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Terebratulacea of the Devonian  
of Northern Iowa

C. H. Belanski

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### TEREBRATULACEA OF THE DEVONIAN OF NORTHERN IOWA

by

C. H. BELANSKI

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# UNIVERSITY OF IOWA STUDIES IN NATURAL HISTORY

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## TEREBRATULACEA OF THE DEVONIAN OF NORTHERN IOWA

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# TEREBRATULACEA OF THE DEVONIAN OF NORTHERN IOWA

C. H. BELANSKI

The species herein described belong to three genera which are members of the subfamily *Dielasmatinae* of the family *Terebratulidae*. The present paper deals with all of the species of terebratuloïd brachiopods which are known to occur in the Upper Devonian beds of northern Iowa. In addition two species from the Cedar Valley of central Iowa are included for comparison. Six of the species are from the Hackberry formation, seven are from the Shellrock formation and one species is from northern beds which are equivalent in age to the Cedar Valley formation of central Iowa. Certain of the species are rare but the majority of them are common. As a rule they are confined to certain definite zones in some zonules of which the shells are very prolific. The list of species could have been increased considerably by the inclusion of imperfect material and it is certain that future paleontologic work will increase the number of species now known from these rocks.

One of the most interesting results of the present study is the fact that of the sixteen species herein described thirteen of them belong to the genus *Cranaena*. The genus ranges through the whole of the Iowa Upper Devonian. *Dielasmella*, not previously reported from the Devonian, is represented by one species occurring in the Cerro Gordo member of the Hackberry. Two of the species studied belong to a new genus for which the name *Stuartella* is here proposed in honor of the late Dr. Stuart Weller. One of the species comes from the Mason City member of the Shellrock, the other is found in the Owen member of the Hackberry. It is found that the form designated by Fenton and Fenton<sup>1</sup> as *Cranaenella* is without definite generic characters by which it may be distinguished from *Cranaena*, this being discussed under *Cranaena*.

The generic characters of nearly all of the species of this paper have been determined by a study of the internal structure as revealed by successive sections of the rostral portions of the shells. Not only has this clearly shown the generic character but it has

<sup>1</sup> Cont. Mus. Geol. Univ. Mich. vol. I, p.129. 1924.

given help also in distinguishing forms which externally are quite similar. More than fifty sets of sections have been made in this study and in nearly all cases a representative series of sections accompanies each description. Most of the material used in this paper is in the writer's personal collection at the geological museum of the State University of Iowa. These are designated by the letters C.H.B. A few types are in the museum of the University of Cincinnati (U.C.M.) and a number of types are in the museum of the State University of Iowa (S.U.I.).

Acknowledgments are due to several people. Dr. A. O. Thomas has carefully inspected the manuscript of the present paper and his criticisms and suggestions have been most helpful. The late Dr. Stuart Weller kindly inspected nearly all of the sections here used and his advice regarding them is keenly appreciated. His generic descriptions, as given in *Mississippian Brachiopoda*, have been freely drawn upon and in many places copied verbatim. Authentic specimens of *Cranaena romingeri* and *C. iowensis* were kindly furnished by Dr. Carroll Lane Fenton for use in comparisons of the internal structure of *Cranaena* and *Cranaenella*.

Genus—**CRANAENA**—Hall and Clarke

Description: Shell terebratuliform. Pedicle valve with or without a median sinus. The foramen large, oblique, encroaching upon the umbonal portion of the valves. Delthyrium triangular, almost completely covered by the deltidial plates. Internally, a stout pseudo-syrinx is developed which may be free or may rest on the deltidial plates between the dental lamellae. Dental lamellae strong and of moderate length. Brachial valve with or without median fold. Internally, the well developed socket plates are connected transversely by a concave hinge plate which is perforated posteriorly near the apex of the valve. Upon the inner, or concave, surface of the hinge plate a pair of ridges originate at or near the anterior margin of the perforation and continue anteriorly across the plate to the front from which they are produced into the crura. These crural ridges upon the hinge plate divide that plate into three subequal parts or into two equal lateral divisions and a broader central one and in some species the crural ridges are accompanied by similar ridge-like thickenings upon the opposite side of the hinge plate. The brachidium is short and Dielasma-like, not reaching to the middle of the valve. Surface of both valves marked by concentric

lines of growth and occasionally by fine radiating costae. Shell substance finely punctate.

Remarks: Sections of more than fifty specimens, including every known species from the Devonian of northern Iowa show that the pseudo-syrinx is a structure developed in all members of the genus. It is well shown in both *C. romingeri* the genotype, and in *C. iowensis* which both Hall and Clarke, and Weller place as one of the types of the genus. The genus *Cranaenella* of Fenton and Fenton supposedly differed from *Cranaena* only in the presence of a pseudo-syrinx in the former and the supposed absence of it in the latter. Since the pseudo-syrinx is present in the genotype of *Cranaena* the name *Cranaenella* stands without valid generic characters and must be considered only as a synonym for *Cranaena*.

*Cranaena romingeri* (Hall)

Plate I, figs. 9-17

- Terebratula romingeri* Hall, 16th. Rept. N. Y. State Cab. Nat. Hist. p. 48, figs. 22, 23. 1863.
- Terebratula romingeri* Hall, Pal. N. Y. vol. IV, p. 389, pl. 60, figs. 17-25, 66, -67. 1867.
- Terebratula romingeri* Nettleroth, Kentucky Fossil Shells, Monograph Kentucky Geol. Survey, p. 155, pl. 16, figs. 20-22. 1889.
- Cranaena romingeri* Hall and Clarke, Pal. N. Y. vol. VIII, pt. 2, p. 297, pl. 80, figs. 13-19. 1893.
- Cranaena romingeri* Schuchert, U. S. Geol. Survey Bull. 87, p. 188. 1897.
- Cranaena romingeri* Kindle, Indiana Geol. Nat. Res. 25th. Ann. Rept. pp. 660-661, pl. 12, figs. 4, 4a. 1901.
- Dielasma romingeri* Grabau and Shimer, North American Index Fossils, I, p. 302, figs. 376a-c. 1909.
- Cranaena romingeri* Branson, Devonian of Missouri, pp. 96, 97, pl. 20, figs. 17-19. 1922.

Description: Shell small, subovate to subpentagonal in outline, longer than wide with the greatest width slightly anterior to the midlength, anterior margin flattened or gently concave. Dimensions of two plesiotypes: length of pedicle valve 10.5 and 10.6 mm.; length of brachial valve 9. and 8.4 mm.; width 9.1 and 9.7 mm.; thickness 6.5 and 8.4 mm.

Pedicle valve strongly convex with the greatest curvature posterior to the midlength. Surface arching strongly from the beak to the anterior margin, gently arched transversely along the midline from which the surface is abruptly arched to the lateral margins which in some cases stand at right angles to the plane of the



valve. Sinus absent in some cases but more commonly shown as a broad poorly defined depression along the anterior third of the valve. In rare cases the margins of the sinus are defined by rounded ridges in which cases the sinus is slightly produced. Beak blunt, rather large, marked apically by a small circular foramen. False cardinal area very small or absent. Internally, the pseudo-syrinx is short and stout and rests upon the deltidial plates. As seen in

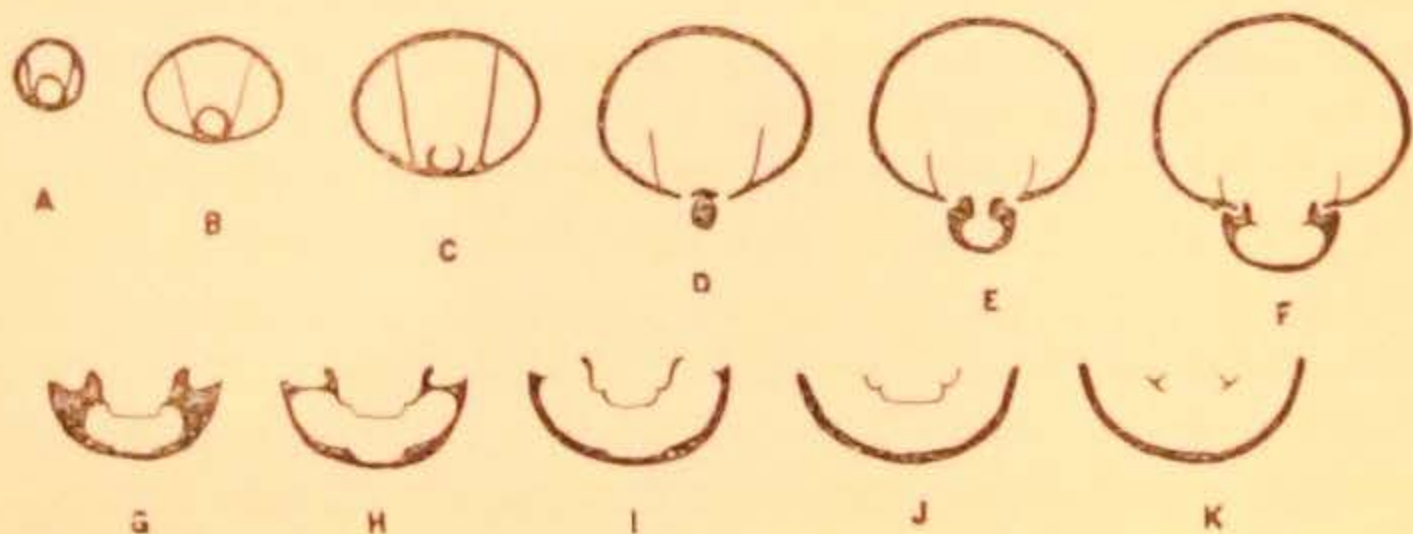


Fig. 1. A series of 11 cross-sections (x 3) from the rostral portion of the shell of *Cranaena romingeri* showing the pseudo-syrinx and dental lamellae of the pedicle valve and the dental sockets, hinge plate and crura of the brachial valve.

section the dental lamellae are rather stout and their tops are gently divergent. They extend forward about one-sixth the distance to the front of the shell.

Brachial valve nearly as convex as the pedicle with the greatest curvature slightly posterior to the midlength. Surface arching strongly from beak to front, broadly rounded transversely along the median line of the valve from which it arches gently to the lateral and postero-lateral margins. In some cases the surface is flattened or gently concave along the median line in which cases the surfaces of the lateral slopes are sharply deflected toward the opposite valve. Internally, the hinge plate is well elevated above the floor of the valve. The crural ridges and crura are heavy. Surface of both valves marked by numerous fine concentric growth lines which are very prominent along the marginal portions of the valves.

Remarks:—The above description is based upon a number of specimens from both the Traverse beds of Michigan and from the Cedar Valley beds of central Iowa.

Occurrence:—Common in the upper member of the Cedar Valley

formation in central Iowa, less common in the lower member. Traverse beds of Michigan, Mineola limestone of Missouri.

Types:—Plesiotypes No. 6316, 6317, 10123, 10125, 10126 C.H.B. No. 505 U.C.M. No. 6-901 S.U.I.

