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New Species of Brachiopods¹ from the Traverse Group (Devonian) of Michigan

BY JOHN IMBRIE¹

INTRODUCTION

The present paper describes two species of brachiopods from Devonian rocks of the Michigan region, *Pholidostrophia gracilis* Imbrie, new species, and *Strophodonta extenuata* Imbrie, new species. Both species are considered polytypic, hence the categories treated here include six new subspecies: *P. g. gracilis*, *P. g. nanus*, *S. e. extenuata*, *S. e. rockportensis*, *S. e. bellensis*, and *S. e. ferrenensis*.

The type material on which these species and subspecies are based is housed at the United States National Museum. The holotype of *S. e. extenuata* was collected from an abandoned shale pit of the Alpena Portland Cement Company, SE $\frac{1}{4}$ Sec. 18, T. 32 N., R. 9 E., Alpena County, Michigan. Holotypes of all the other categories mentioned in this paper come from beds exposed in the quarry of the Kelly Island Lime and Transport Company, Rockport, Michigan.

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¹ Research Associate, the American Museum of Natural History, and Associate Professor of Geology, Columbia University.

DESCRIPTIONS OF SPECIES AND SUBSPECIES

GENUS *STROPHODONTA* HALL, 1850*Strophodonta extenuata* Imbrie, new species

Figures 1-20

DISTINGUISHING CHARACTERS: Although this species exhibits an extraordinarily wide range of variation, several features combine to distinguish it without difficulty from known congeneric forms. The outline, although variable, is always markedly wider than long and generally subsemicircular. The lateral profile is always moderately to strongly concavo-convex. Two extremes of ornamentation, with intermediate types, occur: some shells possess subequal and angular costellae, numbering about 13 per 5 mm. at midlength, and decreasing regularly and gradually in size as they increase in number from beak to margin; other forms have costellae markedly coarser umbonally and decreasing rapidly in size as they increase in number to about 13 per 5 mm. near the front margin.

DESCRIPTION: Shells of medium size. Outline variable, subsemicircular to transversely subelliptical; slightly mucronate. Slopes to cardinal extremities moderately concave; lateral profile moderately to deeply concavo-convex. Ornamentation varying between two extremes: some forms with costellae numbering about 13 per 5 mm. at midlength and increasing in number gradually from beak to front margin as they decrease in size; others with markedly larger umbonal costellae, decreasing in size rapidly marginally. Costellae low, subround to subangular, about equal to striae in width.

Pedicle valve: Lateral profile varying from moderately to strongly convex, generally evenly convex. Anterior profile generally evenly and either moderately or strongly convex. Rarely subcarinate. Umbonal region gently to moderately inflated. Interarea low. Interior with adductor scar from one-third to one-half of the length of the muscle field; extremities of ventral process narrowly divergent and projecting as tiny bosses.

Brachial valve: Anterior profile commonly evenly and moderately concave. Lateral profile either with greatest concavity between midlength and the front margin, or evenly and moderately concave. Interior typical of the genus.

OCCURRENCE: The species is known from the Bell, Rockport Quarry, Ferron Point, and Genshaw formations in Michigan, and from the Arkona shale of Ontario.

Strophodonta extenuata bellensis Imbrie,
new species and subspecies

Figures 16-20

DISTINGUISHING CHARACTERS: The following characteristics distinguish this subspecies from conspecific groups: (1) small size; (2) subquadrate outline; (3) deeply concavo-convex lateral profile; (4) gently inflated umbonal region; (5) subgeniculate profile; (6) finely and rather uniformly multicostellate ornamentation.

DESCRIPTION: Shell small. Outline subquadrate, a little wider than long, slightly mucronate. Profile commonly strongly concavo-convex. Ornamentation uniformly and finely multicostellate; costellae low, rounded, subequal, numbering about 17 in a distance of 5 mm.

Pedicle valve: Lateral profile moderately to strongly convex, with point of greatest convexity between midlength and front margin. Anterior profile evenly convex. Umbonal region gently inflated.

Brachial valve: Lateral and anterior profiles gently and evenly concave. Umbonal region depressed.

MEASUREMENTS OF HOLOTYPE: Length, 21 mm.; width, 24 mm.; thickness, 8 mm.

OCCURRENCE: Bell shale of Michigan.

HOLOTYPE: U.S.N.M. No. 124325 from the upper Bell shale.

