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Pentameracea of the Devonian
of Northern Iowa

C. H. Belanski

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PENTAMERACEA OF THE DEVONIAN OF NORTHERN IOWA

BY

C. H. BELANSKI

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PENTAMERACEA OF THE DEVONIAN OF NORTHERN IOWA

C. H. BELANSKI

This paper discusses fifteen species of fossil brachiopods belonging to the superfamily Pentameracea. They are found in the Upper Devonian strata of northern Iowa. The Wapsipinicon and State Quarry stages do not occur in the northern area and although beds of Cedar Valley age do occur, they have as yet yielded no pentameroids. The most richly fossiliferous beds of the area are in the Hackberry and Shellrock stages and it is from these two formations that most of the following species were obtained.

To clear up certain obscure points regarding the genus *Gypidula* it has been necessary to re-describe *G. comis* and *G. occidentalis*, both of which are from Cedar Valley strata of south-central Iowa. One other Cedar Valley species, *Camarophoria swallovi* (Branson), is included for comparison with northern members of the genus. Later, it is hoped that all of the Pentameracea of the Iowa Devonian may be dealt with in one paper. This, however, must be deferred until the Cedar Valley and Wapsipinicon stages are more fully known.

Three genera, *Gypidula*, *Sieberella* and *Camarophoria*, are the only pentameroid shells known to occur in the Shellrock and Hackberry stages. Of these *Camarophoria* is the most prolific, both in species and in individuals. The genus has not heretofore been reported from the Iowa Devonian, in which it has a wide geographical distribution and great vertical range although each horizon has its own sharply defined species. The genus *Sieberella* is also new to the Iowa Devonian but its representatives are few in comparison with the other pentameroids and apparently they are confined to the members of the Shellrock stage. The genus *Gypidula* is fairly common in the northern Devonian. In the Shellrock strata specimens occur in most of the zonules, but in the Hackberry stage the genus appears to be confined to three thin horizons, each separated from the others by a considerable vertical interval. Five species of this genus are described from these two stages, although considerable material too fragmentary for description indicates the presence of other species at different levels.

Before taking up the descriptions it will be well to discuss briefly the strata of the Northern Iowa Devonian so that the horizons of the different species may be fixed. Beds of Cedar Valley age are well developed and they attain a thickness of nearly 120 feet. These northern strata differ markedly from the Cedar Valley beds of central and southern Iowa, not only in their lithologic character but in their faunal content as well; the two areas show strata that ap-

STAGE	SUBSTAGE
HACKBERRY	OWEN
	CERRO GORDO
JUNIPER HILL	
SHELLROCK	NORA
	ROCK GROVE
	MASON CITY
CEDAR VALLEY	UNDIVIDED

Fig. 1. Diagram illustrating the succession of beds in the Upper Devonian of Northern Iowa.

parently represent two distinct provinces, although they are almost continuously exposed from Davenport to the Minnesota line. For the strata of this northern province it may eventually be necessary to provide distinct names, but at present no attempt is made to subdivide them. The Upper Davenport limestones of the Iowa Survey are here made the basal member of the Cedar Valley stage, thus removing them from the Wapsipinicon stage.¹ Since both the "Spir-

¹ This is in accordance with field work done by Dr. Merrill A. Stainbrook. (Unpublished thesis, State University of Iowa).

ifer pennatus beds" and the "Acervularia profunda beds" of central Iowa have been well discussed by Calvin, it is not necessary to redefine or to relocate them.

The beds forming the Shellrock stage consist of from thirty to eighty feet of limestones, shales and dolomites which are known only in parts of Floyd, Butler, Cerro Gordo and Worth counties. They overlie Cedar Valley strata of the northern province and are separated from them by a strong unconformity, and moreover show a marked overlap to the south and east. The Shellrock fauna bears but slight resemblance to the faunas of either the northern or southern Cedar Valley provinces. On the other hand, the Shellrock fauna shows a marked resemblance to that of the Cerro Gordo member of the Hackberry; a large number of genera are common to both although in most cases the species of each are distinct. The Shellrock stage has been fully discussed in another paper² and the subdivisions given in that paper need not be repeated here.

Resting unconformably upon the Shellrock strata, and in much the same geographical area, are the heavily bedded, bluish, mud shales of the Juniper Hill stage. These attain a thickness of from forty to fifty feet and preserve a lithologic and faunal unity throughout. Although in various papers of the Iowa Survey these shales have been united with the overlying Hackberry beds, they would seem to merit separate stage rank on the basis of their marked lithologic and faunal differences. The line of contact between the two formations, although not marked by an erosion plane, is very distinct and the transition from the fine mud shales of the Juniper Hill to the gritty shales of the Cerro Gordo is abrupt. The Juniper Hill stage is characterized by an abundance of plant remains and a fauna consisting largely of thin shelled brachiopods and molluscs. Some twenty species are known thus far, two of the most common being *Lingula fragila* Webster and *Iowaspongia annulata* Thomas. With the exception of *Ptyctodus calceolus* N. & W. no species common to the two formations is known.

As here used, the Hackberry stage follows largely the terminology of Fenton and Fenton,³ although it has been necessary, for various reasons, to change the names of some of the minor units. Beds of this stage attain a thickness of from sixty to ninety feet, the lower, or Cerro Gordo member, being composed of shale and shaly lime-

² Am. Mid. Nat. Vol. X, No. 10, 1927.

³ Cont. Mus. Geol. Univ. Mich. Vol. 1, 1924.

stone and reaching sixty feet in thickness. The upper twenty to thirty feet, largely limestone and dolomite, forms the Owen sub-stage. The Hackberry fauna begins abruptly in the *Xenocidaris* zonule, in which occurs about one-third of the nearly three hundred species of the Hackberry fauna.

The generic determination of nearly all species herein described has been ascertained by sectioning the rostral portion of the shells and wherever possible illustrations of a representative series of sections of each species accompanies the description. Virtually all of the material upon which this paper is based is in the writer's personal collection which is in the geological museum of the State University of Iowa. This collection has its own catalogue, and specimen numbers are followed by the letters C. H. B. A number of pleisotypes and paratypes are from the collection of the University of Iowa (S. U. I.) and one or two species are also thus represented in the University of Cincinnati Museum (U. C. M.) and the United States National Museum (U. S. N. M.).

The writer wishes to express his appreciation to Dr. A. O. Thomas of the State University of Iowa for his valuable aid in the preparation of this paper. Dr. Thomas has gone over the manuscript thoroughly and his kindly advice and criticisms have been most helpful.

Genus—**GYPIDULA**—Hall

Description:—Shells of medium size or smaller, subrotund in shape, subpentagonal to subovate in outline, the width generally slightly less than the length; the cardinal extremities rounded. Pedical valve strongly convex, the umbonal area prominent, the beak bluntly pointed and more or less incurved; marked anteriorly by a median fold which may range from strong to nearly obsolete. Surface marked by strong plications or folds which may be very weak and marginal in disposition, or may be strong and affect nearly the entire valve; they are present on both the fold and lateral slopes, those on the fold usually being the strongest. Cardinal area triangular, its margins not sharply defined, marked by transverse wrinkles and in some cases by fine vertical striae. Delthyrium triangular and open. Internally, the dental lamellæ unite to form a triangular spondylium which continues forward to or beyond the midlength, being supported for a part of its length by a strong median septum. Brachial valve generally much less convex than the pedicle, in rare cases equally convex. Beak small and strongly

incurved. Mesial sinus of varying degrees of strength but generally failing to reach posterior to the midlength. Plications similar to those of the pedicle valve but considerably shorter. Internally, the hinge-plate is divided by a narrow crural cavity. The crural plates rest directly upon the floor of the valve. As seen in cross-section they form a harp-shaped design, the upper curved portion, representing the crura, generally more or less inclined outward; their

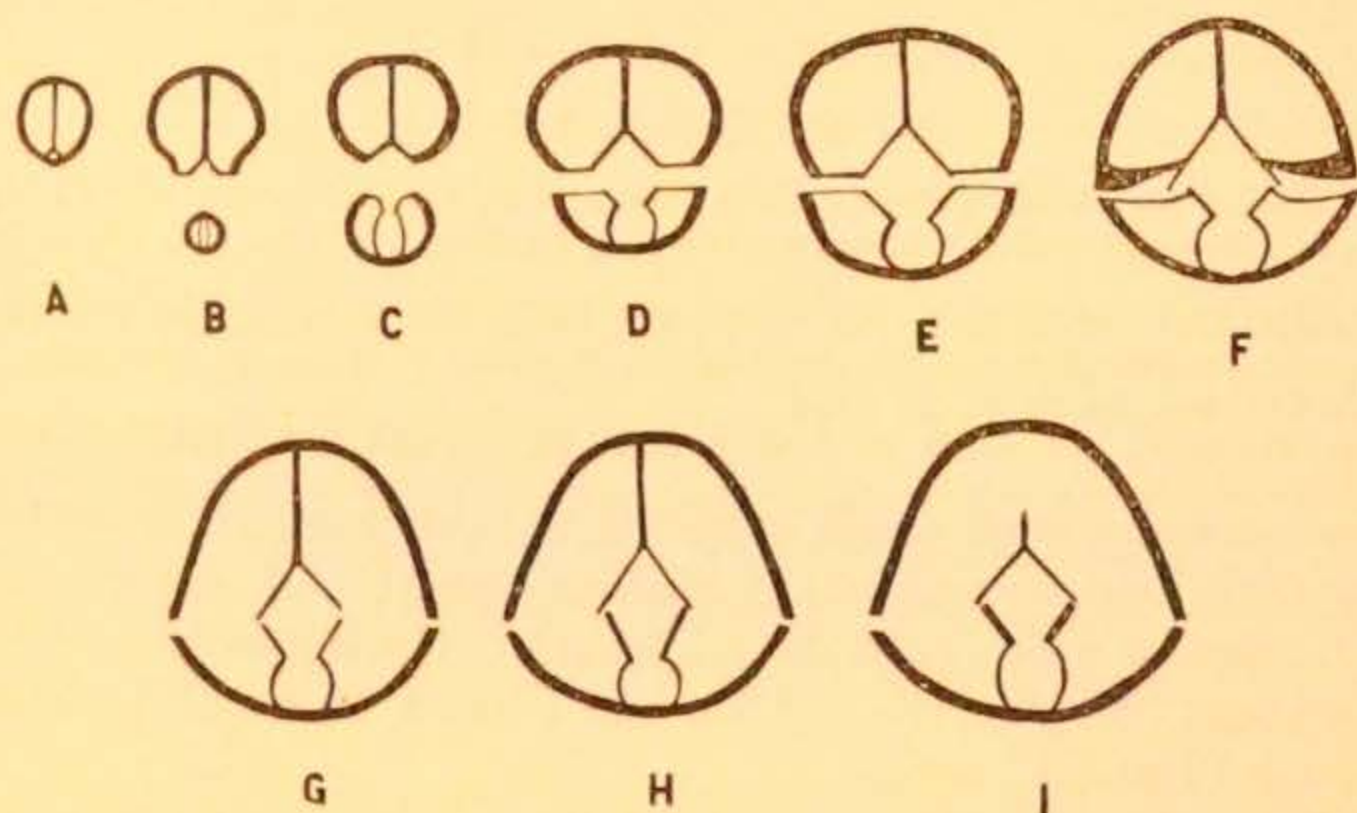


Fig. 2. A series of nine cross-sections (x2) from the rostral portion of the shell of *Gypidula occidentalis*, the genotype. Note the long median septum of the pedicle valve and the nearly erect crura and high crural septa of the brachial valve.

lower portions, here termed the crural septa, rather low, nearly vertical and separated from each other by considerable space.

Remarks:—The genus *Gypidula* was originally based on plicate pentameroid shells having the fold on the pedicle valve, a sinus on the brachial valve and with a distinct cross-striated cardinal area. Particular emphasis was laid upon the last character and but little import was attached to the internal structure. The original definition, although permitting ready separation from *Pentamerella*, would also include shells belonging to *Sieberella* of Ehlert. Apparently Hall, Hall and Clarke, and Ehlert overlooked the fact that *Sieberella* has a well defined cardinal area. Their different descriptions state that the beaks of the latter genus are strongly incurved and in contact but no reference is made to the cardinal area.

Externally, *Gypidula* and *Sieberella* are very similar, about the only difference being in the more numerous plications of *Sieberella*. In the genotype of *Gypidula*, *G. occidentalis* Hall, the crural septa

of the brachial valve are separate and attached directly to the floor, whereas in the genotype of *Sieberella*, *S. sieberi* (Von Buch), the crural septa unite to form a spondylium which is supported by a distinct median septum. Internally, the pedicle valves of the two genera are quite similar. Consequently, this leaves but one fundamental character by which to distinguish the shells of these two genera, namely the character of the crural plates.

Gypidula occidentalis Hall

Plate II, figs. 1-8

Pentamerus occidentalis Hall, Geol. of Iowa, Vol. 1, pt. 2, p. 514, Pl. VI, figs. 2a, b, c. 1858. Not *Pentamerus occidentalis* Hall, Pal. N. Y., Vol. II, p. 341. 1852.

Gypidula occidentalis Hall, Pal. N. Y., Vol. IV, p. 380, Pl. 58A, figs. 1-8. 1867.

Gypidula comis Hall and Clarke, Pal. N. Y., Vol. VIII, pt. 2, pp. 247, 248, Pl. LXXII, figs. 18-20, 22, 23. 1894.

Gypidula comis Schuchert, U. S. G. S. Bull. 87, pp. 225, 226. 1897.

Description:—Shell small, subovate to subtriangular in outline, wider than long or occasionally with the length and width nearly equal, greatest width near the midlength. The dimensions of two plesiotypes: length 16.5 and 13. mm.; width 18.3 and 16. mm.; thickness 12. and 9.5 mm.

Pedicle valve strongly convex, with the greatest curvature in the umbonal region. Surface arching from the beak to the anterior margins, sloping rather sharply to the postero-lateral and cardinal margins, the central and umbonal regions rather strongly elevated with the surface arching abruptly to the lateral margins. Fold low and poorly defined, sometimes obsolete. Surface marked by from two to six short, angular folds of which there are two or three on the fold and one or two on the lateral slopes; both fold and plications generally absent on small specimens and in all cases confined to the anterior third of the valve. Beak prominent, rather sharply pointed, strongly incurved and nearly in contact with the umbo of the brachial valve. Cardinal area low, strongly concave, its lateral margins poorly defined, marked by faint growth wrinkles and on well preserved specimens by faint vertical striae. Delthyrium higher than wide. Internally, the median septum is long and high, the spondylium extends forward beyond the middle of the valve.