*Cranaena iowensis* (Calvin)

Plate I, figs. 1-8

*Terebratula* (*Cryptonella*) *iowensis* Calvin, Bull. S. U. I. Lab. Nat. Hist. vol. I, p. 174, pl. 3, fig. 4. 1890.

*Cranaena iowensis* Hall and Clarke, Pal. N. Y. vol. VIII, pt. 2, p. 297, pl. 80, figs. 36-39, pl. 83, fig. 41. 1893.

*Cranaena iowensis* Schuchert, U. S. Geol. Survey, Bull. 87, p. 188. 1897.

*Cranaena iowensis* Cleland, Wisconsin Geol. Nat. Hist. Survey, Bull. 21, p. 72, pl. 13, figs. 10, 11. 1911.

*Cranaena iowensis* Weller, Mississippian Brachiopoda, p. 249, figs. a-j. 1914.

*Cranaena iowensis* Branson, Devonian of Missouri, p. 95, pl. 20, figs. 20-22. 1922.

Description:—Shell of medium size, subovate in outline, longer than wide with the greatest width slightly anterior to the midlength, the anterior margin flat or broadly rounded. Dimensions of two plesiotypes: length of pedicle valve 27.7 and 23.8 mm.; length of brachial valve 24. and 20.5 mm.; width 21.3 and 20. mm.; thickness 16.2 and 14.9 mm.

Pedicle valve strongly convex. Surface curving gently and uniformly from the beak to the anterior margin, broadly rounded transversely along the median line from which the surface arches sharply to the lateral and postero-lateral margins, the lateral margins sometimes standing nearly at right angles to the plane of the valve. Sinus absent or indicated only by a short and rather broad lingual extension the surface of which may be slightly depressed anteriorly. Beak large, prominent, gently incurved, its apex bearing an oval foramen. Surface below the beak forming a very small, strongly concave, false cardinal area. Internally, the pseudo-syrinx is short, resting on the deltidial plates and touching the dental lamellae. The dental lamellae extend forward nearly one-fifth the length of the valve, being nearly vertical in position and very slightly divergent from each other.

Brachial valve somewhat less convex than the pedicle with the greatest curvature in the umbonal region. Along the median line the surface is strongly convex in the umbonal region, gently convex or nearly flat along the midlength, then abruptly arched to the

anterior margin. Along the median line the surface is transversely flattened or very gently convex from which the surface arches with increasing abruptness to the lateral and postero-lateral margins. Beak rather large, bluntly pointed, strongly incurved and partially

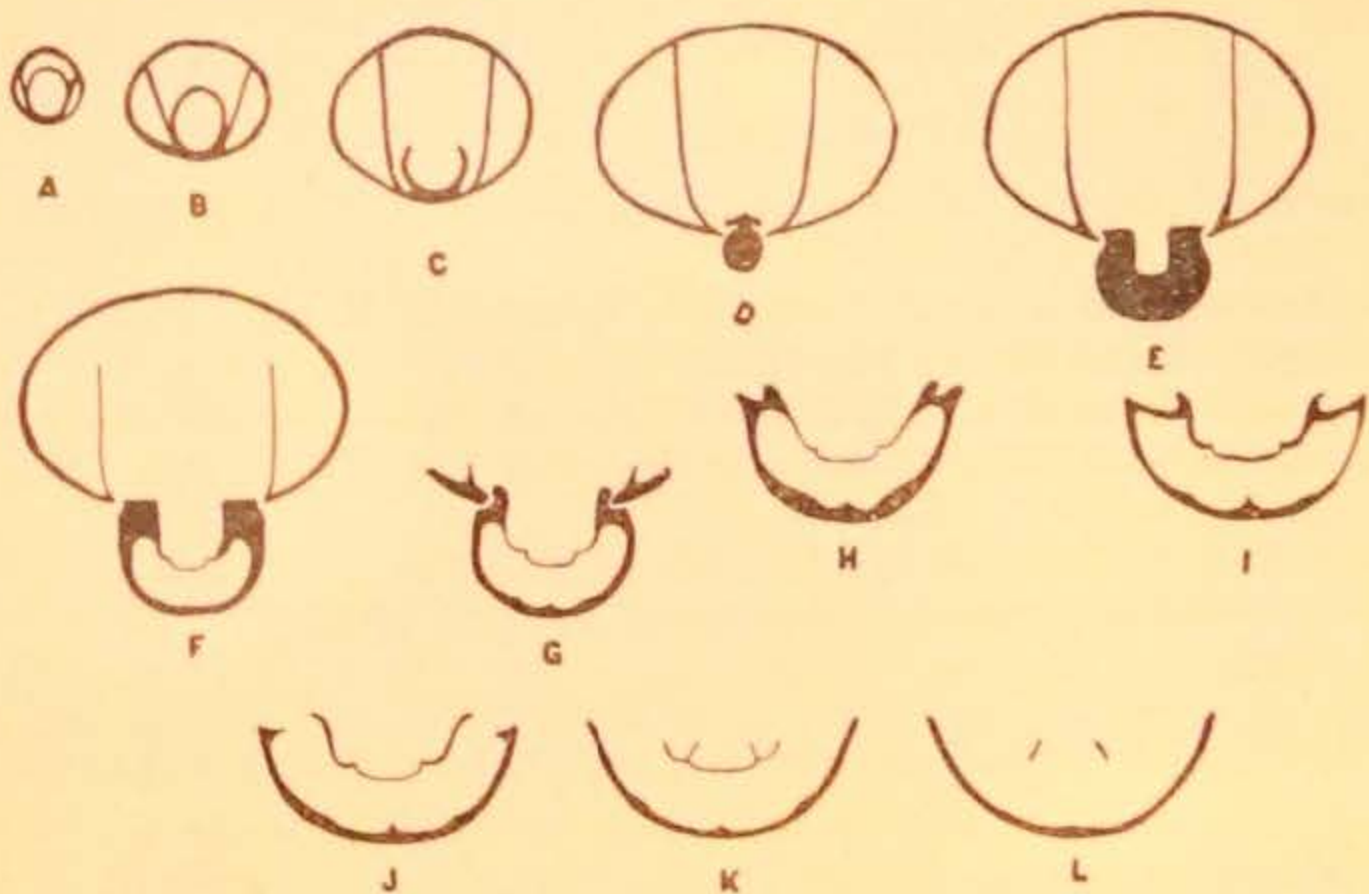


Fig. 2. A series of 12 cross-sections ( $\times 2$ ) from the rostral portion of the shell of *Cranaena iowensis* showing the pseudo-syrinx and dental lamellae of the pedicle valve and the dental sockets, hinge plate and crura of the brachial valve.

concealed by the deltidial plates of the pedicle valve. Internally, the dental sockets are strong and heavy and the strongly arched hinge plate is well elevated above the shell floor. Surface of both valves marked by numerous fine concentric growth lines. On well preserved specimens there are traces of fine radiating striae.

Remarks:—The above description is based upon several nearly perfect specimens obtained from Cedar Valley strata near Randalia, Iowa, the type locality. In the Upper Cedar Valley beds of Johnson County there occurs abundantly a rather flattened form which has been referred to this species. An example is here figured. Judging from the figures given, Hall and Clarke<sup>2</sup> are correct in referring their specimens to *C. iowensis* although they are in error as to locality. Their specimens very evidently came from beds of Cedar Valley age rather than from the Haekberry formation at Rockford, Iowa, as their description states.

Occurrence:—Cedar Valley of central and southeastern Iowa, Callaway limestone of Missouri.

Types:—Plesiotypes No. 6133, 6134, 6136 C.H.B. No. 504, U.C.M.

<sup>2</sup> Pal. N. Y. Vol. VIII, pt. 2, pl. 80, figs. 36-39.

*Cranaena infrequens* n. sp.

Plate I, figs. 18-21

Description:—Shell small, subcircular to subpentagonal in outline, slightly longer than wide with the greatest width near the midlength. Dimensions of the holotype: length of pedicle valve 11.3 mm.; length of brachial valve 9.4 mm.; width 10.1 mm.; thickness 5. mm.

Pedicle valve depressed convex with the greatest curvature in the umbonal region. Surface arching gently from beak to front, very gently arched transversely across the midline from which the surface slopes very gently to the lateral and postero-lateral margins. Beak large, slightly incurved, pierced by a large circular foramen the diameter of which is about one-tenth that of the length of the shell. Surface of the shell beneath the beak flattened to form a transversely elongate false cardinal area the surface of which is very gently concave. Internally, the pseudo-syrinx is short and stout and is attached to the deltidial plates. The short dental lamellae are nearly vertical and diverge but slightly in the course of their length.

Brachial valve very gently convex with the greatest curvature near the midlength. Surface arching very gently from the beak to

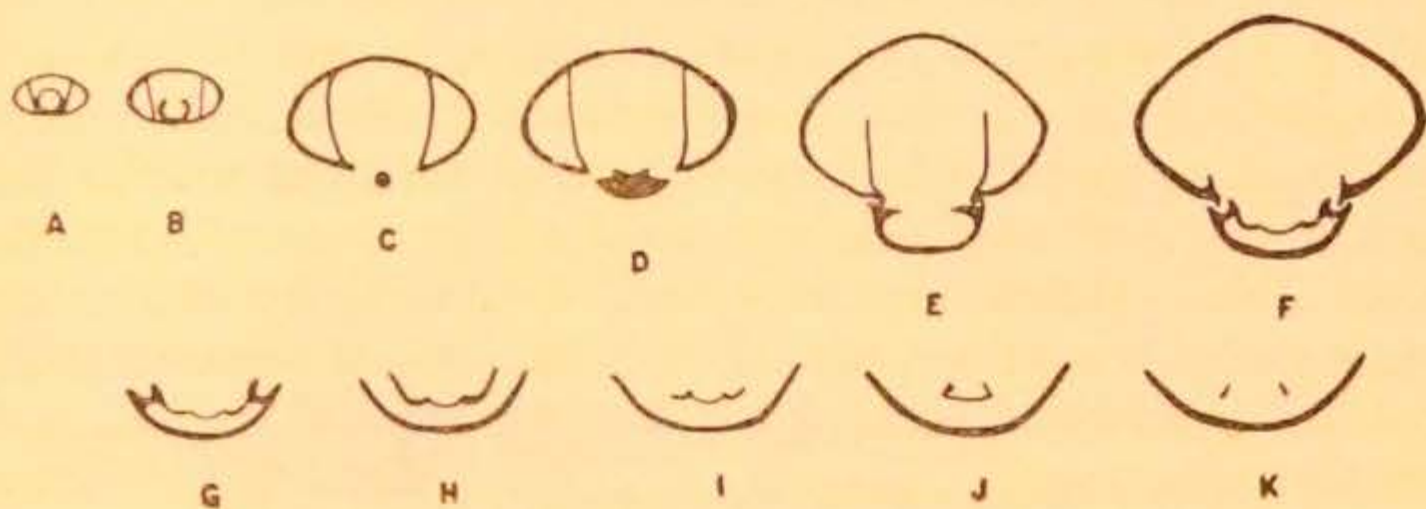


Fig. 3. A series of 11 cross-sections (x 2) from the rostral portion of the shell of *Cranaena infrequens*. Note the short pseudo-syrinx and vertical dental lamellae of the pedicle valve and the dental sockets, hinge plate and crura of the brachial valve.

the anterior margin, broadly rounded transversely along the midline from which the surface slopes very gently to the lateral margins. Internally, the concave hinge plate is moderately elevated above the shell floor and the posterior perforation is of relatively large size and at a considerable distance anterior to the apex. Surface of both valves marked by weak concentric lines of growth.