Strophodonta extenuata rockportensis Imbrie,
new species and subspecies

Figures 6-10

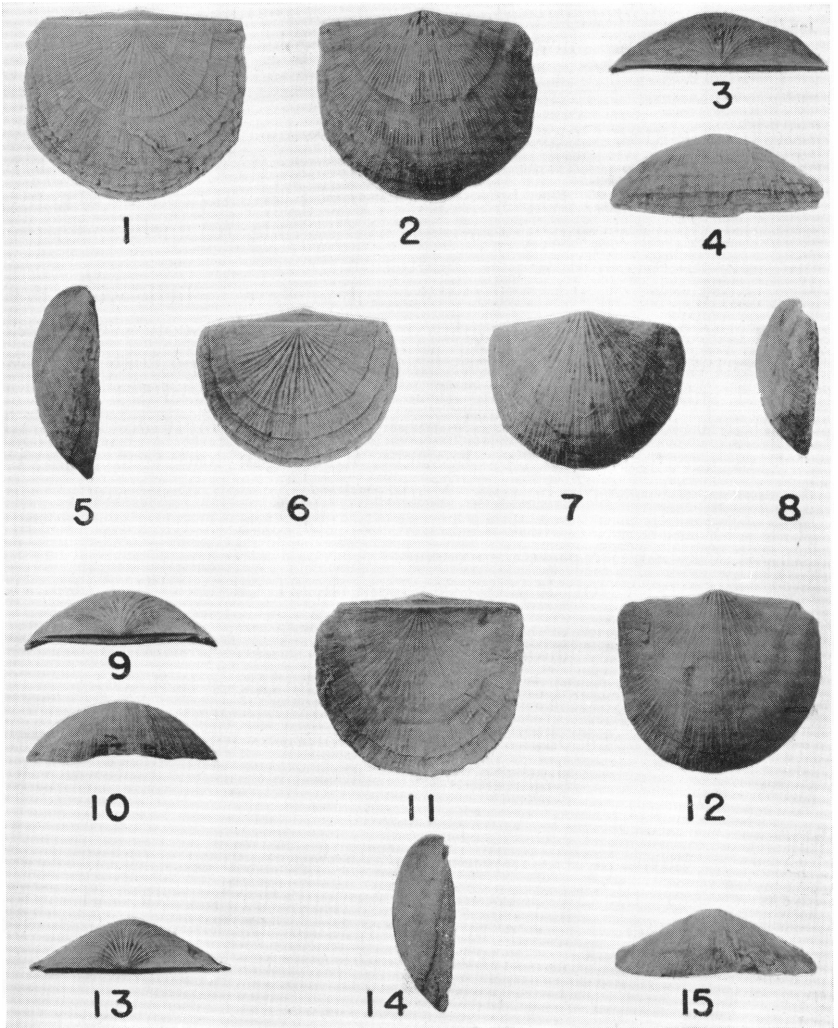
DISTINGUISHING CHARACTERS: This subspecies resembles *S. extenuata extenuata* in the character of its ornamentation, but differs in being larger and flatter. The ornamentation, large size, and relatively low convexity distinguish *S. extenuata rockportensis* from other conspecific groups.

DESCRIPTION: Shell large, commonly 30 mm. long. Outline transversely subelliptical. Lateral profile slightly or moderately convex. Ornamentation as in *S. extenuata extenuata*.

Pedicle valve: Lateral and anterior profiles evenly convex. Umbonal region commonly slightly swollen.

Brachial valve: Lateral and anterior profiles gently and evenly concave.

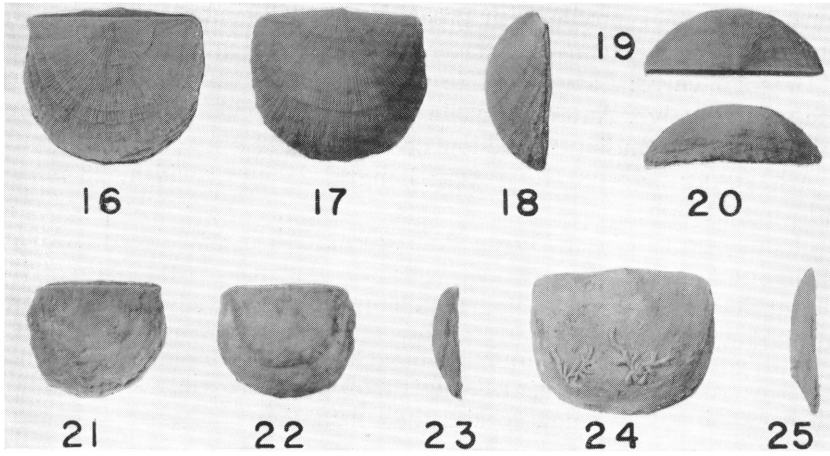
MEASUREMENTS OF HOLOTYPE: Length, 22 mm.; width, 26 mm.; thickness, 7 mm.



FIGS. 1-5. Holotype of *Strophodonta extenuata ferronensis* Imbrie. $\times 1$.
 1. Brachial view. 2. Pedicle view. 3. Posterior view. 4. Anterior view.
 5. Lateral view.

FIGS. 6-10. Holotype of *Strophodonta extenuata rockportensis* Imbrie. $\times 1$.
 6. Brachial view. 7. Pedicle view. 8. Lateral view. 9. Posterior view. 10.
 Anterior view.

FIGS. 11-15. Holotype of *Strophodonta extenuata extenuata* Imbrie. $\times 1$.
 11. Brachial view. 12. Pedicle view. 13. Posterior view. 14. Lateral view.
 15. Anterior view.



FIGS. 16-20. Holotype of *Strophodonta extenuata bellensis* Imbrie. $\times 1$. 16. Brachial view. 17. Pedicle view. 18. Lateral view. 19. Posterior view. 20. Anterior view.