Brachial valve considerably less convex than the pedicle with the greatest prominence at, or slightly posterior to the midlength. Surface arching gently to the anterior margin and sloping with a gently concave curvature to the lateral and postero-lateral margins. Sinus generally developed anteriorly as a shallow undefined depression

which in large specimens is slightly produced into a short, rounded lingual extension. Plications weak, in adult specimens confined to one or two short examples in the sinus and rarely one or more on each lateral slope, absent on immature specimens. Beak blunt and closely incurved. Internally, the crural plates are thin and extend well anterior to the midlength. As seen in section, the crura slant upward and outward from each other at an angle slightly less than ninety degrees. The crural septa are slightly higher than the crura, curved laterally along the middle of their height, their bases separated by a distance nearly equal to their height. Surface of both valves marked by fine concentric growth wrinkles which anteriorly are somewhat lamellose.

Remarks:—For many years this species has been considered as a synonym of *G. comis* (Owen). Although the two forms do occur in the Davenport substage they are found at well separated geographical points, and moreover each species is associated with faunules which differ strongly from each other. Although this alone would not be sufficient for specific distinction, the differences in the characters of the two forms do clearly indicate separate species and for these reasons Hall's specific name is here revived. *G. occidentalis* is uniformly smaller, and the curvature of the valves is more nearly equal than in *G. comis*; furthermore, Hall's species is characterized by the weakly developed sinus, and by the broad, irregular and angular plications. Internally the two species differ even more strongly. In the pedicle valve, the median septum of *G. comis* is very short, reaching forward less than a fourth of the length of the valve, and the spondylium is much higher and larger than that of *G. occidentalis*. In the brachial valve, the crura of *G. comis* are nearly horizontal and the crural septa are very low; in *G. occidentalis* the crura slant strongly upward and the crural septa are nearly twice as high comparatively, as those of *G. comis*.

Occurrence:—*G. occidentalis* is a rather uncommon form and has been found only near the top of the Davenport substage of the Cedar Valley in the vicinity of Independence, Iowa.

Types:—Plesiotypes Nos. 8076, 8077, 8085, C. H. B. No. 6-418 S. U. I.

Gypidula comis (Owen)

Plate I, figs. 1-11

Atrypa comis Owen, Rept. Geol. Surv. Wis. Iowa and Minn., p. 583, Tab. 3a, fig. 4. 1852.

Pentamerus (N. S.) Owen, *ibid.* Tab. 3a, fig. 11.

Pentamerus galeatiformis Meek and Worthen, Geol. Surv. Illinois, Vol. II, p. 325 (footnote). 1866.

Pentamerus comis Meek and Worthen, Geol. Surv. Illinois, Vol. III, p. 428, Pl. 13, figs. 6a-c. 1868.

Pentamerus comis Walcott, U. S. G. S. Mon. VIII, pp. 159-161, Pl. 3, fig. 4. Not Pl. 3, fig. 3; nor Pl. 14, figs. 15a, b. 1884.

† *Pentamerus comis* Whiteaves, Cont. Can. Pal. Vol. I, pt. IV, p. 290. 1892.
Gypidula comis Hall and Clarke, Pal. N. Y. Vol. VIII, pt. 2, p. 248. Not text fig. 177 nor Plate 72, figs. 15-24. 1893.

Gypidula comis Schuchert, U. S. G. S. Bull. 87, p. 226. 1897.

Description:—Shell of medium size or smaller, subovate to sub-pentagonal in outline, longer than wide with the greatest width anterior to the midlength. Dimensions of a rather large plesiotype: length 25. mm.; width 22.5 mm.; thickness 19.6 mm.

Pedicle valve strongly convex, the surface arching uniformly from the beak to the anterior margin and somewhat more sharply to the lateral margins. Fold broad, low and poorly defined, originating anterior to the midlength, marked by a distinct emargination at the front of the valve. In some cases the fold is nearly smooth but on most specimens it bears from two to four low, rounded plications and on each lateral slope there is one, or rarely two, similar but weaker plications; all plications are absent on the posterior half of the valve and some large examples lack both fold and plications. Umbo very conspicuous; beak bluntly pointed and strongly incurved. The cardinal area is narrow, its lateral margins poorly defined; surface gently arched and marked by faint vertical striae and by transverse growth wrinkles; delthyrium rather large, slightly higher than wide. Internally, the spondylium is large and heavy, reaching forward beyond the middle of the valve. The median septum is very short and confined to the rostral portion of the valve.

Brachial valve much less convex than the pedicle, the greatest convexity in the umbonal region. Surface arching gently from the beak to the anterior margin, more gently curved to the lateral and cardinal margins; on some specimens the surface is flattened or gently concave toward the postero-lateral margins. Sinus generally broad and shallow, originating near the midlength and produced into a short, subquadrate lingual extension deflected nearly at right angles to the plane of the valve. Plications similar to those of the pedicle valve, being strongest in the sinus and very weak or absent on the lateral slopes. Beak moderately large, blunt, strongly incurved. Internally, the crural plates are very heavy and reach forward beyond the middle of the valve; the crura are flat and

nearly parallel to the plane of the valve. The crural septa are low, nearly vertical, their bases well separated. Occasionally a low ridge lies on the floor of the valve between them.

Remarks:—The above description is based upon specimens obtained from the Davenport substage of the Cedar Valley near Solon, Iowa. Those forms of *Gypidula* from a similar horizon at

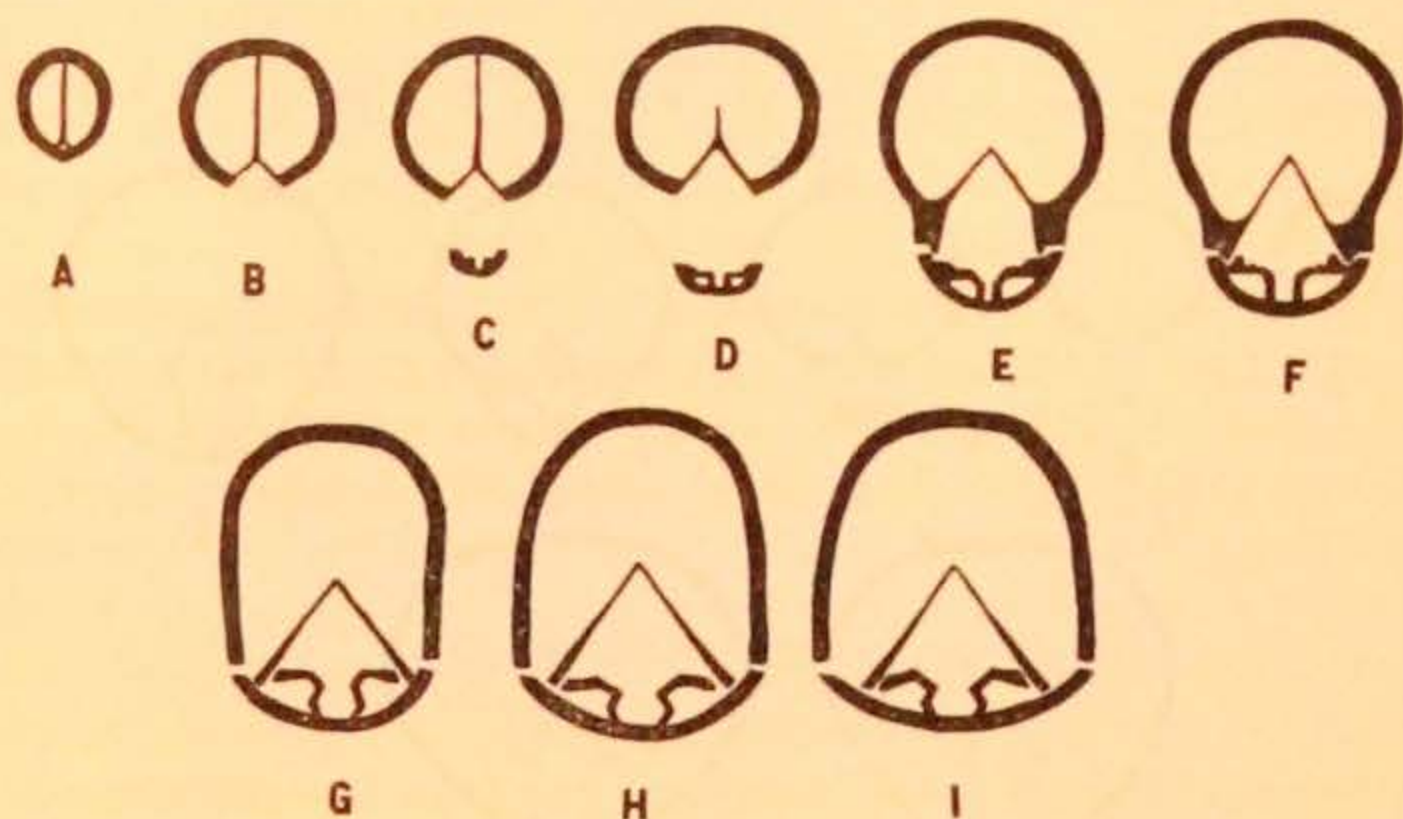


Fig. 3. A series of nine cross-sections (x 1.5) from the rostral portion of the shell of *Gypidula comis*. Note the short median septum and heavy spondylium of the pedicle valve and the low crural septa and nearly horizontal crura of the brachial valve.

Independence, Iowa, although customarily referred to *G. comis*, were originally described by Hall as *Pentamerus occidentalis* and Hall's species is here revived; the differences between the two forms are discussed under *G. occidentalis*. Hall and Clarke⁴ referred other forms from the Cerro Gordo substage of the Hackberry to *G. comis*. The Cerro Gordo substage lies some 200 feet above the top of the Davenport substage and the two species just alluded to are here discussed under *G. cornuta* and *G. parva*. Thus it would appear that four distinct species have heretofore been included under *G. comis*.

Occurrence:—Common in the upper beds of the Davenport substage at Solon, Iowa and southeastward to Davenport.

Types:—Plesiotypes Nos. 8176, 8177, 8180 and 8181, C. H. B. No. 1467 U. C. M.

⁴ Pal. N. Y. Vol. VIII, pt. 2, p. 247.

Gypidula papyracea n. sp.

Plate II, figs. 9-13; Plate III, figs. 20-24

Description:—Shell of medium size or smaller, subovate to sub-pentagonal in outline, wider than long with the greatest width near the midlength. Dimensions of the holotype and a paratype: length 22. and 13.6 mm.; width 24. and 15.3 mm.; thickness 18.2 and 9.4 mm.

Pedicle valve moderately convex with the greatest depth near the

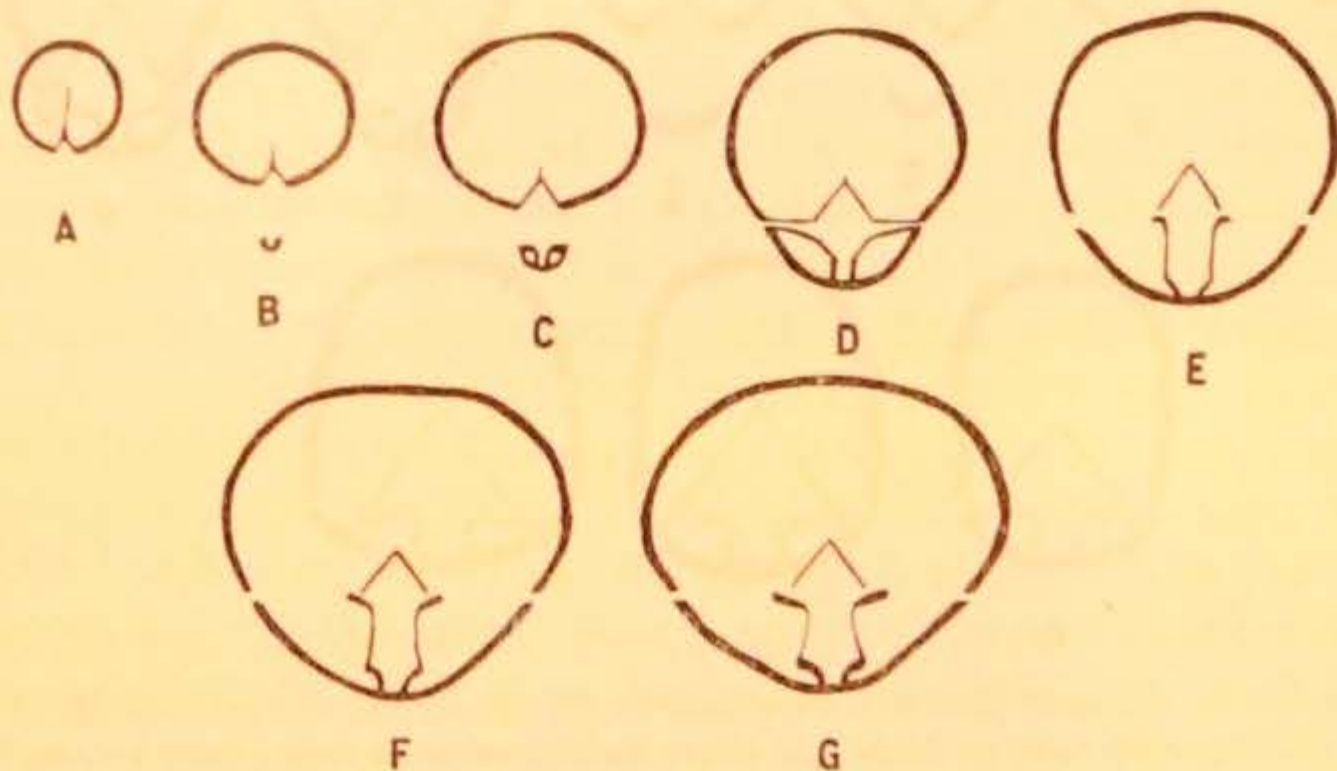


Fig. 4. A series of seven cross-sections (x 2) of the rostral portion of the shell of *Gypidula papyracea*. Note the very short median septum of the pedicle valve and the short crural septa and high, nearly vertical crura of the brachial valve.

midlength. Surface arching gently from the beak to the anterior and lateral margins, sloping sharply to the cardinal and postero-lateral margins. Fold absent or indicated only by a broad undefined swelling at the front of the shell. Plications wanting on most specimens but when present they are marginal and consist of broad ridges of which two are on the fold and one on each lateral slope. Umbo small for the genus; the beak blunt and moderately incurved. Internally, the median septum is confined to the rostral portion of the valve; the small spondylium continues nearly to the midlength.