Remarks:—This species can be readily distinguished from any other here studied by its compressed form and by the relatively large beak and foramen.

Occurrence:—Confined to the *Atrypa lineata* zonule near the central portion of the Devonian strata at Charles City, Iowa. It is an uncommon form.

Types:—Holotype No. 7041, paratypes No. 7042, 7044, 7045, C.H.B.

*Cranaena maculata* n. sp.

Plate I, figs. 22-28

Description:—Shell of medium size or smaller, subovate to subpentagonal in outline, longer than wide with the greatest width slightly anterior to the midlength, anterior margin gently rounded. Dimensions of the holotype and a paratype: length of pedicle valve 23.5 and 20.8 mm.; length of brachial valve 20.5 and 17.8 mm.; width 21. and 18. mm.; thickness 11.5 and 8.7 mm.

Pedicle valve moderately convex with the greatest curvature slightly posterior to the midlength. Surface arching gently from beak to front, strongly rounded transversely along the median line from which the surface arches gently to the lateral and postero-lateral margins. Sinus weak, in most cases consisting of a broad shallow depression near the anterior margin; in rare cases a faint ridge borders the extreme anterior portion. Beak rather large, blunt, moderately incurved; marked by a rather large circular foramen which is directed nearly at right angles to the plane of the valve. False cardinal area very small or absent. Internally, the pseudo-syrinx is short and free. The dental lamellae are moderately divergent and extend forward less than one-sixth of the length of the valve.

Brachial valve slightly less convex than the pedicle with the greatest curvature near the midlength. Surface arching gently from the beak to the anterior margin, broadly rounded transversely along the median line from which the surface slopes very gently to the lateral and postero-lateral margins. In some cases the shell is slightly elevated mesially along the anterior half of the valve. Beak small and largely concealed by the deltidial plates of the pedicle valve. Internally, the broad hinge plate is but slightly elevated above the shell floor; the posterior perforation is rather long. Internal casts show the muscle scars as a pair of slender grooves

radiating from the beak. Surface of both valves marked by fine concentric lines of growth. Most specimens show the original color pattern occurring as small maculae of chocolate-brown hue. These spots are up to 1 mm. in diameter and are scattered rather evenly

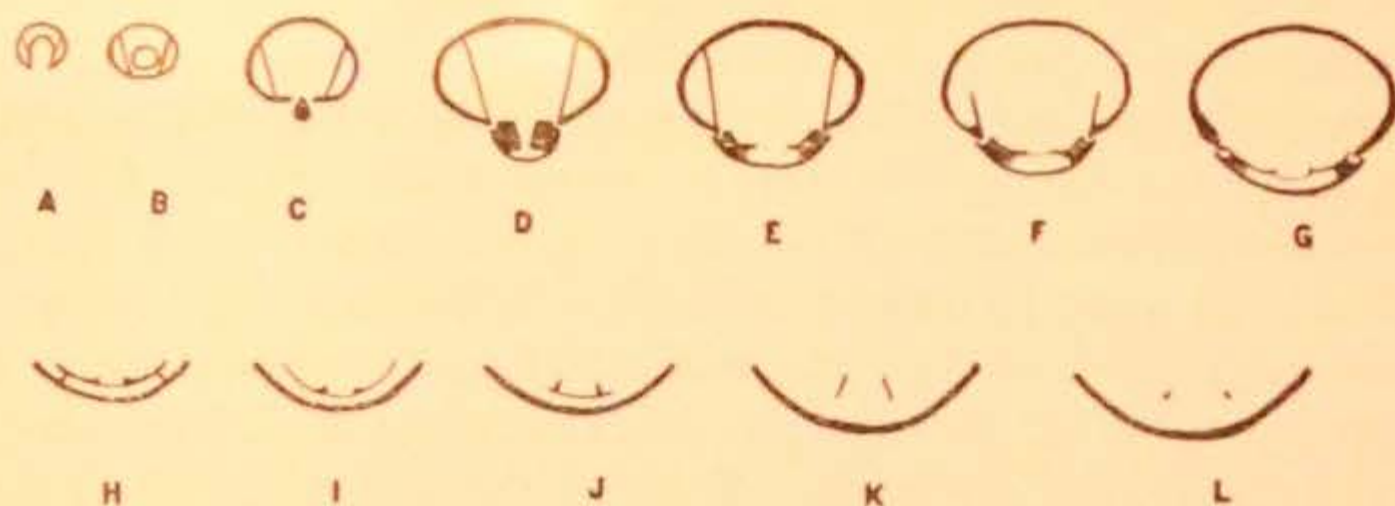


Fig. 4. A series of 12 cross-sections (x 1.5) from the rostral portion of the shell of *Cranaena maculata* showing the pseudo-syrinx and dental lamellae of the pedicle valve and the socket plates, hinge plate and crura of the brachial valve.

over the shell at distances of from 1 to 2 millimeters from each other. The coloring material is embedded in the shell substance.

Remarks:—The form most closely related to this in the Iowa Devonian is *C. calvini* of the Hackberry formation. From this *C. maculata* differs in its uniformly smaller size, greater convexity of the valves and in the almost complete absence of a false cardinal area. Both show color patterns but whereas that of *C. maculata* consists of small, evenly distributed maculae that of *C. calvini* consists of much larger masses which are very irregular in position on the valves. Mixed lots of the two species can be separated with ease.

Occurrence:—Confined to the Eatonian zone near the top of the Mason City substage of the Shellrock. It is particularly common in the Baumgardner phase south of Nora Springs, Iowa, but has been found as far southward as Greene, Iowa.

Types:—Holotype No. 1813, paratypes No. 265, 1182, 1183, 1184 C.H.B. No. 6-898 S. U. I.

*Cranaena parvirostra* n. sp.

Plate II, figs. 1-5.

Description:—Shell of medium size, subovate in outline, longer than wide with the greatest width varying from slightly anterior to the midlength to a point considerably posterior to the midlength,

anterior margin broadly rounded or slightly flattened. Dimensions of the holotype and a paratype: length of pedicle valve 28.7 and 25.5 mm.; length of brachial valve 27. and 23. mm.; width 24.3 and 21.6 mm.; thickness 13.2 and 15. mm.

Pedicle valve moderately convex, the surface arching gently and uniformly from the beak to the anterior margin. Broadly rounded transversely along the median line from which the surface arches gently to the lateral and postero-lateral margins. Sinus absent. Beak small, rather sharply pointed, very slightly incurved, marked apically by a small, inconspicuous oval foramen which is directed posteriorly at an angle of about sixty degrees to the plane of the valve. Internally, the pseudo-syrinx is small and free for the greater portion of its length. The thin dental lamellae are nearly vertical in position and extend forward less than one-seventh of the length of the valve.

Brachial valve somewhat less convex than the pedicle with the greatest depth near the midlength. Surface arching gently and

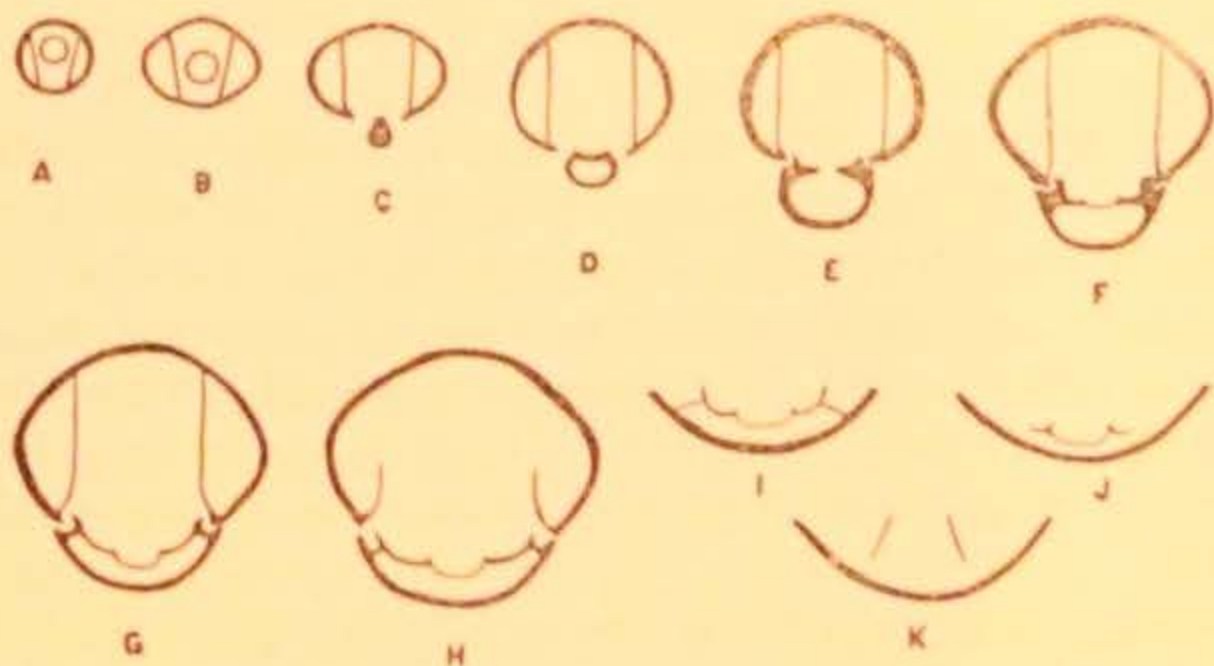


Fig. 5. A series of 11 cross sections ( $\times 2$ ) from the rostral portion of the shell of *Cranaena parvirostra* showing the pseudo-syrinx and dental lamellae of the pedicle valve and the dental sockets, hinge plate and crura of the brachial valve.

uniformly from beak to front, narrowly rounded transversely across the median line from which the surface slopes rather sharply to the lateral and postero-lateral margins. Internally, the dental sockets are well developed. The posterior perforation is small and short and the hinge plate is well elevated above the floor of the valve. Surface of both valves marked by fine concentric lines of growth.

Remarks:—In general size this species is intermediate between

*Cranaena calvini* of the Hackberry and *C. iowensis* of the Cedar Valley but can be distinguished readily from both by its small inconspicuous beak and small foramen.

Occurrence:—Confined to the Camarophoria zonule at the top of the Mason City substage of the Shellrock only in the vicinity of Nora Springs, Iowa.

Types:—Holotype No. 847, paratypes No. 196, 438, 1001, 1708 C.H.B. No. 6-897 S. U. I.

