria erithrea* Haughton, by E. C. Case. Pages 115-127, with 2 plates and 4 text figures. Price, \$.25.
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  10. Revision of Alexander Winchell's Types of Brachiopods from the Middle Devonian Traverse Group of Rocks of Michigan, by G. M. Ehlers and Virginia Kline. Pages 143-176, with 4 plates, 1 text figure, and 1 map. Price, \$.35.
  11. A Preliminary Study of the Fossil Flora of the Michigan Coal Basin, by Chester A. Arnold. Pages 177-204, with 7 plates and 1 map. Price, \$.35.
  12. Common Ostracoda of the Traverse Group, by Aldred S. Warthin, Jr. Pages 205-226, with 1 plate. Price, \$.25.