Brachial valve depressed convex with the greatest curvature near the midlength. Surface arching gently and uniformly from the beak to the anterior and lateral margins, sloping gradually from the midline to the lateral and postero-lateral margins. Sinus confined to the anterior third of the valve where it is shown as a broad poorly defined depression; on many specimens no sinus is developed.

Plications apparently wanting. Internally, the crural plates reach well beyond the midlength. As seen in section the crura are high and near vertical, their crests abruptly deflected laterally; the crural septa are low and gently arched laterally. Shell substance thin and papery, exfoliating readily.

Remarks:—*G. papyracea* can be readily distinguished by the poorly developed fold and sinus and by the nearly complete absence of plications. In no other species studied does the width exceed the length as in *G. papyracea*, and moreover the thin fragile shell is a feature found in no other member of the genus from the Iowa Devonian.

Occurrence:—Common in and confined to the Camarophoria zonule at the top of the Mason City substage of the Shellrock. It is found only in the western portion of Floyd County, Iowa.

Types:—Holotype No. 1445, paratypes Nos. 511, 644, 1316 and 2059, C. H. B.

Gypidula rostrata n. sp.

Plate II, figs. 15-19

Description:—Shell small, subquadrate in outline, longer than wide with the greatest width slightly anterior to the midlength. Dimensions of two pedicle valves (holotype and paratype): length 16. and 12.5 mm.; width 14. and 11.5 mm.; depth 8.7 and 5.3 mm.

Pedicle valve moderately convex with the greatest curvature in the umbonal region. Surface arching gently from the beak to the anterior margin, more sharply curved to the lateral and postero-lateral margins, abruptly arched from the midline to the lateral

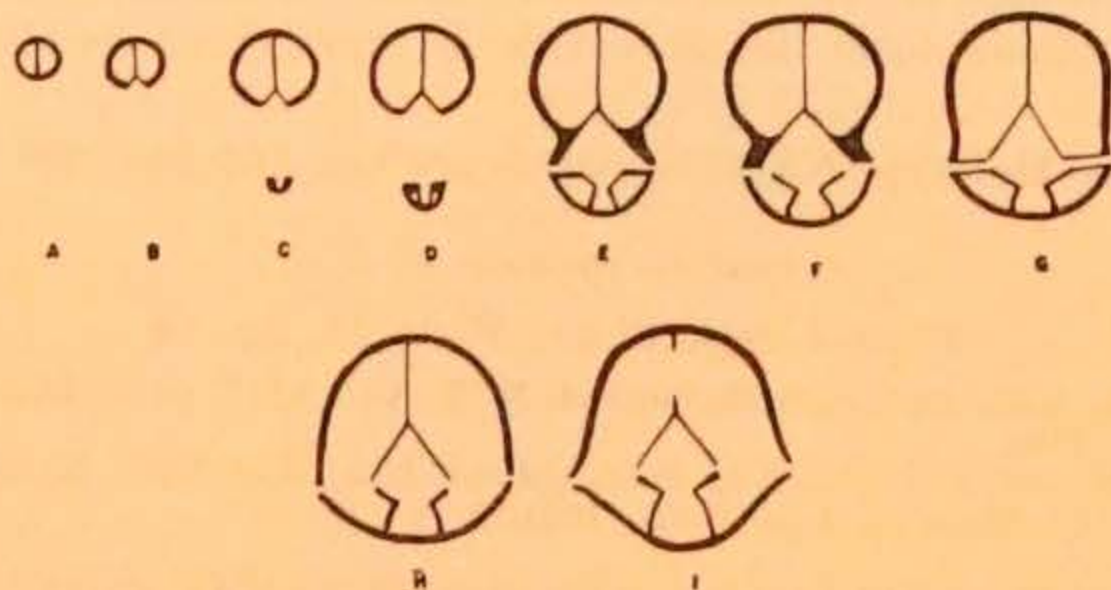


Fig. 5. A series of nine cross-sections (x 2) of the rostral portion of a pedicle and brachial valve of *Gypidula rostrata*. Note the long median septum of the pedicle valve and the short crura and high crural septa of the brachial valve.

margins. The narrow fold originates anterior to the midlength, moderately elevated and well defined at the front of the valve. The fold is not developed on immature specimens and in some cases it is absent on adult shells. Plications feebly developed, absent as a rule but when present they are limited to a broad elongate swelling on either side of the fold. Umbo very large and prominent; beak large, blunt, moderately incurved. Internally, the high median septum reaches nearly to the midlength; the spondylium is capacious; its height, when fully developed, is nearly half that of the valve.

Brachial valve depressed convex with the greatest curvature posterior to the midlength. Surface arching gently from the beak to the anterior and lateral margins, slightly flattened toward the postero-lateral margins. Sinus, when present, shown only as a broad depression at the front of the shell. Plications apparently wanting. Internally, the crural plates reach beyond the midlength. As seen in section the crura are nearly straight and inclined horizontally from each other at an angle of about 120 degrees. The crural septa are higher than the crura and their crests are rather strongly convergent.

Remarks:—*G. rostrata* finds its closest relative in *G. comis* of the Cedar Valley. It can be distinguished from that species by the uniformly smaller size, narrow fold and by the almost complete absence of plications. Internally, the crural septa of *G. rostrata* are proportionately higher and more convergent distally than those of *G. comis*.

Occurrence:—Confined to the Loxonema zonule of the Rock Grove substage in the immediate vicinity of Rudd, Iowa. It is a rather common form but as a rule is represented by dissociated valves.

Types:—Holotype No. 1317, paratypes Nos. 164, 288, 339, C. H. B.

Gypidula cornuta F. & F.

Plate I, figs. 12-24; Plate II, fig. 14

Gypidula comis Hall and Clarke, Pal. N. Y. Vol. VIII, pt. 2, Plate 72, figs. 15-17, 21. 1894.

Gypidula cornuta Fenton and Fenton, Cont. Mus. Geol. Univ. Michigan, Vol. I, pp. 121-122, Plate 25, figs. 26-31. 1924.

Description:—Shell of medium size or smaller, subquadrate to subpentagonal in outline, generally longer than wide with the greatest width at, or anterior to, the midlength. Dimensions of two

plesiotypes: length 22.5 and 19.7 mm.; width 22.5 and 19.3 mm.; thickness 14.6 and 12. mm.

Pedicle valve strongly convex with the greatest curvature in the umbonal region. Surface arching strongly from the beak to the anterior margin, more abruptly curved to the lateral margins, sloping sharply to the cardinal margins. Fold broad and low, in most cases poorly defined, sometimes absent; its position is marked by a shallow emargination. Plications commonly absent but when present they are very broad and low, from one to three are shown on the fold and one or rarely two on each lateral slope; these latter are faint and marginal in position, those on the fold extend posteriorly less than a fourth of the length of the valve. Umbo prominent, beak rather sharply pointed, strongly incurved, occasionally almost touching the brachial valve. Cardinal area small and poorly defined, no vertical striæ noted. Delthyrium slightly higher than wide. Internally, the spondylium is thin, rather low, extending beyond the midlength, its posterior half supported by a thin high median septum.

Brachial valve much less convex than the pedicle, most prominent posterior to the midlength. Surface arching gently from the beak to the anterior margin, sloping with gently concave curvature to the lateral margins, more strongly depressed toward the cardinal margins. The sinus originates rather abruptly at a point anterior to the midlength, marked anteriorly as a broad shallow depression, occasionally produced into a very short, subquadrate lingual extension. The plications, when present, are broad and low, from one to three in number, confined to the anterior third of the sinus. Beak small, blunt, strongly incurved. Internally, as seen in section, the gently arched crura are nearly vertical; the crural septa are low, gently convergent upward, their bases well separated.

Remarks:—This species has generally been considered as a local form of *G. comis* and as such was described by Hall and Clarke. The specimen which these authors show in figures 15, 16, and 17 of plate 72 apparently belongs to *G. cornuta* although, judging from figure 17, the plications shown in figures 15 and 16 are somewhat accentuated. Figure 21 of the same plate apparently represents an immature specimen of this species. *G. cornuta* can be readily distinguished from other Iowa members of the genus by the closely incurved beak of the pedicle valve, by the very small cardinal area,

flattened brachial valve, and particularly by the broad, short and very faint plications.

Occurrence:—Although common, this species is confined to the basal zonule of the Cerro Gordo substage of the Hackberry. Fenton and Fenton place it somewhat higher, giving its horizon (*Gypidula* faunule) as about two feet below the *Lioclema* zonule. This is an error since careful collecting for many years has failed to reveal them at this horizon but they are abundant some twelve feet lower.

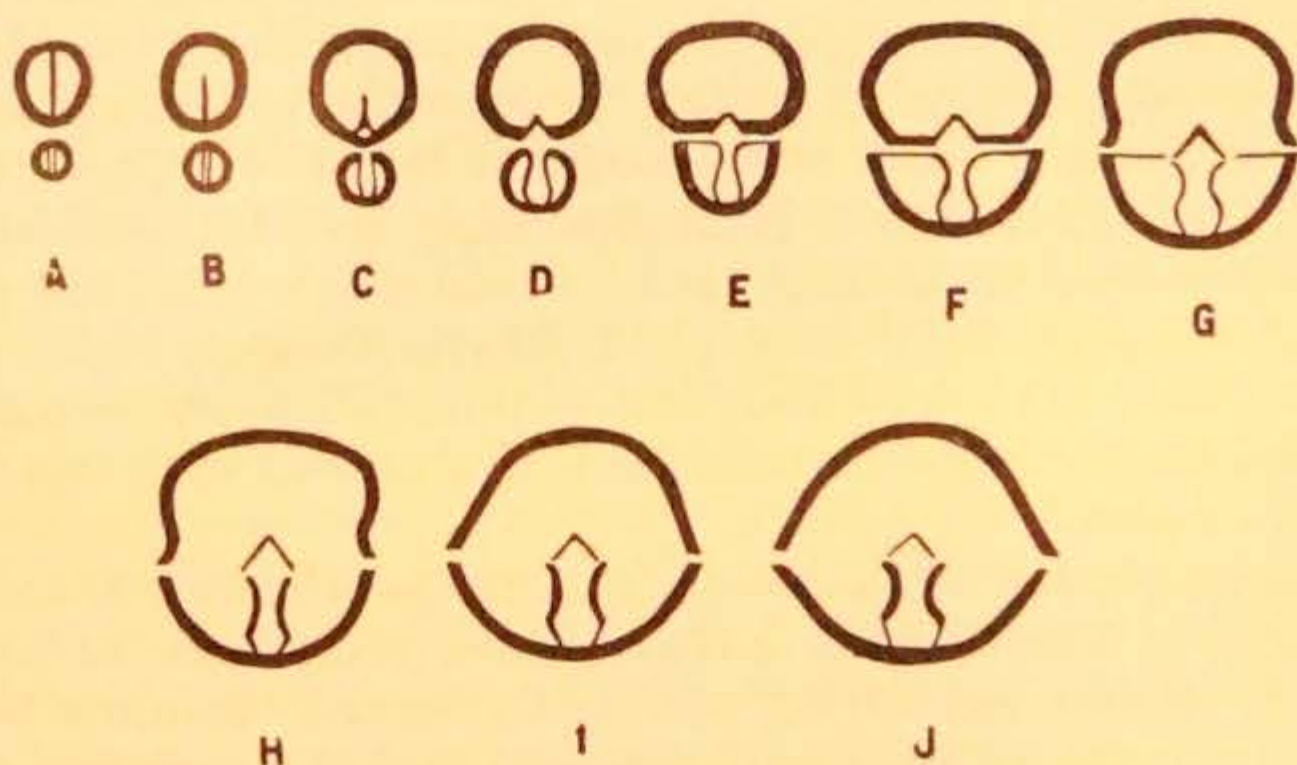


Fig. 6. A series of ten cross-sections (x 1.5) from the rostral portion of the shell of *Gypidula cornuta*. Note the short median septum and small spondylium of the pedicle valve and the high, vertical crura and short crural septa of the brachial valve.

The stratum in which they occur was termed the *Xenocidaritis* zone by Thomas⁵ and since that term has precedence over Fentons' term, and further since *Gypidula* is absent in the horizon they designated, the term *Gypidula* faunule must be dropped.

G. cornuta is most abundant at Rockford. It has been found occasionally at Hackberry Grove although the specimens found there are almost invariably crushed and in most cases represented by separated valves.

Types:—Plesiotypes Nos. 3153, 3685, 3897, C. H. B. No. 3146 U. C. M., No. 71362 U. S. N. M.

Gypidula parva F. and F.

Plate III, figs. 1-11

Gypidula comis Hall and Clarke, Pal. N.Y. Vol. VIII, pt. 2, p. 247, text fig. 177. 1894.

⁵ Iowa Geol. Surv. Vol. 29, p. 499. Feb. 1924.

† *Gypidula laviuscula* *ibid.* Pl. 72, figs. 25, 26.

Gypidula cornuta parva Fenton and Fenton, *Cont. Mus. Geol. Univ. Michigan*, Vol. I, p. 123, Pl. 25, figs. 32-35. 1924.

Description:—Shell small, subovate to subquadrate in outline, longer than wide with the greatest width slightly anterior to the midlength. Dimensions of two plesiotypes: length 17. and 14.5 mm.; width 15.2 and 13.6 mm.; thickness 11. and 9.5 mm.

Pedicle valve strongly convex, most prominent near the midlength. Surface arching strongly from the beak to the anterior and lateral margins and sloping sharply to the postero-lateral and cardinal margins. Fold weak, originating posterior to the midlength, always low and with more or less flattened summit; marked anteriorly by a shallow rounded emargination. In adult shells the fold bears from one to four, low, rounded plications which originate well posterior to the midlength; the grooves between the plications are rounded at the bottom and slightly produced at the front of the shell. Each lateral slope bears from one to three similar plications. Umbonal region prominent, the beak bluntly pointed and moderately incurved. Cardinal area comparatively large, its limits poorly defined; it is distinctly striated vertically and bears weak transverse growth wrinkles. Internally, the median septum is very short, the small, low spondylium extends beyond the middle of the valve.