*Cranaena sarcophaga* n. sp.

Plate II, figs. 6-9

Description:—Shell small, subquadrate in outline, longer than wide with the greatest width posterior to the midlength, anterior margin narrowly rounded. Dimensions of the holotype: length of pedicle valve 15.2 mm.; length of brachial valve 13.7 mm.; width 6.1 mm.; thickness 6.5 mm.

Pedicle valve moderately convex. Surface arching gently from beak to front with the greatest curvature posterior to the midlength, sharply rounded transversely across the median line from which the surface slopes rather sharply to the lateral margins. Beak rather large, moderately incurved, marked apically by a small circular foramen which is directed posteriorly at an angle of about fifty degrees to the plane of the valve. Internally, the dental lamellae extent forward about one-sixth the length of the valve.

Brachial valve slightly less convex than the pedicle with the greatest curvature slightly anterior to the beak. Surface curving very gently from the beak to the anterior margin, narrowly rounded transversely along the midline from which the surface slopes rather sharply to the lateral and postero-lateral margins. Aside from heavy dental sockets shown through the translucent shell the internal characters are unknown. Surface of both valves marked by very fine concentric growth lines.

Remarks:—The above description is based upon one specimen, the general form of which is so unique that separation as a distinct species seems warranted. No other terebratuloid is known to occur in the zonule or zone in which this species occurs. It can be readily distinguished from other species here described by its elongate, coffinlike shape, its comparatively straight lateral margins and by the obtuse beak and postero-lateral margins.

Occurrence:—Confined to the Alveolites zonule near the base of



the Mason City substage of the Shellrock at "Parker's Mill" in Mason City, Iowa.

Type:—Holotype No. 1135 C.H.B.

*Cranaena seminula* n. sp.

Plate II, figs. 10-18

Description:—Shell very small and seedlike, subovate in outline, longer than wide with the greatest width near the midlength. Dimensions of the holotype and a paratype: length of pedicle valve 7.6 and 7.3 mm.; length of brachial valve 6.5 and 6.7 mm.; width 5.3 and 6. mm.; thickness 4.4 and 3.8 mm.

Pedicle valve strongly convex with the greatest convexity near the midlength. Surface curving strongly from the beak to the anterior margin, broadly rounded transversely with the surface arching rather strongly from the midline to the lateral margins. Sinus absent or indicated only by a poorly defined depression at the front of the shell. Beak acute, conspicuous, gently incurved, marked apically by a small circular foramen. False cardinal area very narrow.

Brachial valve nearly as convex as the pedicle with the greatest depth near the midlength. Surface arching strongly and uniformly from beak to front, broadly rounded transversely along the midline from which the surface arches gently to the lateral margins. Surface of both valves marked by very faint concentric growth lines.

Remarks:—From other small species here described *C. seminula* differs in its elongate, seedlike form and in the slender pointed beak.

Occurrence:—Common in the Strobilocystites zonule at Rockford, Iowa, and in the Prismaephyllum zonule at Rudd, Iowa.

Types:—Holotype No. 563, paratypes No. 1332, 1333, 1334 C.H.B.

*Cranaena brevisyrinx* n. sp.

Plate II, figs. 19-22

Description:—Shell small, subovate to subquadrate in outline, longer than wide with the greatest width near the midlength. Dimensions of the holotype: length of pedicle valve 9.3 mm.; length of brachial valve 8.2 mm.; width 8.2 mm.; thickness 4.7 mm.

Pedicle valve moderately convex, the surface arching gently from the beak to the anterior margin with the greatest curvature

in the umbonal region; flattened or broadly rounded transversely along the midline from which the surface arches with increasing convexity to the lateral and postero-lateral margins. Sinus weak, in most cases confined to a slight flattening of the shell near the

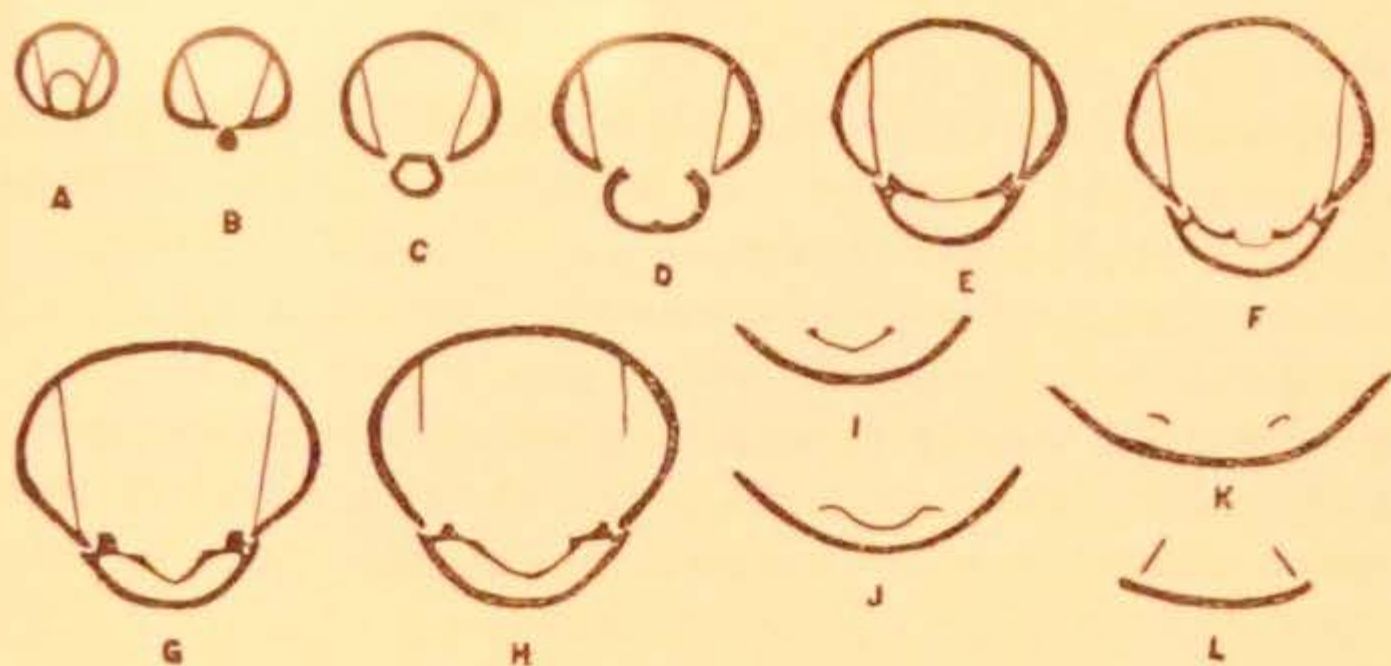


Fig. 6. A series of 12 cross-sections (x 4) from the rostral portion of the shell of *Cranaena brevisyrinx* showing the short pseudo-syrinx and dental lamellae of the pedicle valve and the dental sockets, concave hinge plate and crura of the brachial valve.

anterior margin. Beak blunt, moderately incurved, marked apically by a rather large, circular foramen which is directed posteriorly at an angle of about seventy degrees to the plane of the valve. False cardinal area absent. Internally, the pseudo-syrinx is very short and is attached to the deltidial plates. The stout dental lamellae extend forward about one-fifth of the length of the valve; as seen in successive sections they diverge moderately both upward and forward.

Brachial valve considerably less convex than the pedicle with the greatest curvature in the umbonal region. Surface arching gently from beak to front, narrowly rounded transversely with the surface sloping rather sharply from the midline. Internally, the dental sockets are strong and heavy and the posterior perforation is rather large. As seen in section the hinge plate is broadly V-shaped with the crural ridges lying near the tops of the V. The entire hinge plate is well elevated above the shell floor.

Remarks:—*Cranaena brevisyrinx* can be readily distinguished from *C. seminula* of this paper by the blunt beak, greater proportionate width and by the lesser convexity of the valves.

Occurrence:—Confined to the Schuchertella zonule near the base of the Nora substage of the Shellrock. It has been found only in

the vicinity of Rockford, Iowa, where it is a rather common form.

Types:—Holotype No. 1179, paratypes No. 52, 1177, 1178 C.H.B.

*Cranaena brevilamella* n. sp.

Plate II, figs. 23-27

Description:—Shell of medium size, subrhombic to subovate in outline, longer than wide with the greatest width slightly anterior to the midlength. Dimensions of the holotype: length 23.8 mm.; width 18.4 mm.; thickness 11.1 mm.

Pedicle valve moderately convex with the greatest curvature in the umbonal region. Surface arching gently from the beak to the anterior margin, narrowly rounded transversely with the surface arching gently from the midline to the lateral and postero-lateral margins. Sinus absent. Beak small, blunt, moderately incurved,

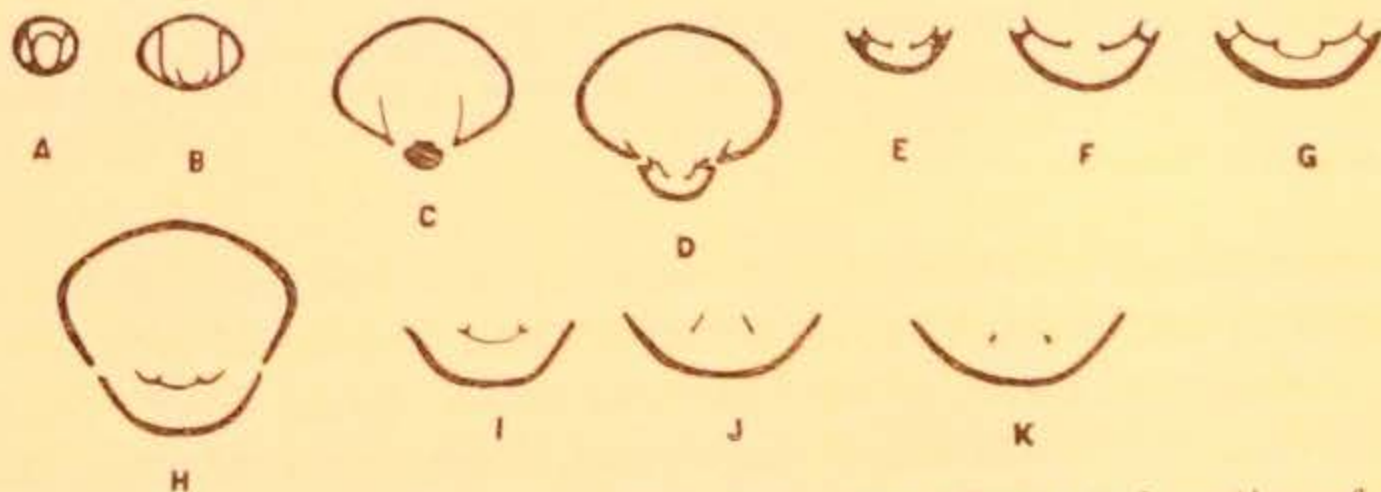


Fig. 7. A series of 11 cross-sections (x 2) from the rostral portion of the shell of *Cranaena brevilamella* showing the pseudo-syrinx and short dental lamellae of the pedicle valve and the dental sockets, hinge plate and crura of the brachial valve.

marked apically by a small circular foramen which is directed almost at right angles to the plane of the valve. Internally, the pseudo-syrinx is attached to the deltidial plates. The dental lamellae are very short, extending forward less than one-tenth the length of the valve.