FIGS. 21-23. Holotype of *Pholidostrophia gracilis gracilis* Imbrie. $\times 1$. 21. Brachial view. 22. Pedicle view. 23. Lateral view.

FIGS. 24-25. Holotype of *Pholidostrophia gracilis nanus* Imbrie. $\times 2$. 24. Pedicle view. 25. Lateral view.

OCCURRENCE: Lower 8 inches of the Rockport Quarry limestone of Michigan.

HOLOTYPE: U.S.N.M. No. 124327 from the Rockport Quarry limestone.

Strophodonta extenuata extenuata Imbrie,
new species and subspecies

Figures 11-15

DISTINGUISHING CHARACTERS: The following characters distinguish this subspecies: (1) transversely subsemicircular outline; (2) moderately to strongly concavo-convex profile; (3) inflated umbo; (4) the character of the ornamentation.

DESCRIPTION: Shell of medium size. Outline transversely subsemicircular. Lateral profile moderately to deeply concavo-convex. Ornamentation multicostellate; costellae rounded and coarse umbonally, rapidly increasing in number and decreasing in size towards the margin, where the rib count is about 13 in a distance of 5 mm.; costellae subangular to subround, narrower than striae; striae rounded.

Pedicle valve: Lateral profile moderately to strongly and evenly

convex. Anterior profile with greatest convexity along the midline, sloping with gentle convexity laterally. Umbonal region swollen.

Brachial valve: Lateral profile moderately convex, shallower than the pedicle valve. Anterior profile with greatest concavity along the midline, corresponding to the low pedicle carina.

MEASUREMENTS OF HOLOTYPE: Length, 25 mm.; width, 28 mm.; thickness, 8 mm.

OCCURRENCE: Lower Ferron Point formation of Michigan; Arkona shale of Ontario.

HOLOTYPE: U.S.N.M. No. 124326 from the lower Ferron Point formation.

Strophodonta extenuata ferronensis Imbrie,
new species and subspecies

Figures 1-5

DISTINGUISHING CHARACTERS: In ornamentation this subspecies resembles *S. extenuata bellensis*, but it may be distinguished by its larger size and the even convexity of the pedicle valve. In shape it resembles specimens of *S. extenuata rockportensis*, but it differs in ornamentation.

DESCRIPTION: Of medium size. Outline transversely subelliptical to subquadrate, width a little greater than length. Lateral profile moderately concavo-convex. Ornamentation commonly as in *S. extenuata bellensis*, rarely with coarser umbonal costellae.

Pedicle valve: Lateral and anterior profiles evenly and gently to moderately convex. Umbonal region gently inflated.

Brachial valve: Lateral and anterior profiles evenly and gently concave, shallower than pedicle valve. Umbonal region slightly depressed.

MEASUREMENTS OF HOLOTYPE: Length, 26 mm.; width, 30 mm.; thickness, 8 mm.

OCCURRENCE: Upper Ferron Point formation of Michigan; Arkona shale of Ontario.

HOLOTYPE: U.S.N.M. No. 124333 from the upper Ferron Point formation.

GENUS *PHOLIDOSTROPHIA* HALL AND CLARKE, 1892

Pholidostrophia gracilis Imbrie, new species

Figures 21-25

DISTINGUISHING CHARACTERS: The following characters distinguish this species: (1) narrow outline, with lateral margins tapering con-

tinuously anteriorly from the cardinal extremities; (2) very low and even profile; (3) thin, closely appressed valves.

DESCRIPTION: Size variable, commonly large. Outline transversely subelliptical to subquadrate; length-width ratio high for the genus, about 0.85; hinge width the greatest width; cardinal extremities acute, lateral margins tapering continuously forward from the cardinal extremities. Lateral profile gently and evenly concavo-convex.

Pedicle valve: Lateral and anterior profiles very gently and evenly convex. Umbonal region slightly swollen. Interior with diductors extending to or beyond the midpoint of the valve.

Brachial valve: Lateral and anterior profiles greatly and evenly convex. Adductor field typical of the genus.

OCCURRENCE: The species is known from the Bell, Rockport Quarry, Ferron Point, and Genshaw formations.

Pholidostrophia gracilis gracilis Imbrie,
new species and subspecies

Figures 21-23

DESCRIPTION: Mean length about 16 mm., with a few individuals 25 mm. long. Otherwise as described for the species.

MEASUREMENTS OF HOLOTYPE: Length, 16 mm.; width, 19 mm.; thickness, 3.6 mm.

OCCURRENCE: Lower Bell shale, Rockport Quarry limestone, Ferron Point formation, and Genshaw formation.

HOLOTYPE: U.S.N.M. No. 124318 from the Rockport Quarry limestone.

Pholidostrophia gracilis nanus Imbrie,
new species and subspecies

Figures 24-25

DESCRIPTION: Mean length about 11 mm., with largest individual about 13 mm. long. Otherwise as described for the species.

MEASUREMENTS OF HOLOTYPE: Length, 10.3 mm.; width, 12.8 mm.; thickness, 2.0 mm.

OCCURRENCE: Upper 12 feet of Bell shale.

HOLOTYPE: U.S.N.M. No. 124320 from the upper Bell shale.