Brachial valve depressed convex, most prominent in the umbonal region. Surface arching gently to the anterior margin and sloping with gently concave curvature to the lateral margins. Sinus originating anterior to the midlength, becoming rather deep at the front where it is produced into a short rounded lingual extension deflected at a low angle to the plane of the valve. Mesially one strong subangular plication extends less than half the distance to the beak; each lateral slope bears one or two similar, but much shorter plications. On small specimens few or no plications are shown. Beak small, blunt, incurved. Internally, as seen in section, the strongly arched crura diverge from each other at an angle of about ninety degrees; the crural septa are low and quite strongly divergent at their summits.

Remarks:—This little species differs sufficiently from both *G. cornuta* and *G. comis* to permit ready separation. From *G. cornuta* it differs in the uniformly smaller size, in the much stronger plications and in the larger and better developed cardinal area. From *G. comis* it differs in much longer plications, closely incurved beak and much smaller size.

From the section shown in figure 7 H below it would appear that this species, rather than *G. comis* of the Cedar Valley, is the one shown in section by Hall and Clarke in their text figure 177. That this could be the case is easily seen since they figure indiscriminately as *G. comis* specimens from both the Hackberry and Cedar Valley stages. A large proportion of their collection was obtained from hillside exposures near Rockford, Iowa, and based on these the specimens found would almost certainly be *G. parva* inasmuch as its horizon is well shown at these old outcrops whereas the horizon of *G. cornuta* offers no natural exposures except at Hackberry Grove

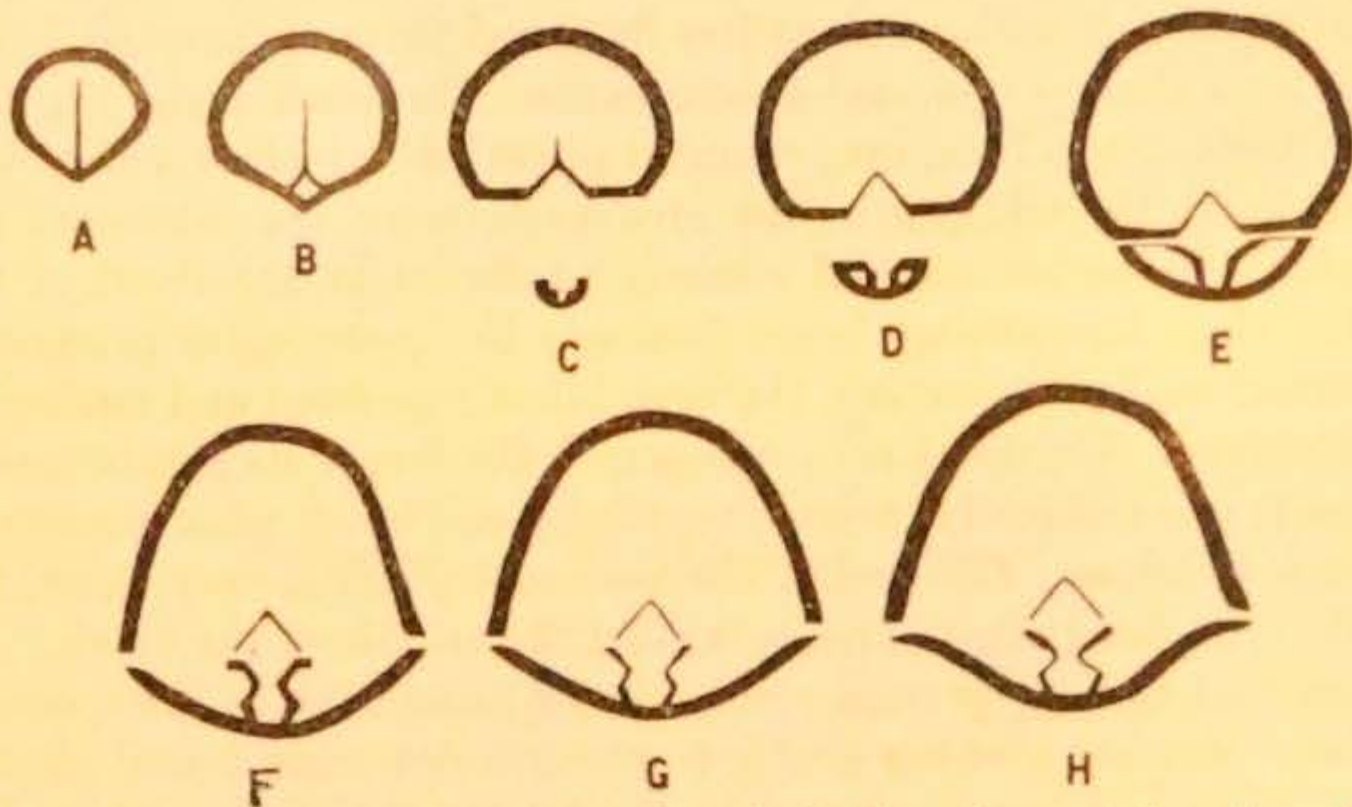


Fig. 7. A series of eight cross-sections (x 2) from the rostral portion of the shell of *Gypidula parva*. Note the small spondylium of the pedicle valve and the low strongly arched crura and low crural septa of the brachial valve.

where specimens are uncommon and as a rule are poorly preserved.

In figures 25 and 26 of plate 72 they show a small *Gypidula* under the name of *G. laeviuscula* and state that it is from "Lime Creek, Iowa." If the specimen really came from the Hackberry it is very likely an immature specimen of *G. parva*. *G. laeviuscula* is a small species which occurs in Cedar Valley strata in the vicinity of Waterloo, Iowa and it is very likely that the form figured by them is from the Cedar Valley rather than the Hackberry, in which case it is correctly identified. Three views of a typical specimen of *G. laeviuscula* are illustrated for comparison on Plate I.

Occurrence:—Common in and confined to the Devonocidaris zone (Leptostrophia faunule of F. and F.) near the center of the Cerro Gordo substage. It has been found wherever that horizon is exposed in Floyd and Cerro Gordo counties.

Types:—Plesiotypes 3417, 3425, 3764, C. H. B. No. 1468 U. C. M., No. 71363 U. S. N. M.

Gypidula nucleolata n. sp.

Plate III, figs. 12-19

Description:—Shell below medium size, subovate to subquadrate in outline, slightly wider than long or in some cases with the width and length equal, greatest width near the midlength. Dimensions of the holotype and paratype: length 14.7 and 14. mm.; width 16. and 14.5 mm.; thickness 12.5 and 12. mm.

Pedicle valve very convex; the surface arching strongly from the beak to the anterior and lateral margins and sloping abruptly to

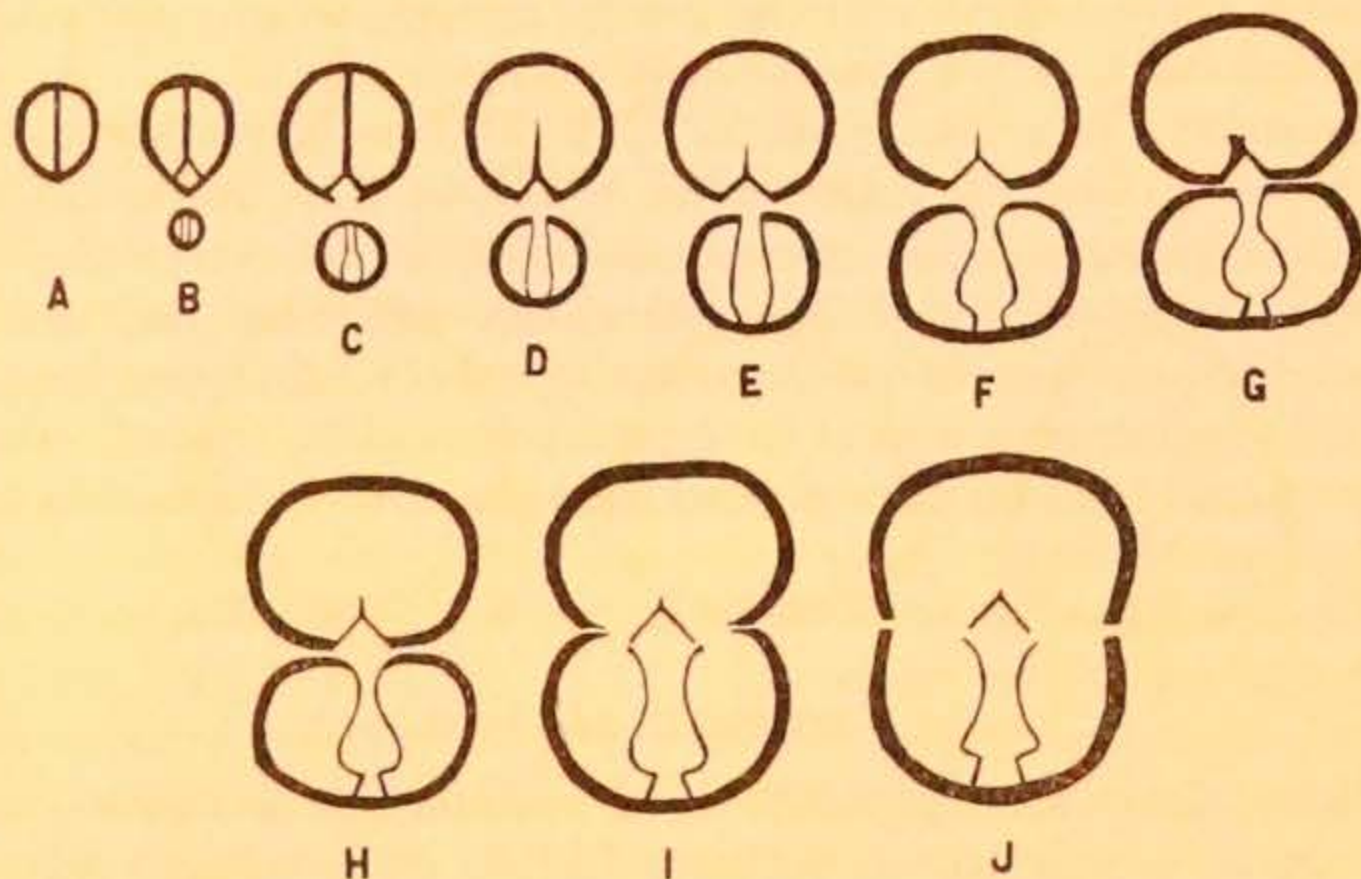


Fig. 8. A series of ten cross-section (x 2) of the rostral portion of the shell of *Gypidula nucleolata*. Note the high, erect crura and low crural septa of the brachial valve.

the cardinal margins. The fold originates near the midlength where it is broad and low, becoming higher and wider anteriorly, its summit very gently rounded at the front of the shell. The fold bears three or four low, subangular or broadly rounded plications which reach nearly to the midlength; each lateral slope bears two or three similar plications, those bordering the fold a little the strongest and separated from the fold by a broad, rounded furrow. Beak bluntly pointed, very strongly incurved, on some specimens nearly touching the umbo of the brachial valve. Cardinal area small and poorly defined; delthyrium small, slightly higher than wide. Internally, the

spondylium reaches beyond the midlength and is supported by a median septum only in the rostral portion.

Brachial valve slightly less convex than the pedicle. The surface curves strongly and uniformly to the anterior and lateral margins and less sharply to the cardinal margins. Sinus very shallow, originating slightly anterior to the midlength, its anterior portion very gently depressed and produced into a short, subquadrate lingual extension which is deflected at nearly a right angle to the plane of the valve. Two or three rounded plications are situated on the anterior half of the sinus and on each lateral slope there are one or two weak marginal plications. Beak small, blunt, moderately incurved. Internally, as seen in section, the crura are very high and nearly vertical, their central portions gently arched inward; the crural septa are short, their summits slightly convergent.

Remarks:—This species differs markedly from any other species in the Iowa Devonian in its rotund or globose form, in the shallow rounded sinus and in the strongly deflected lingual extension.

Occurrence:—Shells of this species are common but they are restricted to a six inch horizon near the top of the *Idiostroma* zone of the Owen substage, shown at the type exposure along Owen Creek in Cerro Gordo County. For this stratum the term *Goldius zonule* is here proposed.

Types:—Holotype No. 5005, paratypes Nos. 5006, 5009, C. H. B.

Genus—**SIEBERELLA**—Ehlert

Description:—Shell galeatiform, of medium size or smaller, subpentagonal to subovate in outline. Pedicle valve strongly convex with a more or less strongly developed mesial fold. Umbo prominent; beak strongly incurved. Cardinal area small, concave, its surface marked by vertical and transverse striae. Delthyrium triangular. Internally, the dental lamellæ unite to form a triangular spondylium which is supported posteriorly by a median septum. Brachial valve less convex than the pedicle with well developed mesial sinus. Internally, the hinge-plate is strong and is divided by a narrow crural cavity. The crural plates unite to form a trough shaped spondylium which is supported for most of its length by a strong median septum. Surface of both valves marked by plications which may affect nearly the entire shell or may be confined to the marginal portions of the valves.

Remarks:—According to Hall and Clarke, the genus *Sieberella*

differs from *Gypidula* chiefly in the absence of a cardinal area, the spondylium and median septum of the brachial valve being considered as of minor import. The Iowa material was sent to the United States National Museum for comparison with authentic specimens of the genotype and with other pentameroids of the western Devonian of the United States. Mr. Erwin R. Pohl, who reported on the comparisons, stated that *Sieberella sieberi* has a well defined cardinal area and that the Iowa material was similar in internal characters to that of the genotype. The cardinal area of *S. sieberi*, because of poor preservation, apparently was overlooked both by Ehlert and by Hall and Clarke. Present knowledge renders the spondylium and median septum in the brachial valve the diagnostic character of *Sieberella*.

Sieberella emarginata n. sp.

Plate III, figs. 25-31

Description:—Shell below medium size, subpentagonal in outline, wider than long with the greatest width slightly anterior to the hinge line, cardinal extremities rounded. Dimensions of the holotype: length 13.5 mm.; width 16.5 mm; thickness 9.7 mm.