Brachial valve nearly as convex as the pedicle with the greatest depth at or slightly posterior to the midlength. Surface sharply rounded transversely along the midline from which it slopes rather sharply to the lateral and postero-lateral margins. Internally, the posterior perforation is small—the short hinge plate is highly elevated above the floor of the valve.

Remarks:—Externally this species bears considerable resemblance to *C. parvirostra* of this paper, differing from that species in its

more elongate form, larger beak and more convex brachial valve. Internally, *C. brevilamella* may be readily distinguished by its short dental lamellae, its short and attached pseudo-syrinx and its short highly elevated hinge plate.

Occurrence:—Confined to the various members of the Upper Actinostroma zone at the top of the Nora substage of the Shell-rock. It is most common in the Pseudotectus zonule in the Rockford and Nora Springs phases.

Types:—Holotype No. 1591, paratypes No. 238, 400, 712 C.H.B.

*Cranaena calvini* (Hall and Whitfield)

Plate III, figs. 1-7

*Cryptonella eudora* Hall and Whitfield, 23rd. Ann. Rept. New York State Cab. p. 225. 1873.

*Cryptonella calvini* Hall and Whitfield, *ibidem*, p. 239. 1873.

*Cryptonella calvini* Whiteaves, Cont. Can. Pal. vol. I, p. 235. 1891.

*Dielasma calvini* Hall and Clarke, Pal. New York, vol. VIII, pt. 2, p. 296, (not figs. 20-22, pl. 80). 1894.

*Dielasma calvini* Schuchert, U. S. Geol. Surv. Bull. 87, p. 212. 1897.

*Cranaena calvini* Fenton, Am. Jour. Sci. 4th. ser. vol. 48, p. 372. 1919.

? *Cranaena calvini* Branson, Devonian of Missouri, p. 94, (not figs. 3-5, pl. 20, fig. 5, pl. 18). 1922.

*Cranaenella calvini* Fenton and Fenton, Cont. Mus. Geol. Univ. Mich. vol. I, p. 132, figs. 23-25, pl. 25. 1924.

*Dielasma calvini* Nicolas, Canadian Geol. Surv. Index to Pal. p. 95. 1926.

Description:—Shell large, subovate to subpentagonal in outline, longer than wide with the greatest width near the midlength, anterior margin flat or broadly rounded. Dimensions of two plesiotypes: length of pedicle valve 33. and 34.5 mm.; length of brachial valve 28.3 and 31. mm.; width 29.7 and 31.3 mm.; thickness 13. and 12.5 mm.

Pedicle valve gently convex with the greatest curvature posterior to the midlength. Surface arching gently from beak to front, flattened or broadly rounded along the midline from which the surface arches very gently to the lateral and postero-lateral margins. The sinus may be absent but in most cases it is shown as a broad flattened area on the anterior third of the valve. Rarely the margins of the sinus are defined by abrupt depressions in which case the sinus is produced into a short subquadrate lingual extension. Beak large, blunt, moderately incurved, marked apically by a large subcircular foramen which is directed posteriorly at an angle of

about seventy degrees to the plane of the valve. False cardinal area comparatively large, its surface gently concave. Internally, the stout pseudo-syrinx does not rest on the deltidial plates. The erect dental lamellae extend forward about one-sixth the length of the valve.

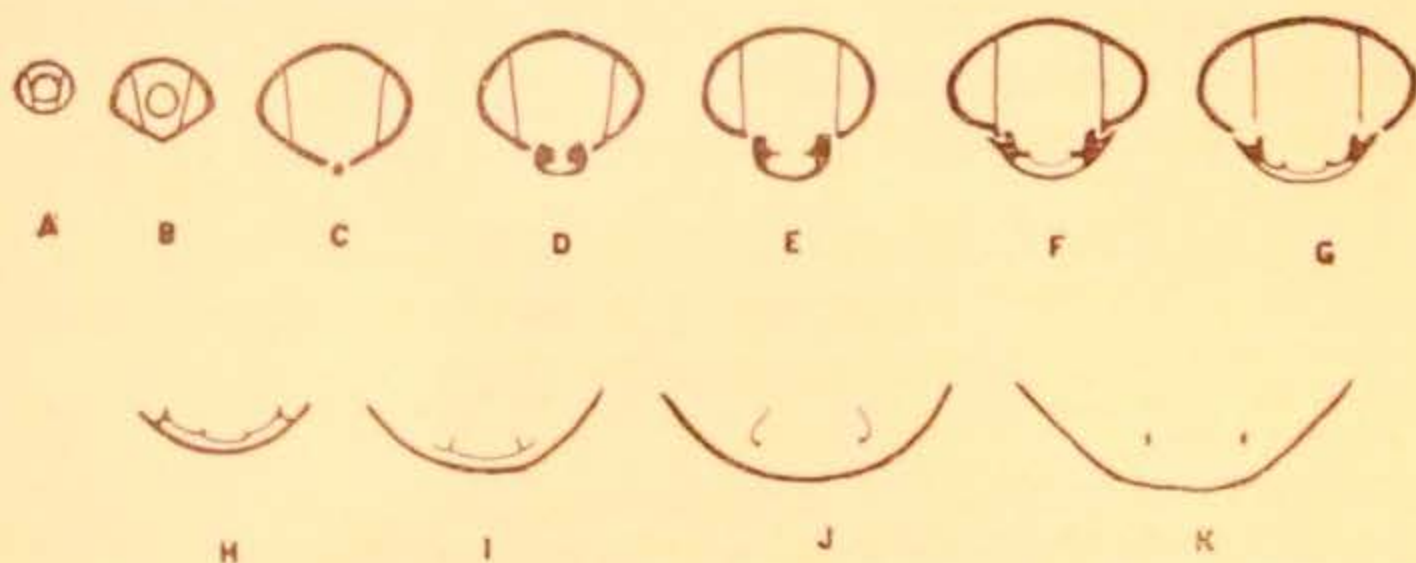


Fig. 8. A series of 11 cross-sections ( $\times .75$ ) from the rostral portion of the shell of *Cranaena calvini* showing the pseudo-syrinx and dental lamellae of the pedicle valve and the dental sockets, hinge-plate and crura of the brachial valve.

Brachial valve slightly less convex than the pedicle. Surface arching very gently from the beak to the anterior margin, broadly rounded transversely along the midline from which the surface arches gently to the lateral margins. In some cases the anterior third of the valve is flattened and on those specimens with well defined sinus in the pedicle valve the surface is corresponding elevated into a short flattened fold the margins of which are defined by shallow depressions. Internally, the broad hinge plate is but slightly elevated above the shell floor and the posterior perforation is small. Surface of both valves marked by numerous fine concentric lines of growth which are most marked near the margins. In many cases the original color pattern is shown as small irregular spots from one-half to two millimeters in diameter and which are irregularly scattered over both valves.

Remarks:—Only one species from the Iowa Devonian resembles *C. calvini* closely enough to warrant comparison. That species is *C. maculata* of the Shellrock formation which differs from the present species in its uniformly smaller size, more convex valves, more acute beak and in the differences in the color pattern discussed under *C. maculata*. The form from Missouri, described under *C. calvini* by Branson, differs from any described Iowa

species in its large foramen, obtuse postero-lateral margin and relative curvature of the valves.

Occurrence:—*C. calvini* apparently is confined to the Norton-echinus zonule near the center of the Cerro Gordo substage of the Hackberry. It is a rather common form and has been found wherever that horizon is exposed in Floyd and Cerro Gordo counties of northern Iowa. The form figured under this species by Hall and Clarke is erroneously identified. *C. calvini* does not occur at Buffalo, Iowa, or in any known faunule of the Cedar Valley.

Types:—Plesiotypes No. 3159, 3176, 3561, 3920, 4286, 4475 C.H.B. No. 6-896, 6-903 S. U. I.

*Cranaena navicella* (Hall)

Plate III, figs. 8-16

*Terebratula navicella* Hall, Pal. New York, vol. IV, p. 391, pl. 60, figs. 38-44. 1867.

*Centronella ? navicella* Hall and Clarke, Pal. New York, vol. VIII, pt. 2, pl. 79, figs. 40-42. 1895.

*Centronella ? navicella* Schuchert, U. S. Geol. Surv. Bull. 87, p. 171. 1897.

*Centronella navicella* C. L. Fenton, Am. Jour. Sci. 4th. ser. vol. 48, p. 372. 1919.

*Cranaenella navicella* Fenton and Fenton, Cont. Mus. Geol. Univ. Mich. vol. I, p. 130, text fig. 9, pl. 25, figs. 18-22. 1924.

Description:—Shell small, subovate in outline, longer than wide with the greatest width slightly anterior to the midlength, anterior margin broadly rounded. Dimensions of a plesiotype: length of pedicle valve 13.8 mm.; length of brachial valve 12. mm.; width 10.9 mm.; thickness 5.7 mm.

Pedicle valve moderately convex. Surface arching gently from the beak to the anterior margin,—flattened or broadly rounded transversely along the median line from which the surface slopes gently to the lateral margins and arches more strongly to the postero-lateral margins. In most cases the sinus is absent; rarely it is indicated by a broad, poorly defined, flattened area near the front of the shell. Beak large, blunt, moderately incurved, pierced apically by a small oval foramen which is directed posteriorly at an angle of about seventy degrees to the plane of the valve. False cardinal area small and nearly at right angles to the plane of the valve. Internally, the pseudo-syrinx is short and free. The strong subparallel dental lamellae extend forward about one-fifth the length of the valve.

Brachial valve in transverse direction nearly as convex as the pedicle. Longitudinally the surface is flattened or very gently arched along the midline with the greatest curvature near the beak; transversely the shell is broadly rounded along the midline from which the surface arches gently to the lateral and postero-lateral

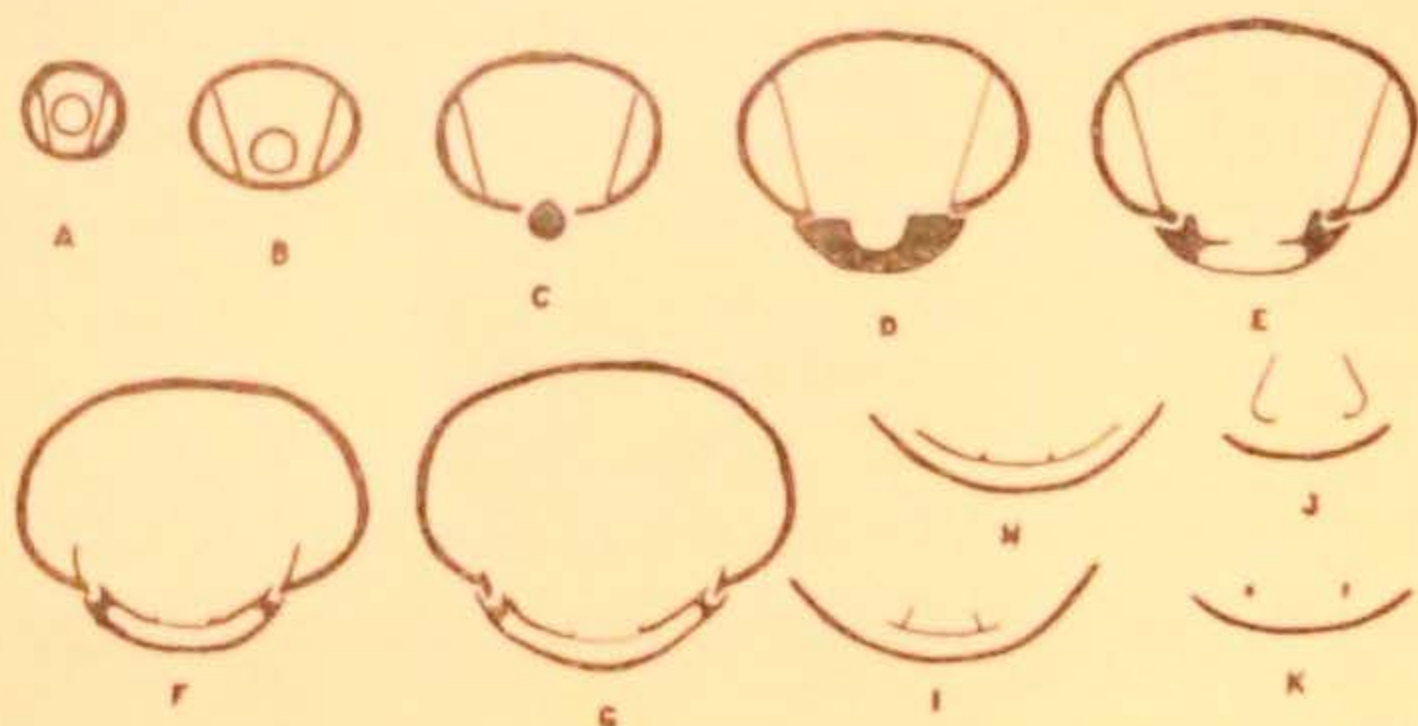


Fig. 9. A series of 11 cross sections (x 4) from the rostral portion of the shell of *Cranaena navicella* showing the pseudo-syrinx and dental lamellae of the pedicle valve and the dental sockets, hinge plate and crura of the brachial valve.

margins. Fold absent on most specimens but rarely it appears as a short, slightly elevated area near the front of the shell. Internally, the hinge plate is broad and low and the posterior perforation is comparatively small. Surface of both valves marked by numerous fine concentric growth lines.

Remarks:—This species can be distinguished from immature specimens of *C. calvini* by its more elongate form and more convex valves. Externally, it bears some resemblance to *Diclasmella praecursor* although shells of the last species commonly have a more pronounced fold and sinus. When this is lacking the two forms can be separated by moistening the brachial valve and noting the position of the dental sockets. A study of the internal characters of *C. navicella* and *C. romingeri* is given under the generic description.

Occurrence:—One of the commonest species of the Cerro Gordo substage of the Hackberry. It has been found more or less commonly in every zonule of the Cerro Gordo but is most common in the Pugnoides zonule near the top of the substage. At present it is

known only from Floyd and Cerro Gordo counties of northern Iowa.

Types:—Plesiotypes No. 3144, 3145, 3174, 3177 C.H.B. No. 6-900, 6-908 S. U. I.

*Cranaena micula* n. sp.

Plate III, figs. 21-25

Description:—Shell minute, subovate to subpentagonal in outline, longer than wide with the greatest width well anterior to the midlength, anterior margin flattened or broadly rounded. Dimensions of the holotype: length of pedicle valve 5.7 mm.; length of brachial valve 5.1 mm.; width 4.8 mm.; thickness 2.8 mm.

Pedicle valve moderately convex with the greatest curvature slightly posterior to the midlength. Surface arching gently from beak to front, narrowly rounded transversely along the midline

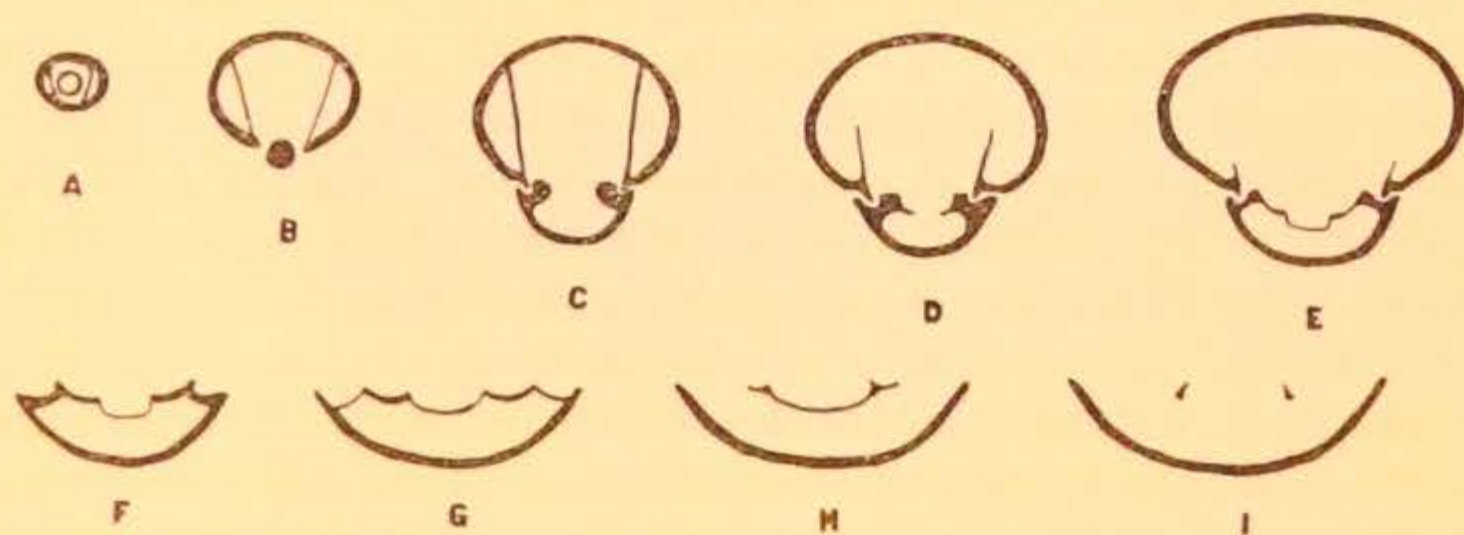


Fig. 10. A series of nine cross-sections (x 8) from the rostral portion of the shell of *Cranaena micula* showing the pseudo-syrinx and dental lamellae of the pedicle valve and hinge plate, crura and dental sockets of the brachial valve.

from which the surface arches gently to the lateral and posterolateral margins. Beak comparatively large, blunt, marked by a minute circular foramen which is directed almost at right angles to the plane of the valve. Internally, the pseudo-syrinx is short and free. The thin, short dental lamellae extend forward about one-seventh the length of the valve.

Brachial valve slightly more convex than the pedicle with the greatest depth near the midlength. Surface curving gently and uniformly from beak to front, broadly rounded transversely across the midline from which the surface arches rather strongly to the lateral margins. Internally, the rather broad hinge plate is highly



elevated above the shell floor and is divided into three well marked parts which lie at about the same general level. The posterior perforation is comparatively large.

Remarks:—This little species can be distinguished from *C. seminula* of the Shellrock by its blunt beak and more elongate form.

Occurrence:—Confined to the central portion of the Owen substage of the Hackberry. It is quite common in the Stuartella zonule at Rockwell, Iowa, where it is associated with *C. rockwellensis*. It is equally common in the corresponding Micula zonule at Owens Grove of which it is the only known terebratulid.

Types:—Holotype No. 3173, paratypes No. 4010, 4279 C.H.B.

*Cranaena rockwellensis* n. sp.

Plate III, figs. 17-20

Description:—Shell of medium size, subpentagonal in outline, longer than wide with the greatest width slightly anterior to the midlength, anterior margin sharply rounded. Dimensions of the holotype: length of pedicle valve 27.3 mm.; length of brachial valve 25.2 mm.; width 23.8 mm.; thickness 13. mm.

Pedicle valve moderately convex with the greatest depth slightly posterior to the midlength. Surface arching gently and uniformly from the beak to the anterior margin, narrowly rounded transversely along the midline from which the surface slopes rather sharply to the lateral and postero-lateral margins. Sinus absent on most specimens, when present it is confined to the anterior third of the valve, its margins defined by rounded grooves between which the

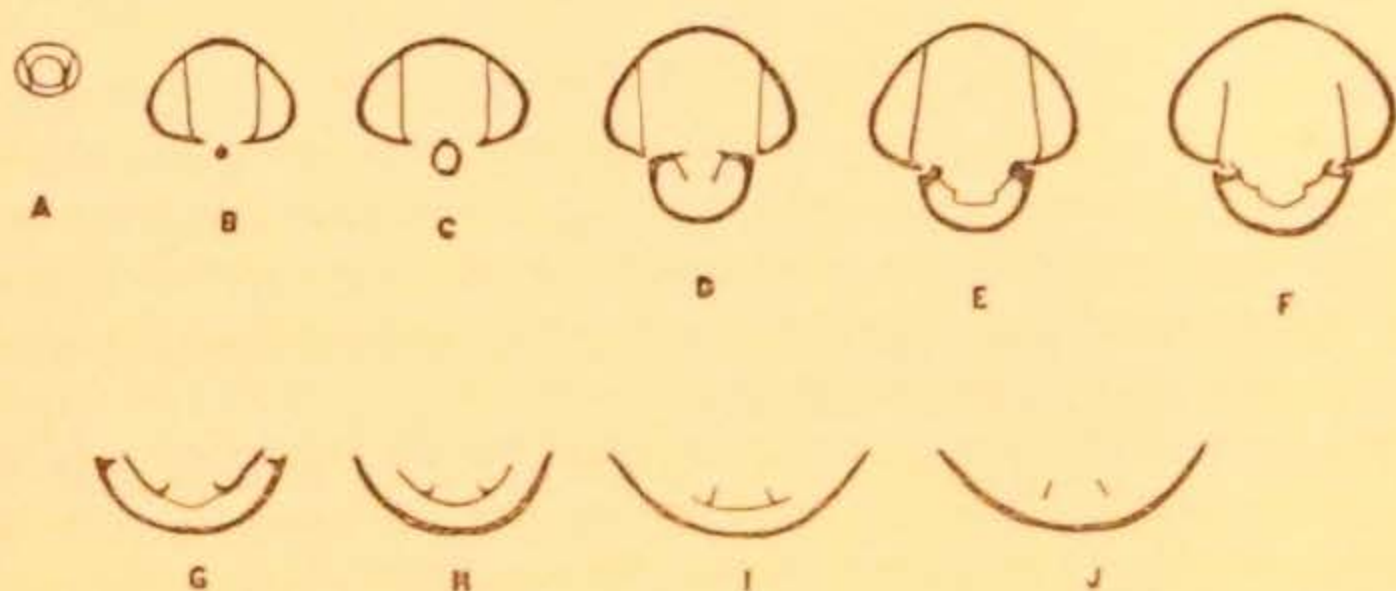


Fig. 11. A series of 10 cross-sections (x 2) from the rostral portion of the shell of *Cranaena rockwellensis* showing the pseudo-syrinx and dental lamellae of the pedicle valve and the dental sockets, hinge plate and crura of the brachial valve.

surface arches upward to conform to the general curvature of the valve. Beak large, blunt, moderately incurved, marked apically by a large oval foramen which is directed posteriorly at an angle of about forty-five degrees to the plane of the valve. Internally, the short pseudo-syrinx does not rest on the deltidial plates. The dental lamellae are nearly vertical and extend forward about one-seventh the length of the valve.