Pedicle valve moderately convex with the greatest convexity in the umbonal region. Surface arching strongly from the beak to the anterior and lateral margins and sloping sharply to the cardinal margin. Fold broad, low and poorly defined, extending back from the anterior margin less than one-third the length of the valve. Surface marked by eight or ten low rounded plications which are most strongly marked at the anterior margin, and which reach posteriorly less than one-fourth of the length of the valve. Four or five plications are on the fold and two or three on each lateral slope; those bordering the fold are somewhat stronger than the others. Umbo prominent, beak obtusely pointed, moderately incurved. Cardinal area small, low and gently concave, its lateral margins poorly defined, its surface marked by faint vertical striæ. Delthyrium nearly as wide as high. Internally, the spondylium reaches anteriorly more than two-thirds the length of the valve; its posterior half is supported by a high median septum.

Brachial valve depressed convex with the greatest convexity posterior to the midlength. Surface arching gently from the beak to the anterior margin and sloping gently for about two-thirds the distance to the lateral margins where it becomes flattened or slightly

depressed. Sinus originating about one-third the distance from the front of the shell as a broad, illy defined depression which becomes somewhat deeper and better defined anteriorly. Surface marked by plications similar to those of the pedicle valve. Beak blunt, rather large, slightly incurved. Internally, the spondylium reaches anterior to the midlength and is supported for most of its length by

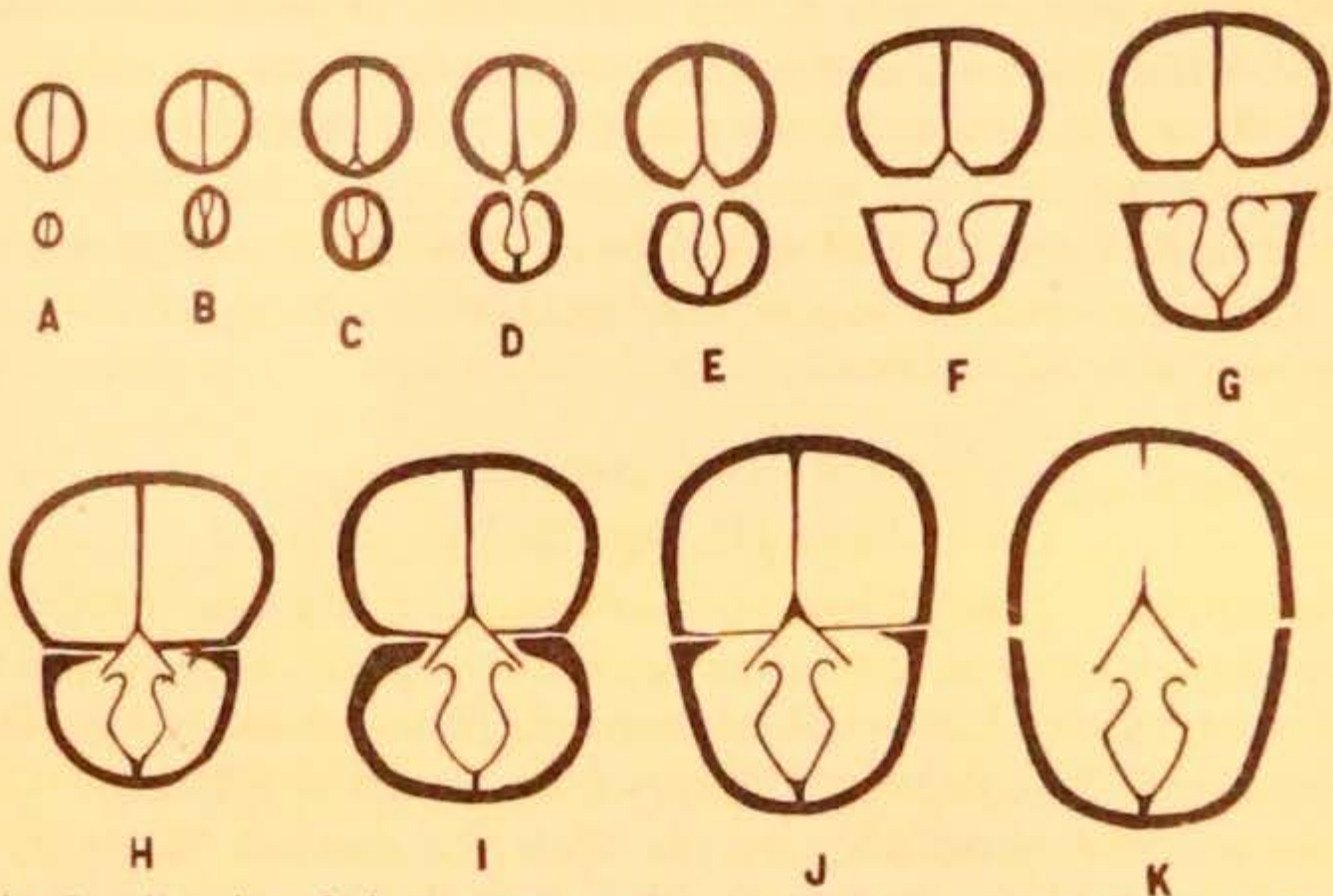


Fig. 9. A series of eleven cross-sections (x 2) from the rostral portion of the shell of *Sieberella emarginata*. Note the long median septum of the pedicle valve and the high narrow spondylium and low median septum of the brachial valve.

a low median septum. As seen in section the crural plates form a harp shaped structure.

Remarks:—*S. emarginata* differs from *S. sieberi* in its uniformly smaller size and in the shorter and less numerous plications.

Occurrence:—Most common in the Camarophoria zonule of the Mason City substage at Nora Springs where in most cases it is found only as separated valves. Casts, apparently of this species, have been found in the Ulsterensis zonule of the Rock Grove substage.

Types:—Holotype No. 1440, paratypes Nos. 128, 940, C. H. B.

Sieberella insolita n. sp.

Plate III, figs. 32-36

Description:—Shell small, subpentagonal in outline, slightly wider than long with the greatest width posterior to the midlength.

Dimensions of the holotype: length 12. mm.; width 13. mm.; thickness 8.5 mm.

Pedicle valve gently convex with the greatest convexity posterior to the midlength. Surface arching gently from the beak to the anterior and lateral margins, more sharply to the cardinal margins. Beak obtusely pointed, strongly incurved. Fold originating considerably posterior to the midlength as a low, poorly defined elevation; it is marked medially by a shallow groove and bordered on either side by deep rounded furrows the bottoms of which are pro-

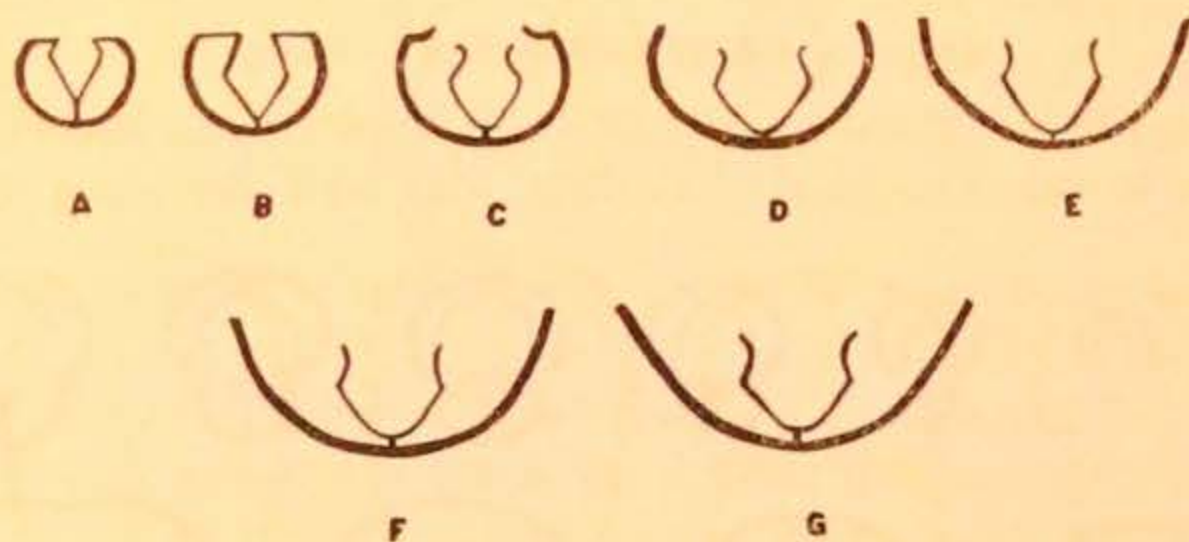


Fig. 10. A series of seven cross-section (x 2.5) from the rostral portion of a brachial valve of *Sieberella insolita*. Note the broad, stout spondylium and the short median septum.

duced into short lingual extensions. Each lateral slope bears two rounded plications which extend posteriorly slightly beyond the midlength.

Brachial valve slightly more convex than the pedicle with the greatest convexity near the midlength. Surface arching strongly to the anterior margin, sloping gently to the lateral margins and very gently concave to the postero-lateral and cardinal margins. Sinus originating near the midlength, becoming rather deep anteriorly where it is produced into a short subquadrate lingual extension which is marked mesially by a low, subangular plication. Each lateral slope bears two or three plications; those bordering the sinus are subangular, nearly twice as high as the others and separated from them by deep subangular furrows. Internally, as seen in section, the spondylium is low, nearly as wide as high, its bottom gently rounded. The median septum is stout and very low, reaching forward nearly to the midlength.

Remarks:—In outward expression this species differs markedly from any other pentameroid from the Iowa Devonian. *S. insolita* bears some resemblance to the form from the Nevada limestone

which was described by Walcott as *Pentamerus lotis*, which apparently is a *Sieberella*. The Nevada species is uniformly more rotund and much smaller than *S. insolita*,—less than half the size, and its plications are much fewer in number, more rounded, and less conspicuous.

Occurrence:—Confined to the Upper Actinostroma zone (Pseudotectus zonule) of the Nora substage in the vicinity of Nora Springs, Iowa.

Types:—Holotype No. 1200, paratypes Nos. 273, 420, C. H. B.

Genus—**CAMAROPHORIA**—King

Description:—“Shell usually small or below median size, rostrate, subovate to subpentagonal in outline, with well developed median

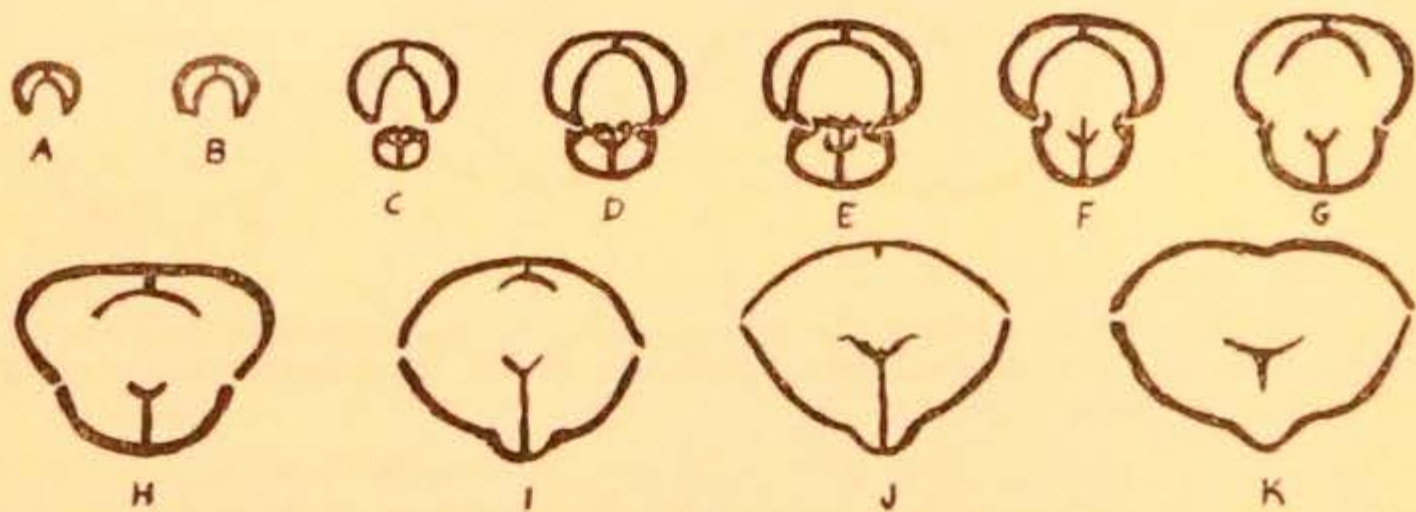


Fig. 11. A series of eleven cross-sections (x 2.5) from the rostral portion of the shell of *Camarophoria schlotheimi* (von Buch), the genotype of *Camarophoria*, from the Permian of Possneck, Germany, showing dental lamellae and spondylium of the pedicle valve, and the median septum, cruralium and hinge-plate of the brachial valve. Weller, 1912.

sinus in the pedicle valve and fold in the brachial valve, both valves either plicated or with the plications nearly or quite obsolete. In the pedicle valve the dental lamellæ are continued anteriorly into a well developed spondylium which is either supported by a median septum or rests directly upon the floor of the valve for a part or the whole of its length. In the rostral portion of the brachial valve the hinge plate is continuous and is supported by a strong median septum; between the hinge plate and the floor of the valve the median septum also supports a concave cruralium which is continued far beyond the hinge plate, becoming broader and more highly elevated anteriorly; posteriorly the median septum passes through the cruralium for the support of the hinge plate but the extension of septum above the concave surface soon disappears beyond the anterior margin of the hinge plate” Weller, 1912.

Remarks:—The genus *Camarophoria* has been reported but sparingly in the Devonian. Hall and Clarke list one species, *C. rhomboidalis* H. and C., from the Onondagan of Indiana. On the other hand some species clearly belonging to this genus have been referred to other genera by various authors; *Pugnoides swallowi* Branson, for example, upon sectioning proves to be a *Camarophoria*: and the form figured by Walcott⁶ as *Rhynchonella duplicata* Hall so strongly resembles some of the members of the genus here described that sectioning it would prove of interest. A figure illustrating the internal characters of the genotype, *C. schlotheimi* (von Buch), has been copied from Weller and is here introduced for comparison.

Camarophoria swallowi (Branson)

Plate IV, figs. 1-5

Pugnoides swallowi Branson, Devonian of Missouri, p. 92, Pl. 16, figs. 13-15. 1922.

Description:—Shell small, subtrigonal to subpentagonal in outline. Length and width about equal with the greatest width anterior to the midlength. Dimensions of nearly complete plesio-type: length 7.7 mm.; width 7.5 mm.; thickness 6. mm.