Brachial valve less convex than the pedicle with the greatest depth posterior to the midlength. Surface strongly convex in the umbonal region, becoming very gently convex or flattened along the median and anterior portions of the valve. Transversely the shell is broadly rounded along the midline from which the surface arches gently to the lateral margins. Internally, the dental sockets are well developed. The highly elevated hinge plate has the central portion considerably depressed below the two lateral portions and the posterior perforation is comparatively small. Surface of both valves marked by weak irregular lines of growth.

Remarks:—The present species can be distinguished readily from *C. calvini* of the underlying Cerro Gordo substage by its more elongate form, greater relative convexity of the valves and by its smaller and more pointed beak. Internally, the high hinge plate of *C. rockwellensis* offers a ready means of separating the two forms.

Occurrence:—Confined to the Stuartella zonule near the central portion of the Owen Substage of the Hackberry. It is known only from the vicinity of Rockwell, Iowa.

Types:—Holotype No. 4330, paratypes No. 4042, 4731 C.H.B.

Genus—**STUARTELLA**—n.gen.

Description:—Shell terebratuliform, of medium size, subovate in outline. Pedicle valve with well developed dental lamellae between which and attached to the inner surface of the deltidial plates is a short pseudo-syrinx. Brachial valve with well developed socket plates which do not retreat from the lateral margins of the valve. Hinge plate imperforate, deeply concave for the posterior half of its length. Apically it is sessile on the floor of the valve and is divided laterally into three subequal portions by a pair of geniculations on its upper surface, the central portion considerably depressed below the two lateral portions. Anteriorly the two lateral portions soon become separated from the shell floor and in a

short distance the central portion is similarly elevated so that the entire hinge plate is supported only by the socket plates. The socket plates and lateral portions of the hinge plate disappear a short distance anterior to the point where the hinge plate becomes free but the central portion of the hinge plate continues forward to the base of the crural apophyses. The geniculations of the hinge plate thicken where the plate becomes free and pass forward into the bases of the crura. The short brachidium fails to reach the midlength of the shell, the anterior recurved lamella is very short. Shell substance minutely punctate.

Remarks:—Although the general shape of the hinge plate and the character of the brachidium is suggestive of that of *Cranaena* the fact that the apical part of the hinge plate is sessile precludes reference to that genus. The only other known terebratulid with imperforate hinge plate is Weller's genus *Hamburgia* from the Mississippian. In that genus the socket plates retreat from the lateral margins of the valve and the crura originate as low ridges on the gently concave upper surface of the hinge plate at a point considerably anterior to the apex. Generic name in honor of the late Dr. Stuart Weller who examined the sections of both species here included and suggested that they were members of a new genus. Genotype *Stuartella vera* n. sp.

*Stuartella devoniana* n. sp.

Plate IV, figs. 1-7

Description:—Shell of medium size, subovate in outline, longer than wide with the greatest width near the midlength, the anterior margin broadly rounded. Dimensions of the holotype: length of pedicle valve 30.5 mm.; length of brachial valve 27.4 mm.; width 23.5 mm.; thickness 19.6 mm.

Pedicle valve strongly convex. Surface arching strongly and uniformly from the beak to the anterior margin, flattened or gently arched transversely along the midline from which the surface arches with increasing curvature to the lateral and postero-lateral margins which meet those of the opposite valve at a broadly obtuse angle and in some cases are slightly reentrant along the posterior half of the valve. Sinus indicated only by a short rounded sinuosity at the front of the shell. Umbo prominent; beak rather conspicuous, pointed, moderately incurved, marked apically by a small oval foramen which is directed posteriorly at an angle of about thirty

degrees to the plane of the valve. False cardinal area rather large, nearly vertical, composed not only of the deltidial plates but also of a considerable portion of the posterior part of the valve. Internally, the pseudo-syrinx is small and short, resting upon the

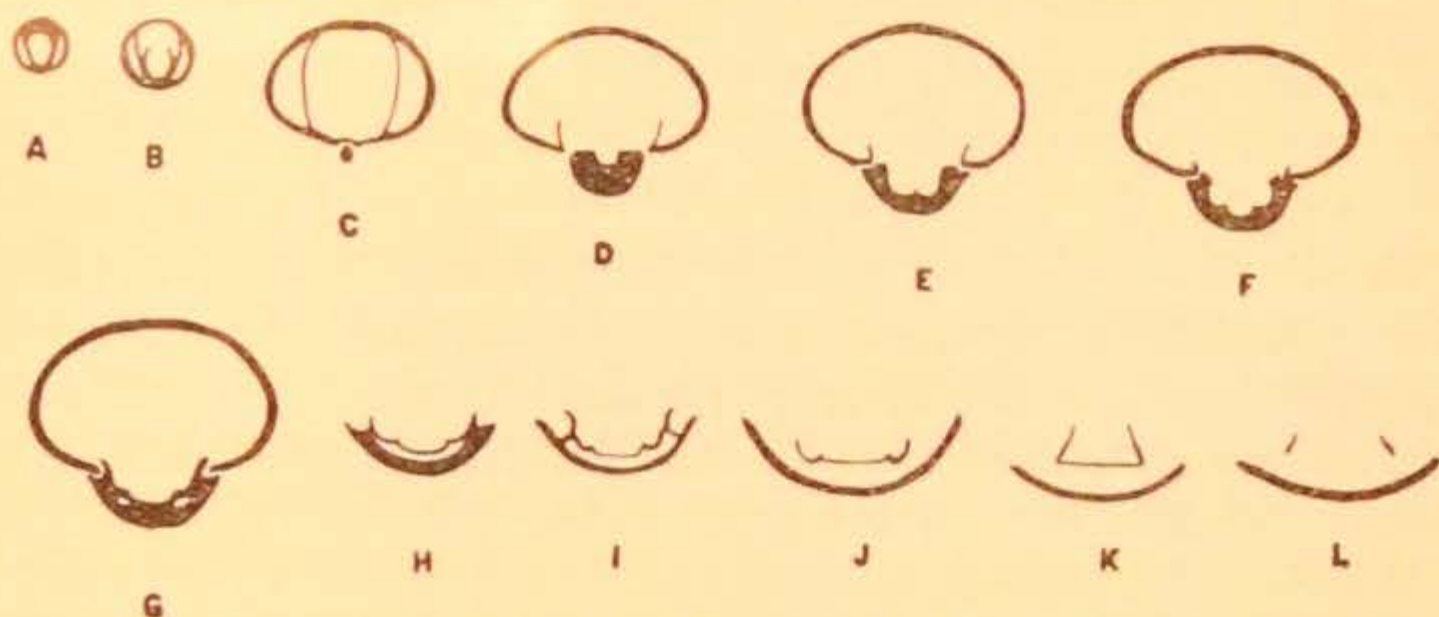


Fig. 12. A series of 12 cross-sections (x 1.5) from the rostral portion of the shell of *Stuartella devoniana* showing the pseudo-syrinx and dental lamellae of the pedicle valve and the socket plates, hinge plate and crura of the brachial valve.

inner surface of the deltidial plates and fused laterally with the dental lamellae. The latter are nearly vertical and extend forward with moderate divergence about one-seventh the length of the valve.

Brachial valve nearly as convex as the pedicle with the greatest depth anterior to the midlength. The surface, from beak to front along the median line, is gently convex in the umbonal region, flattened along the central portion, then abruptly curved at the anterior margin where it meets that of the opposite valve in a broad angle. Transversely, the median portion of the valve is flattened or very gently rounded with the surface arching abruptly to the lateral and postero-lateral margins. Fold absent. Internally, the socket plates are heavy. The hinge plate is comparatively broad, its anterior half being free from the floor of the valve. Surface of both valves marked by occasional strong concentric growth wrinkles.

Remarks:—Externally, this species can be distinguished from *Stuartella vera* of the overlying Hackberry beds by its more robust form, more gibbous valves and by the larger and more prominent umbō. Internally, the hinge plate of *S. devoniana* is much flatter than that of the Hackberry form.

Occurrence:—Confined to the Camarophoria zonule at the top of the Mason City substage of the Shellrock in the vicinity of Nora

Springs, Iowa. It is a rather uncommon form. A form possibly belonging to this species occurs as casts in the Ulsterensis zonule of the Rock Grove substage. One of these casts is figured for comparison.

Types:—Holotype No. 1181, paratypes No. 533, 1180, 1439, 2150 C.H.B.

*Stuartella vera* n. sp.

Plate IV, figs. 10-12

Description:—Shell of medium size, subovate in outline, longer than wide with the greatest width slightly anterior to the midlength, anterior margin rather sharply rounded. Dimensions of the holotype: length of pedicle valve 30. mm.; length of brachial valve 27.8 mm.; width 22.7 mm.; thickness 17.3 mm.