Pedicle valve moderately convex with the greatest convexity in the umbonal region. The surface of the central portion of the valve is flattened or very gently convex becoming abruptly deflected toward the opposite valve along the lateral and postero-lateral margins. Sinus originating posterior to the midlength, broad and shallow for most of its length; anteriorly it is produced into a broad subquadrate lingual extension deflected nearly at right angles to the plane of the valve. The sinus bears from three to four small rounded plications which extend posterior to the midlength and on each lateral slope there are three or four rounded plications which are stronger but shorter than those in the sinus; the plications bounding the sinus are moderately elevated and more angular than the others. Beak acutely pointed, prominent, slightly incurved. Internally, the spondylium is confined to the rostral portion of the valve; the low median septum reaches forward but a very short distance.

Brachial valve slightly more convex than the pedicle with the greatest curvature posterior to the midlength. Centrally, the valve is flattened but near the anterior and lateral margins it is abruptly

⁶ U. S. G. S. Mon. VIII, Pl. 16, fig. 8.

deflected toward the opposite valve. Fold originating slightly posterior to the midlength, low and poorly defined except near the front of the shell where it is bordered by rather deep, subangular furrows. It bears two or three low rounded plications and each lateral slope bears two or three, the latter being stronger than those on the fold; plications are wanting on the posterior half of the valve. Beak small, blunt, incurved and somewhat concealed by that of the pedicle valve. Internally, the hinge plate is short; the cruralium is broad and low, the median septum continues beyond the

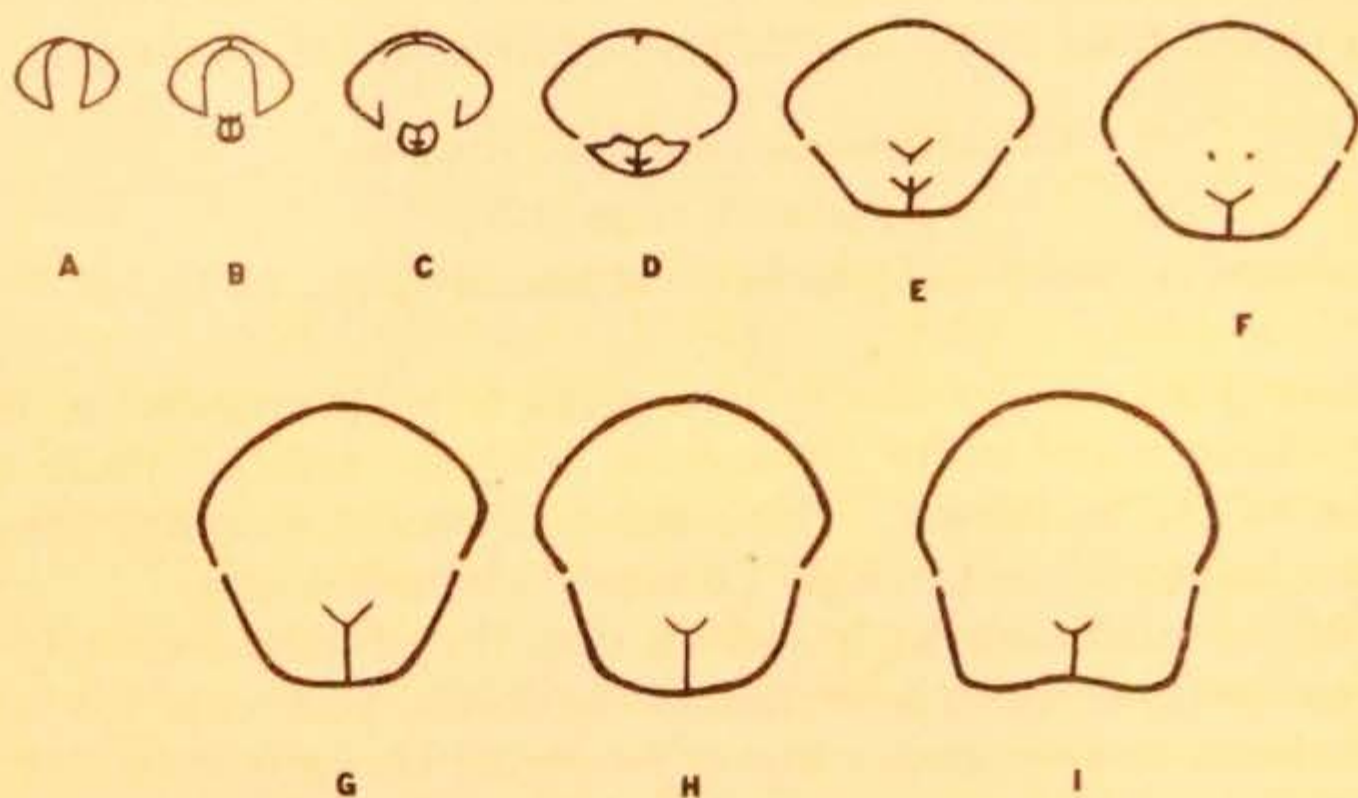


Fig. 12. A series of nine cross-sections (x 4) from the rostral portion of the shell of *Camarophoria swallowi*. Note the sort spondylium and median septum of the pedicle valve and the broad low cruralium of the brachial valve.

midlength. The surface of both valves is marked by rounded concentric growth wrinkles which are quite prominent near the margins.

Remarks:—This species is the earliest *Camarophoria* yet known in the Iowa Devonian. That its internal characters are those of *Camarophoria* was originally determined by Dr. Merrill A. Stainbrook⁷ and this was corroborated by sections made by the writer in preparing the present paper. It can be separated readily from *C. paupera* of this paper by much smaller and less angular plications of the lateral slopes and by the finer and more numerous plications on the fold and sinus.

Occurrence:—The specimens studied are from the "Acervularia profunda beds" near Brandon, Iowa. Its position therefore is

⁷ Unpublished thesis, State University of Iowa.

near the base of the Cedar Valley of Iowa. It was originally described from the Mineola limestone of Missouri.

Types:—Plesiotype No. 6030, C. H. B. No. 6-411, 6-671 S. U. I.

Camarophoria paupera n. sp.

Plate IV, figs. 6-14

Description:—Shell small, subtriangular to subpentagonal in outline. Dimensions of the holotype and a paratype: length 6.3 and 7. mm.; width 7.6 and 8.5 mm.; thickness 5. and 6.2 mm.

Pedicle valve moderately convex with the greatest curvature slightly posterior to the midlength. Surface arching gently toward the anterior and antero-lateral margins for about two-thirds the length of the shell, then abruptly deflected, gently and uniformly arched to the postero-lateral and cardinal margins. Beak conspicuous, acutely pointed, moderately incurved. Sinus originates near the midlength as a rounded depression which broadens and deepens anteriorly and is produced into a broad subquadrate lingual extension which is deflected nearly at right angles to the plane of the valve. Anteriorly it bears one low subangular plication. This may bifurcate on very large specimens and form two plications; the sinus of small specimens may be non-plicate. Each lateral slope bears two, or rarely three, subangular plications which at the front of the shell are strongly elevated,—the central pair in some cases as much as 2 mm. Internally, the median septum reaches forward nearly to the front of the valve and the spondylium extends nearly to the midlength.

Brachial valve slightly less convex than the pedicle with the greatest curvature in the umbonal region. The surface arches gently to the postero-lateral and cardinal margins but is abruptly deflected near the anterior margin with the surface between the plications produced into sharp, cuneate lingual extensions. Fold originating near the midlength where it is abruptly defined by angular grooves, although at the anterior margin its crest is at about the general level of the valve. Mesially it bears two sharply angular plications which are separated by deep subangular furrows; plications lacking on the posterior half of the valve. Internally, the stout median septum reaches nearly to the front of the valve. The cruralium is heavy and extends forward more than two-thirds the distance to the front of the shell, its anterior portion strongly elevated. Surface of both valves marked by faint concentric growth wrinkles which are especially prominent upon the reflected anterior portions.

Remarks:—This species can readily be separated from other species herein described by the strong subangular plications and by the abruptly deflected anterior portion of the valves.

Occurrence:—Confined to the Camarophoria zonule at the top of

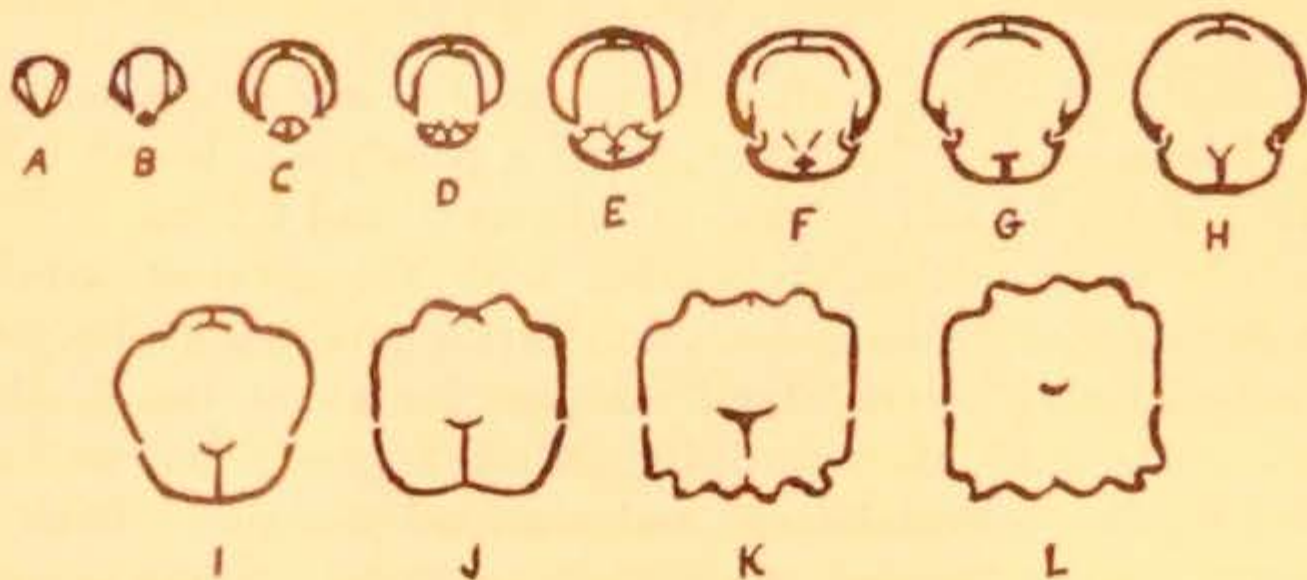


Fig. 13. A series of thirteen cross-sections (x 3) from the rostral portion of the shell of *Camarophoria paupera*. Note the long median septum of the pedicle and brachial valves and the long high cruralium of the brachial valve.

the Mason City substage. It is very common at Nora Springs but has been found sparingly at Rockford, Iowa as well as in the Sherman Bluff phase.

Types:—Holotype No. 10. Paratypes Nos. 15, 16, 18, 20, C. H. B.; 1494, U. C. M. and 71027, U. S. N. M.

Camarophoria nora n. sp.

Plate IV, figs. 15-19

Description:—Shell minute, subquadrate to subpentagonal in outline, slightly wider than long with the greatest width near the midlength. Dimensions of the holotype: length 5.7 mm.; width 6. mm. thickness 3.7 mm.

Pedicle valve moderately convex. Surface arching gently and uniformly to the anterior and lateral margins, somewhat more sharply to the cardinal margins. Sinus smooth, originating posterior to the midlength, produced into a short rounded lingual extension which is deflected at an angle of about 45 degrees to the plane of the valve. Lateral slopes smooth or marked by one faint rounded plication. Other than a median septum seen through the translucent shell, the internal characters are unknown.

Brachial valve more convex than the pedicle with the greatest convexity near the midlength. Surface arching gently from the beak to the anterior margin and strongly curved to the lateral and

cardinal margins. Fold low and rounded, originating near the midlength; very slightly elevated at the front of the shell where it is marked by one or two distinct, subequal plications. Each lateral slope bears one low, rounded plication. Beak small, blunt, incurved and largely concealed by the beak of the pedicle valve. Internal structure unknown.

Remarks:—This little species differs from any other member of the genus known in the Iowa Devonian in its rounded fold and sinus and in its weak plications of the lateral slopes.

Occurrence:—Restricted to the Prismaephyllum zonule at Rudd, Iowa where it is rather uncommon.

Types:—Holotype No. 17, paratype No. 101, C. H. B.

Camarophoria retziaformis n. sp.

Plate IV, figs. 20-26

Description:—Shell minute, subtriangular in outline, wider than long with the greatest width anterior to the midlength. Dimensions of the holotype and a paratype: length 5.5 and 6.8 mm.; width 6.7 and 8. mm.; thickness 1.7 and 3. mm.

Pedicle valve depressed convex, the umbonal region gently arched, the central portion of the valve flattened, becoming gently arched near the lateral and anterior margins. Sinus originating posterior to the midlength, slightly produced anteriorly where it is marked mesially by one strong subangular plication. Each lateral slope bears two or three strong subangular plications which retain their sharpness to the margin of the shell; the plications bounding the sinus are somewhat stronger than the others. Beak pointed, moderately incurved.

Brachial valve slightly more convex than the pedicle with the greatest curvature near the midlength. Surface arching gently and uniformly from the beak to the anterior and lateral margins. Fold limited to the anterior half of the valve, very slightly elevated, defined by a pair of deep angular grooves; mesially it bears a subangular groove. Each lateral slope bears one, or rarely two, plications similar to those of the fold. All plications wanting on the posterior half of the valve. Finer surface markings consist of fine concentric growth wrinkles.

Remarks:—Although an abundance of these little shells are at hand they are invariably filled with crystalline calcite which effectually prevents sectioning. A median septum, as a rule, can be seen

in the shell of either valve, which, in conjunction with the shape of the shell, leaves little room to doubt its reference to *Camarophoria*. *C. retziaformis* differs from any other member of the genus yet studied in its thin, flattened form, in the absence of a reflected anterior margin and in the sharp plications which reach the front of the shell so that the plications of one valve fit snugly into the grooves of the opposite valve.

Occurrence:—Common in the Prismaephyllum zonule at Rudd, Iowa and in the Strobiloecystites zonule at Rockford. Rarely casts of this species are found in the Ulsterensis zonule.

Types:—Holotype No. 104, paratype No. 105, C. H. B.

Camarophoria planodorsata n. sp.

Plate IV, figs. 27-30

Description:—Shell small, subpentagonal to subquadrate in outline, proportions of length and width variable, greatest width near the midlength. Dimensions of the holotype and a paratype: length 8.7 and 8.4 mm.; width 10.5 and 7.4 mm.; thickness 6.2 and 5.5 mm.

Pedicle valve moderately convex, most prominent near the midlength, the surface gently convex from the midline to the lateral and postero-lateral margins. The shallow sinus originates posterior to the midlength, broadening anteriorly so that its width is from two-thirds to three-fourths that of the valve, produced into a long, transversely flattened, lingual extension which is gradually deflected nearly at right angles to the plane of the valve. The sinus may bear from one to three plications but is smooth in most cases. Each lateral slope bears one or rarely two strong rounded plications which are very conspicuous anteriorly but which fail to reach the posterior half of the valve. Beak prominent, acutely pointed, moderately incurved.

Brachial valve flattened or very gently convex on the central and umbonal portions, the lateral and antero-lateral portions abruptly deflected toward the opposite valve to form broad lingual extensions the height of which is equal to more than half the length of the shell. Fold broad and low, shown only on the anterior half of the valve where it is defined laterally by deep rounded furrows. As a rule it is nonplicate, but rarely it bears as many as three small marginal plications. Each lateral slope bears one or two short rounded plications.

Remarks:—*C. planodorsata* can be distinguished from other mem-

bers of the genus in the Iowa Devonian by its depressed brachial valve, broad and nearly smooth fold and sinus and by the weakness of the lateral plications. No other species studied has the lateral margins of the brachial valve produced as strongly as has this species.

Occurrence:—Common in and confined to the Upper Actinostroma zone (*Pseudotectus zonule*) of the Nora substage. It is most common at Rockford and Nora Springs in Floyd county, but has been found also at Wheelerwood in Cerro Gordo county.

Types:—Holotype No. 369, paratypes Nos. 290, 293, C. H. B. No. 71366 U. S. N. M.

Camarophoria perplexa n. sp.

Plate IV, figs. 31-34

Description:—Shell small, subpentagonal to subovate in outline, length and width about equal with the greatest width near the midlength. Dimensions of the holotype and a paratype: length 8.7 and 7.2 mm.; width 9.5 and 6.5 mm.; thickness 5.3 and 3.5 mm.

Pedicle valve strongly convex with the greatest curvature posterior to the midlength. Surface curving sharply from the beak to the anterior margin but less sharply to the lateral margins. The well defined sinus originates near the midlength, becoming rather broad at the front of the shell where it is produced into a short, subquadrate lingual extension deflected at about 30 degrees to the plane of the valve; marked by from one to four short, subangular plications. Each lateral slope bears two or three short plications slightly stronger than those of the sinus. Beak conspicuous, blunt, moderately incurved. Internally, the broad spondylium extends forward less than a third of the length of the shell but the low median septum reaches well beyond the midlength.

Brachial valve gently convex with the greatest curvature near the midlength. Surface arching gently to the anterior margin but more strongly curved to the lateral margins. Fold originating near the midlength, becoming strongly elevated anteriorly where its top is flattened. The sinus bears from two to four plications and each lateral slope bears one or two, none of which affect the posterior half of the valve. Internally, the hinge plate is short, the cruralium well developed and the median septum reaches beyond the midlength. The crura, which in most species are short and inconspicuous, attain a remarkable development, shown as two high thin plates which

reach beyond the midlength. Surface of both valves sparingly marked by very fine concentric growth wrinkles.

Remarks:—The numerous strong subequal plications and the highly elevated fold are external characters which readily distinguish this species. Internally, the highly developed crura resemble no other known species.

Occurrence:—Confined to the basal portion of the Cerro Gordo

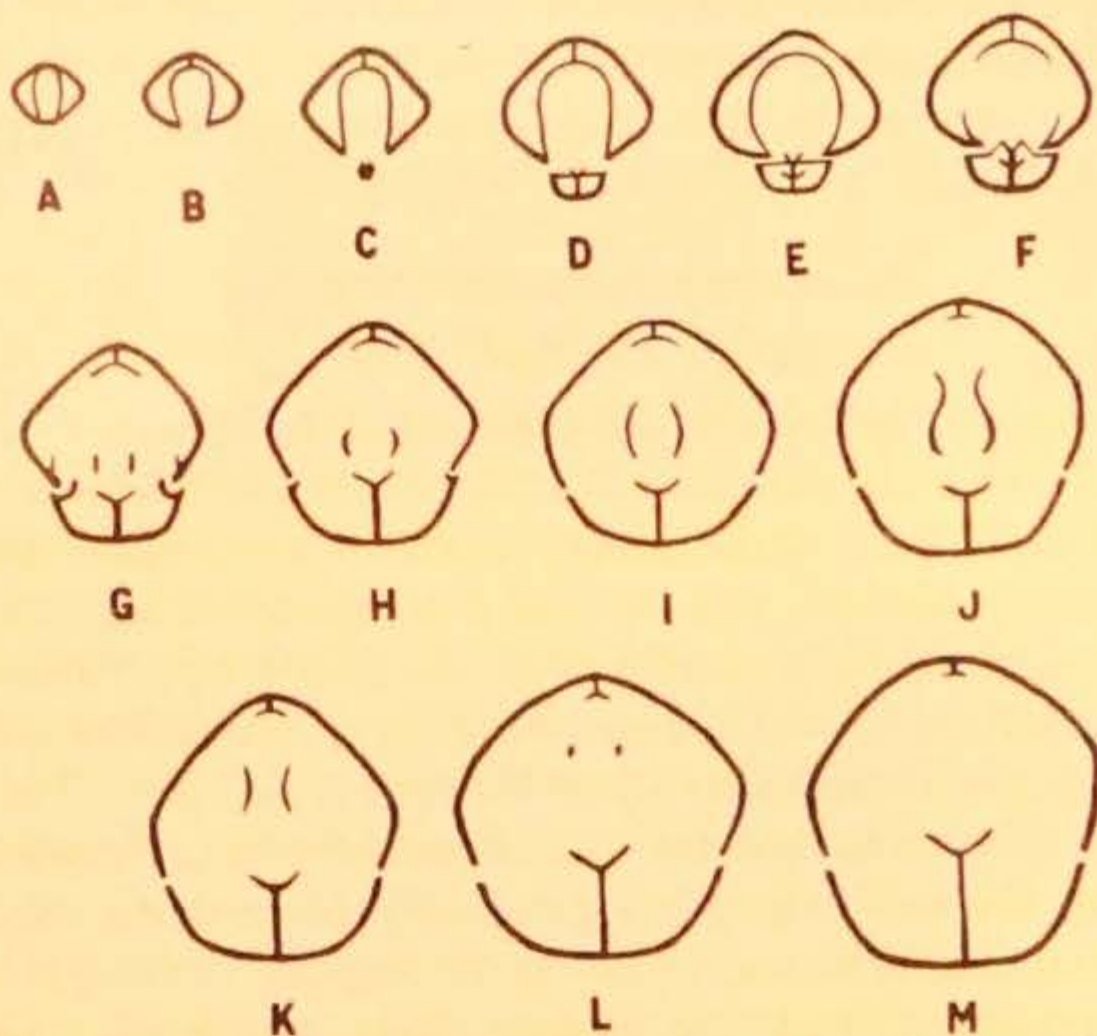


Fig. 14. A series of thirteen cross-section (x 6) from the rostral portion of the shell of *Camarophoria perplexa*. Note the long median septum and spondylium of the pedicle valve and the median septum, cruralium and extensions of the hinge-plate in the brachial valve.

substage (Douvillina zone), being known from both the *Xenocidaris* and *Lioclema* zonules. It is a rare form and in most cases is badly distorted by pressure.

Types:—Holotype No. 4041, paratypes Nos. 3152, 4014, C. H. B.

Camarophoria prolifica n. sp.

Plate IV, figs. 35-40

Description:—Shell minute, subglobose, subpentagonal to ovate in outline, the length and width about equal although some specimens are longer than wide. Dimensions of the holotype and a paratype: length 4.3 and 4. mm.; width 3.7 and 4.1 mm.; thickness 2.5 and 2.6 mm.

Pedicle valve strongly convex with the greatest curvature in the umbonal region. Surface arching gently from the beak to near the anterior and lateral margins where it is more abruptly curved toward the opposite valve, strongly arched from the midline to the lateral margins. Sinus broad and shallow, in most cases poorly defined and always confined to the anterior third of the valve where it bears from two to four low, subangular plications. Each lateral slope bears one obscure plication, which like those of the sinus extend posteriorly less than a third of the length of the valve. Beak

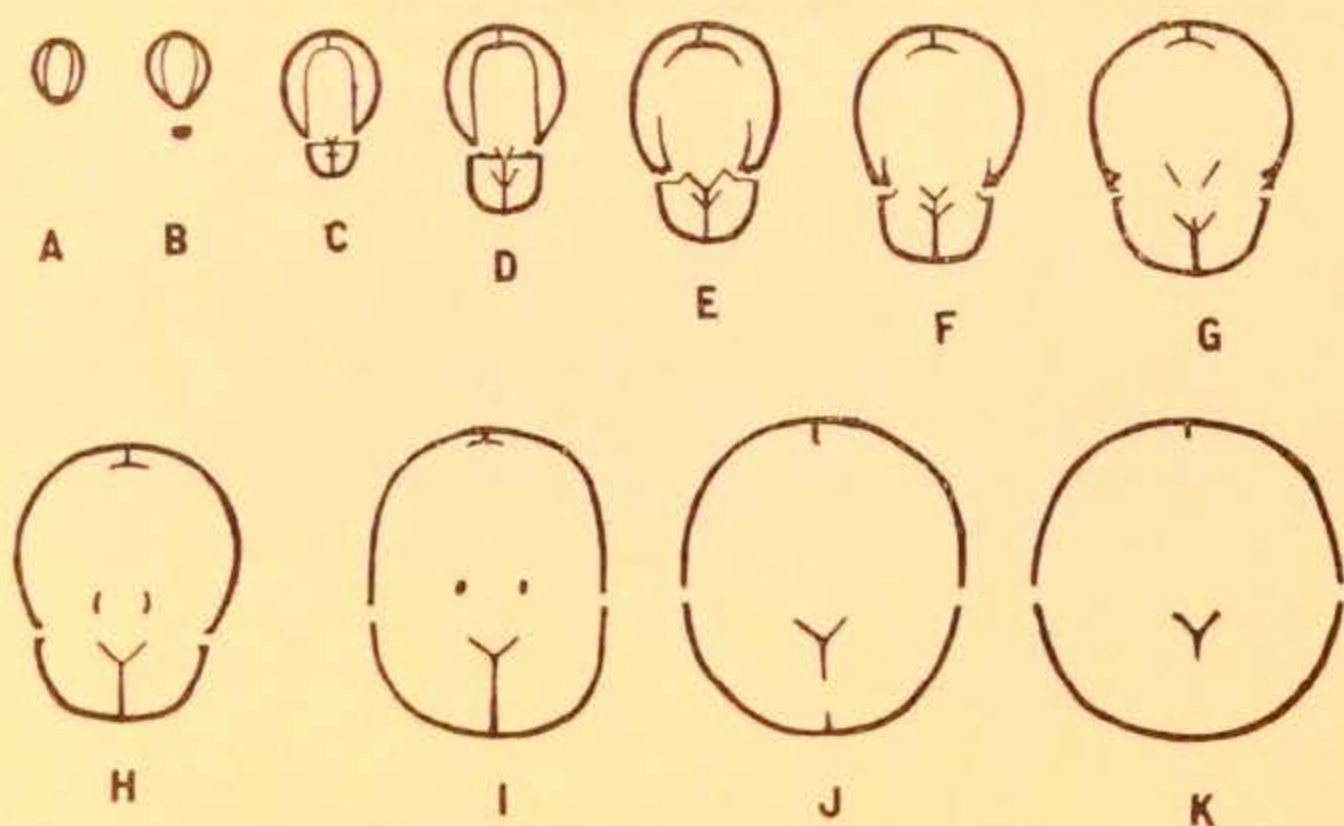


Fig. 15. A series of eleven cross-sections (x8) from the rostral portion of the shell of *Camarophoria prolifera*, showing the median septum and spondylium of the pedicle valve and the hinge-plate, median septum and cruralium of the brachial valve.

acute, strongly incurved. Internally the spondylium reaches anteriorly less than a third of the length of the valve but the median septum reaches beyond the midlength.

Brachial valve nearly as convex as the pedicle with the greatest curvature near the midlength. Surface arching gently from the beak to the anterior and lateral margins. Fold broad and low, originating near the midlength, poorly defined except near the front of the shell where it bears from three to five low, subangular plications. Each lateral slope with one short plication. Internally, the hinge plate is thin and short, the cruralium high and well developed and the median septum reaches forward more than two-thirds the length of the valve.

Remarks:—*C. prolifica* can be distinguished readily by its globose form, by its short, weak fold and by its nearly obsolete plications.

Occurrence:—Confined to the central portion of the Owen sub-stage in the vicinity of Rockwell, Iowa. It is a very prolific form, slabs of limestone being literally covered by the shells of this little brachiopod. Stratigraphically it is the highest known pentameroid from the Iowa Devonian; its horizon is but a few feet below the basal Mississippian (Sheffield) beds.

Types:—Holotype No. 4283, paratypes Nos. 3925, 3960, 4085, C. H. B., No. 71368, U. S. N. M., No. 1466 U. C. M.



1875

PLATE I

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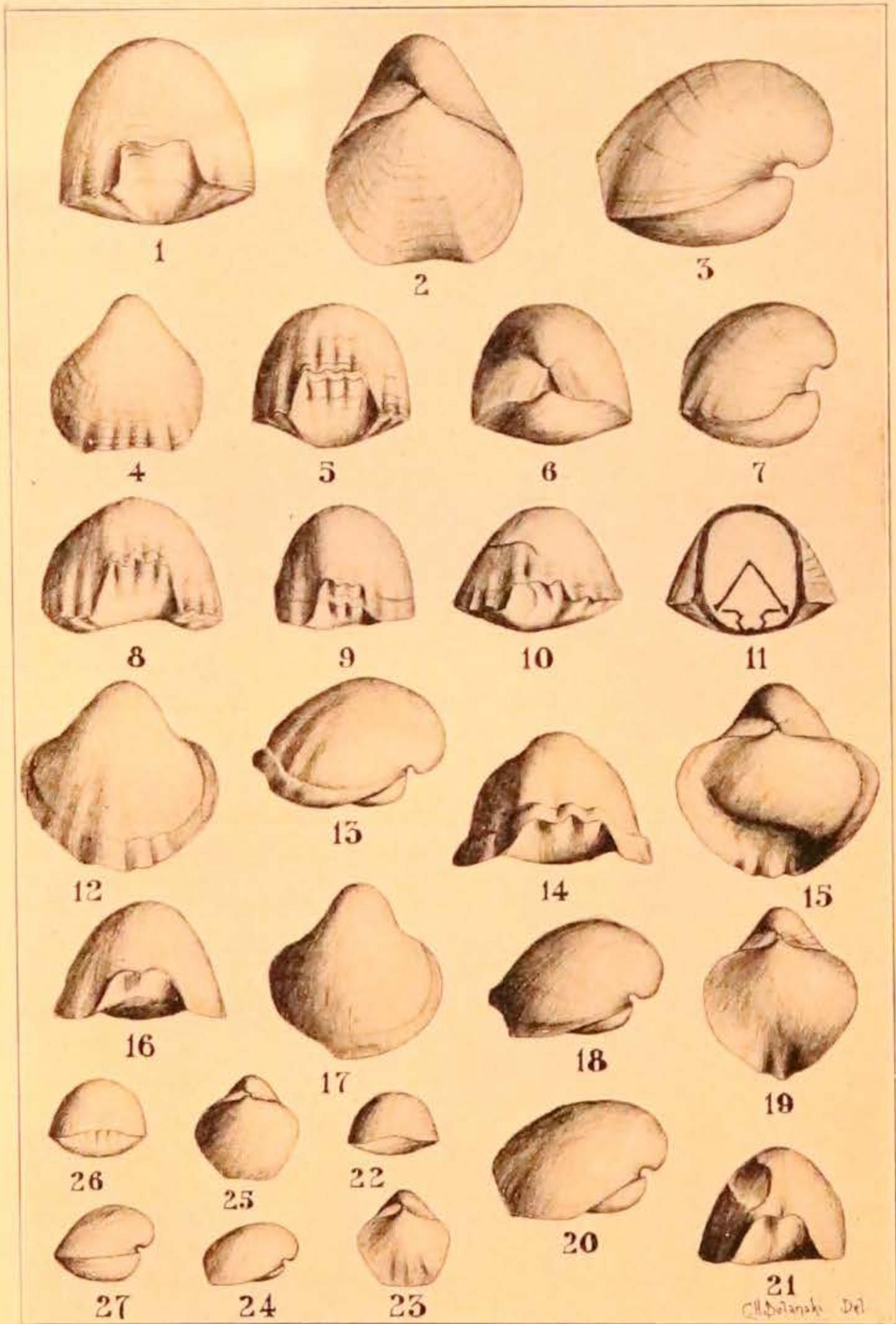


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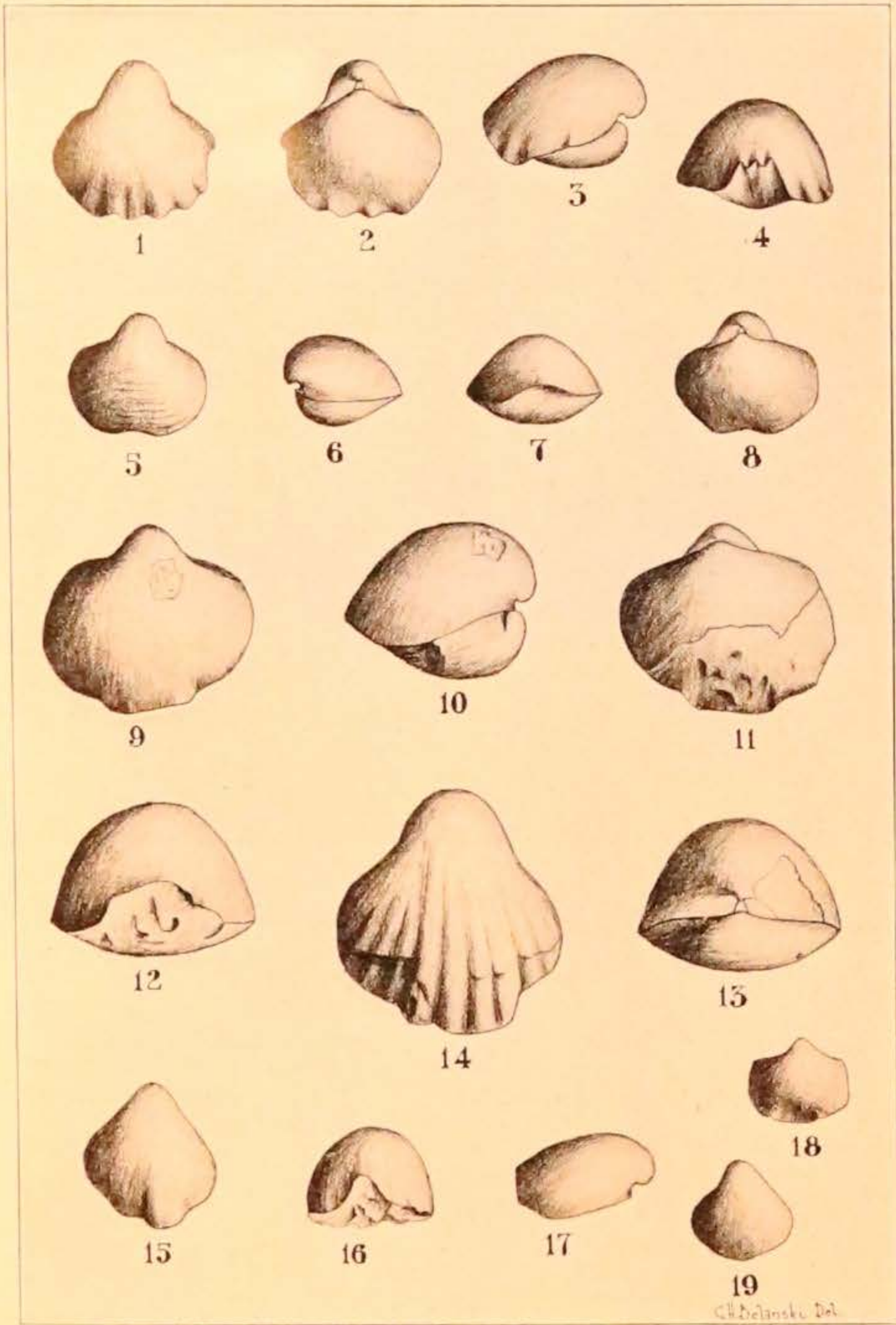


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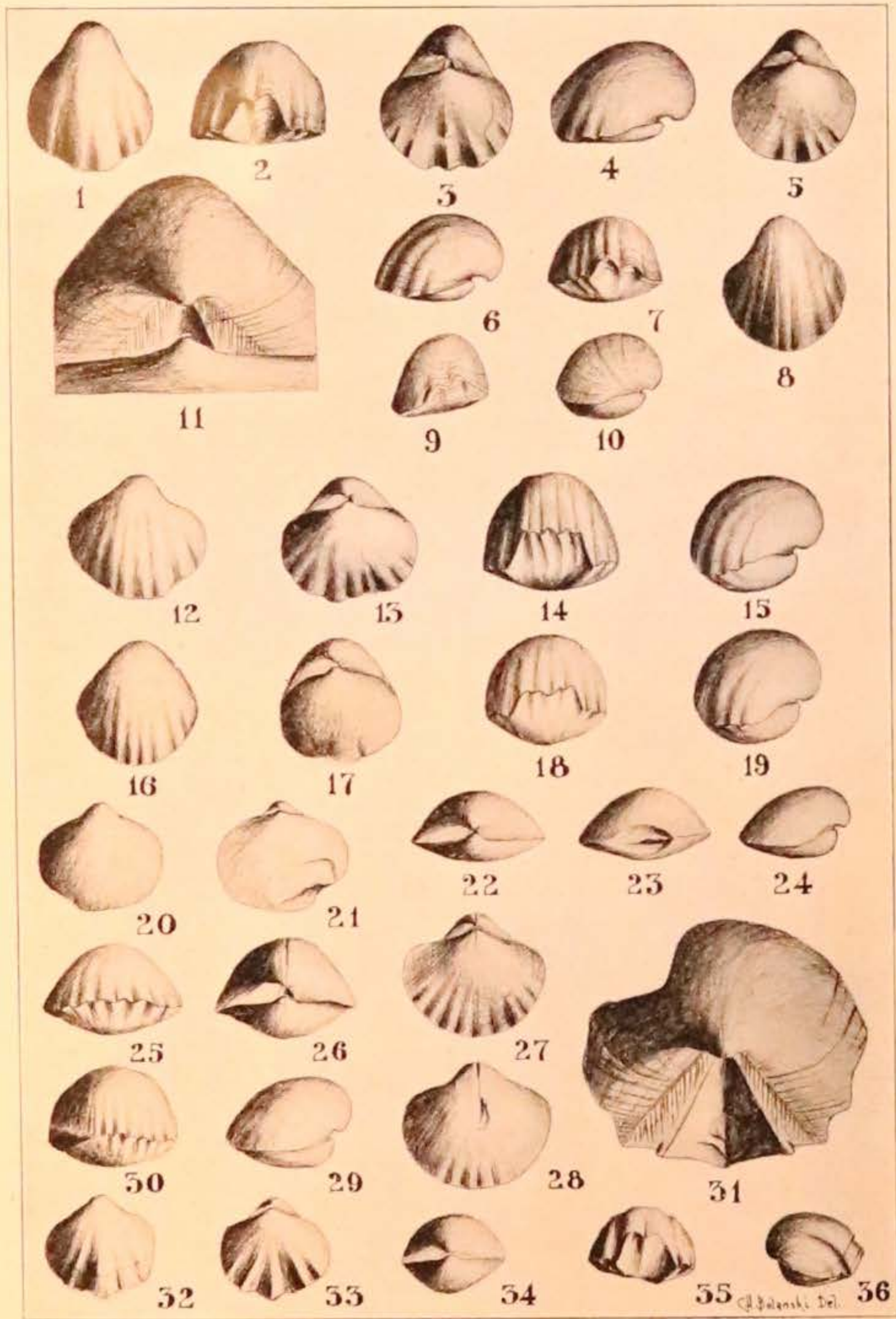
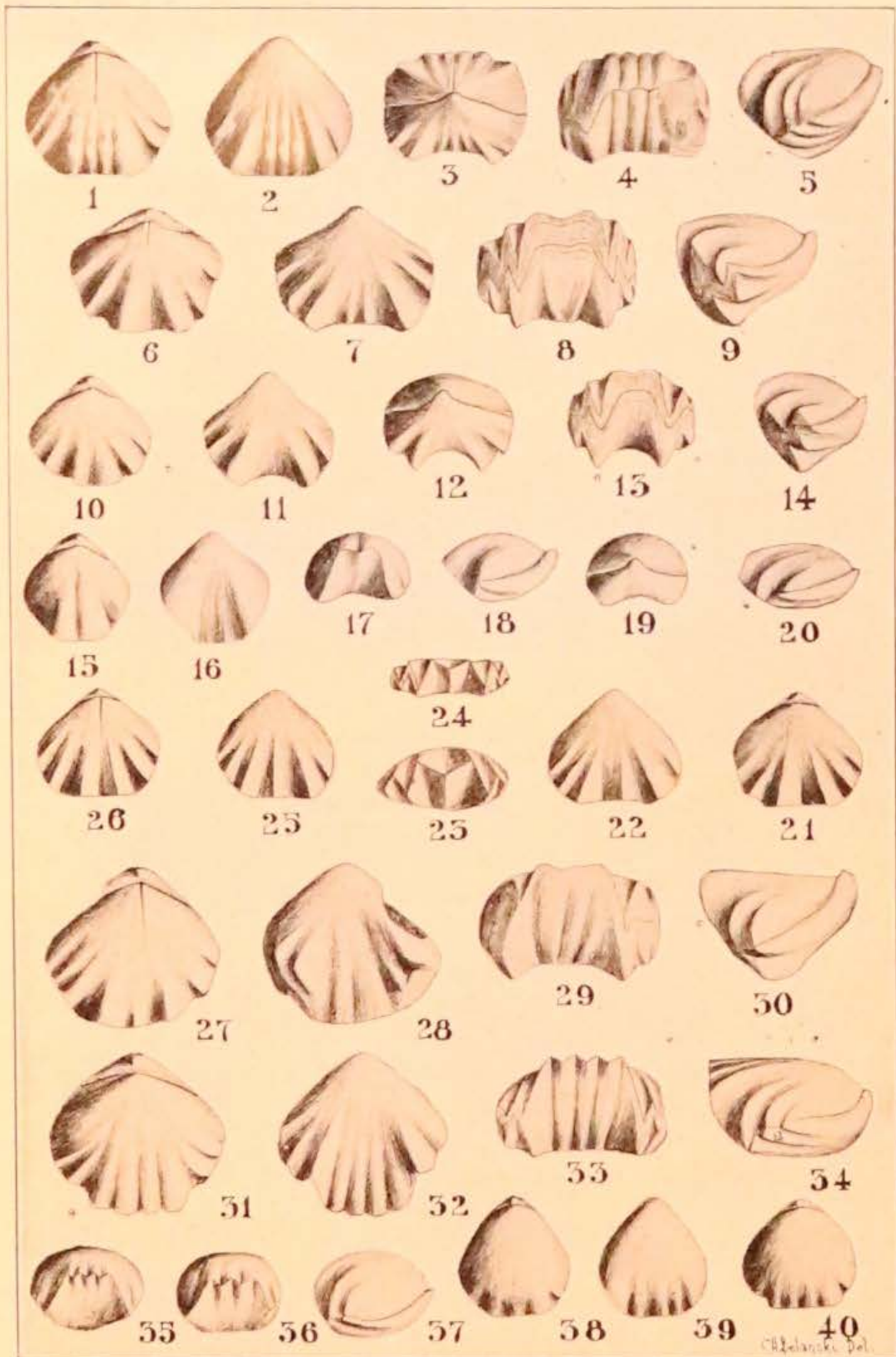


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