Pedicle valve strongly convex with the greatest depth near the midlength. Surface curving strongly and uniformly from the beak to the anterior margin, sharply rounded transversely along the midline from which the surface arches sharply to the lateral and postero-lateral margins. Sinus absent. Beak comparatively large, rather acute, strongly incurved, marked apically by a small oval foramen which is directed posteriorly at an angle of about forty-

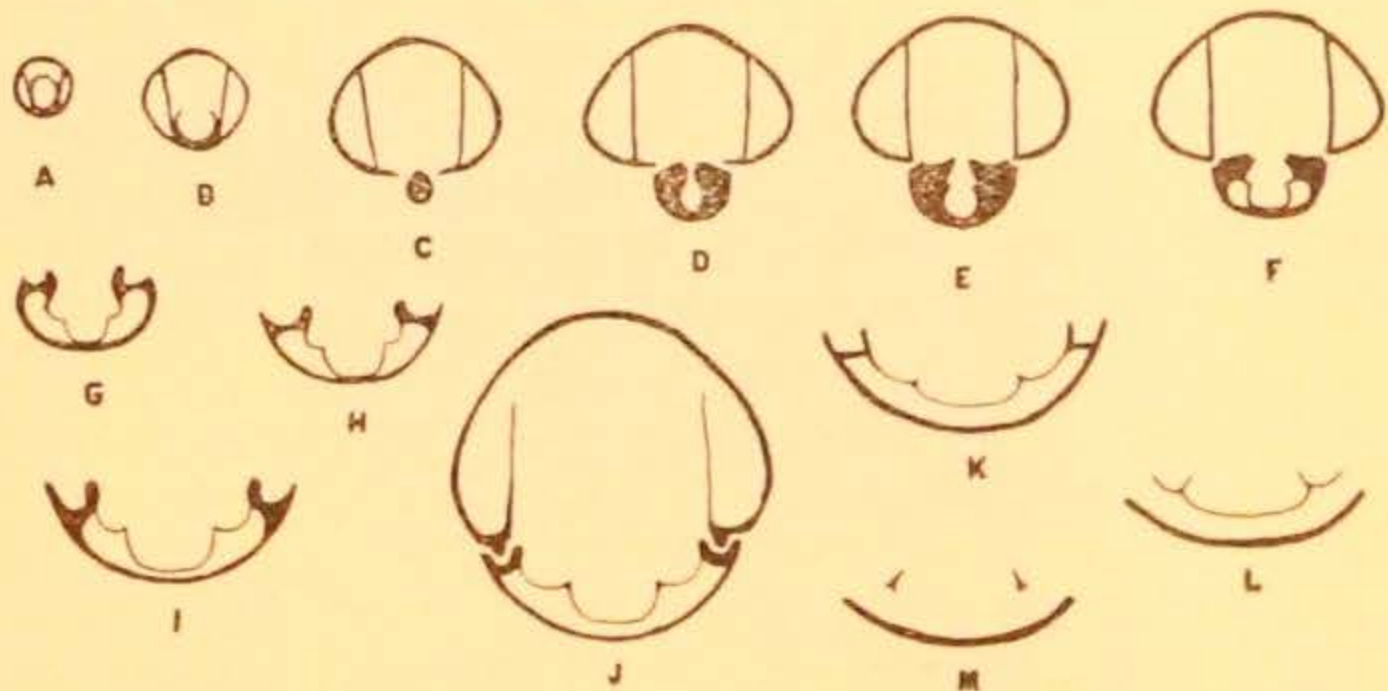


Fig. 13. A series of 13 cross-sections (x 2) from the rostral portion of the shell of *Stuartella vera* showing the dental lamellae and pseudo-syrinx of the pedicle valve and the crura, socket plates and hinge plate of the brachial valve.

five degrees to the plane of the valve. Internally, the dental lamellae are nearly vertical, moderately divergent and extend forward about one-fifth the length of the valve. The pseudo-syrinx is short.

Brachial valve slightly less convex than the pedicle with the greatest depth slightly posterior to the midlength. Surface arching

strongly and uniformly from beak to front, gently rounded transversely along the midline from which the surface arches gently to the lateral margins and somewhat more sharply to the posterolateral margins. Fold absent. Internally, the socket plates are prominent. The deeply concave hinge plate is divided laterally into three well marked divisions by the crural geniculations. Surface of both valves marked by numerous fine concentric growth lines.

Remarks:—Externally this species can be distinguished from its associate *Cranaena rockwellensis* by its more robust form and comparatively smaller beak and foramen. Internally, the two forms may be readily separated by the character of the hinge plate.

Occurrence:—Confined to a bed of shaly limestone some eight feet thick, in the central portion of the Owen substage of the Hackberry. For this bed the term *Stuartella zonule* is here proposed. It is known only in the vicinity of Rockwell, Iowa.

Types:—Holotype No. 4290, paratypes No. 4370, 4511 C.H.B.

Genus—**DIELASMELLA**—Weller

Description:—Shell terebratuliform, compressed. Pedicle valve with well developed dental lamellae of moderate length. Brachial valve without median septum or true hinge plate. The socket plates well developed, retreating from the lateral margins of the valve anteriorly and becoming differentiated into two portions; a basal portion which joins the inner surface of the valve and is directed obliquely inward; and a distal portion which is abruptly bent in a subgeniculate angle so as to be directed obliquely outward. The portion included in the angular bend of the two plates is produced anteriorly into the bases of the crura, and just before the crura become free a narrow transverse band joins their bases. The characters of the brachidium not completely determined, but it is clearly of the sort *Dielasma*-like type. Shell structure finely punctate. Weller-1914.

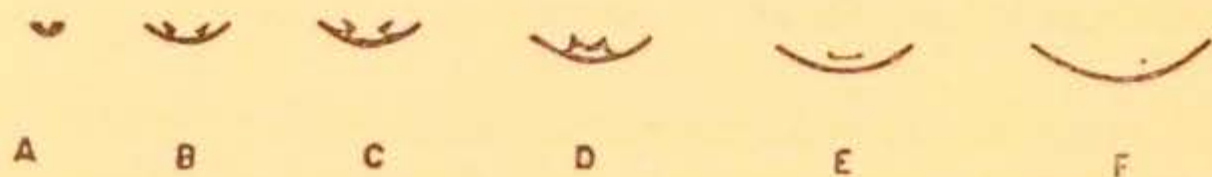


Fig. 14. A series of 6 cross-sections (x 2.5) from the rostral portion of the brachial valve of *Dielasmella compressa* showing the development of the crura from the inner walls of the socket plates, and the narrow band joining the bases of the crura just before, and at the point where they become free. Weller-1914.

Remarks:—This genus, originally founded by Weller on two species of terebratulids from the Mississippian, has not been reported before in the Devonian. Internally, *D. praecursor*, described below, closely resembles the genotype *D. compressa* Weller in all essential respects. Because of abundant material the internal structure could be quite fully determined. In the pedicle valve there is a short, free, well developed pseudo-syrinx. The brachidium is a short recurved loop very similar to that of *Cranaena*, the crural apophyses being considerably anterior to the point where the crura become free.

*Dielasmella praecursor* n. sp.

Plate IV, figs. 13-20

Description:—Shell small, subovate to subrhombic in outline, longer than wide with the greatest width near the midlength. Dimensions of the holotype: length of pedicle valve 16.2 mm.; length of brachial valve 14.6 mm.; width 11.4 mm.; thickness 6.5 mm.

Pedicle valve moderately convex with the greatest depth near the midlength. Surface arching gently and uniformly from the beak to the anterior margin, flattened or very gently rounded transversely along the midline from which the surface slopes gently to the lateral margins and arches strongly to the postero-lateral margins, specimens with a sinus frequently have the surface of the

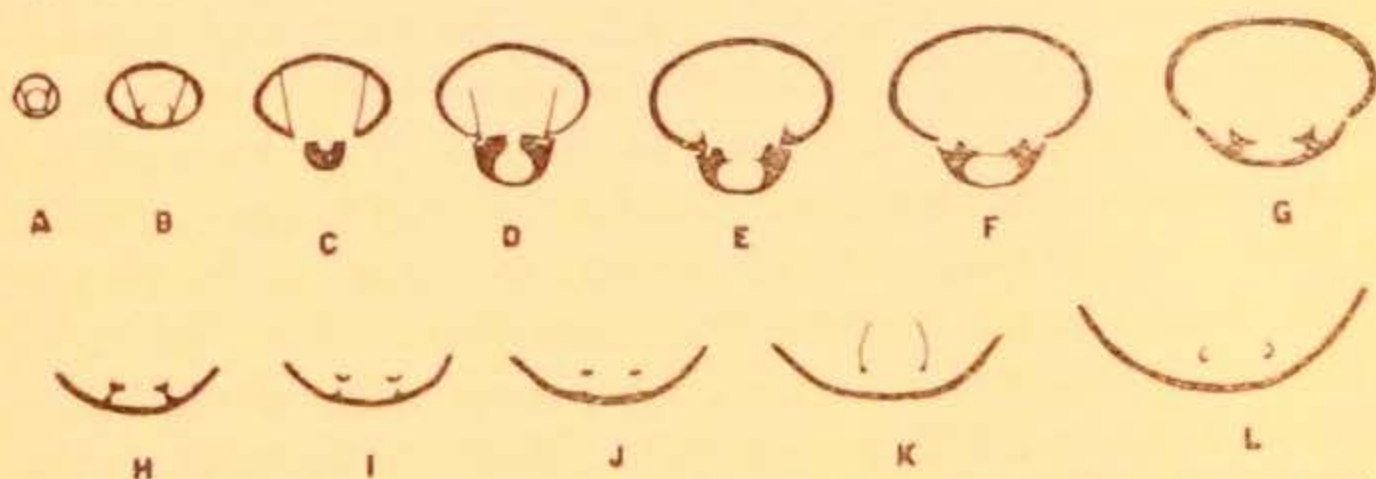


Fig. 15. A series of 12 cross-sections (x 2) from the rostral portion of the shell of *Dielasmella praecursor* showing the pseudo-syrinx and dental lamellae of the pedicle valve and the socket plates, transverse band and crura of the brachial valve.

valve flat or gently concave across the midlength. Sinus commonly absent but when present shown as a flattened or depressed area near the midlength becoming deeper anteriorly where it is produced into a subquadrate lingual extension the length of which may be as much as five millimeters, in some cases the margins of

the sinus nearly at right angles to the surface of the sinus. Beak prominent, very gently incurved, marked apically by a comparatively large oval foramen which is directed almost at right angles to the plane of the valve. Delthyrium triangular, slightly wider than high, almost totally covered by the deltidial plates which form a false cardinal area that is inclined posteriorly at an angle of about thirty degrees to the plane of the valve. Internally, the pseudo-syrinx is short and free. The moderately divergent dental lamellae extend forward less than one-sixth the length of the valve.

Braehial valve nearly as deep as the pedicle with the greatest depth in the umbonal region. The surface from beak to front nearly flat except in the umbonal region where it is very gently convex, strongly rounded transversely along the midline from which the surface slopes sharply to the lateral and postero-lateral margins. Fold, when present, marked as a rounded elevation on the anterior portion of the valve. In some cases its margins are sharply defined. Internally, the prominent socket plates extend anteriorly nearly one-fifth the length of the valve with but little divergence. The transverse band joins them at a point well posterior to the point of separation of the crura. Surface of both valves marked by fine concentric wrinkles of growth.

Remarks:—The internal characters of this shell at once distinguish it from any other terebratulid yet known from the Iowa Devonian. Although associated with *Cranaena navicella*, which somewhat resembles it externally, *D. praecursor* can be distinguished by the very slightly divergent socket plates which plainly show through the shell when moistened.

Occurrence:—Known only in the central and upper portions of the Cerro Gordo substage of the Hackberry. It is most common in the Nortonechinus and Devonocidaris zonules.

Types:—Holotype No. 3171, paratypes No. 3131, 3169, 3172 and 4415 C.H.B. No. 6-899, 6-909 S. U. I.

Department of Geology, February, 1929  
State University of Iowa.



PLATES

PLATE I

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PLATE I

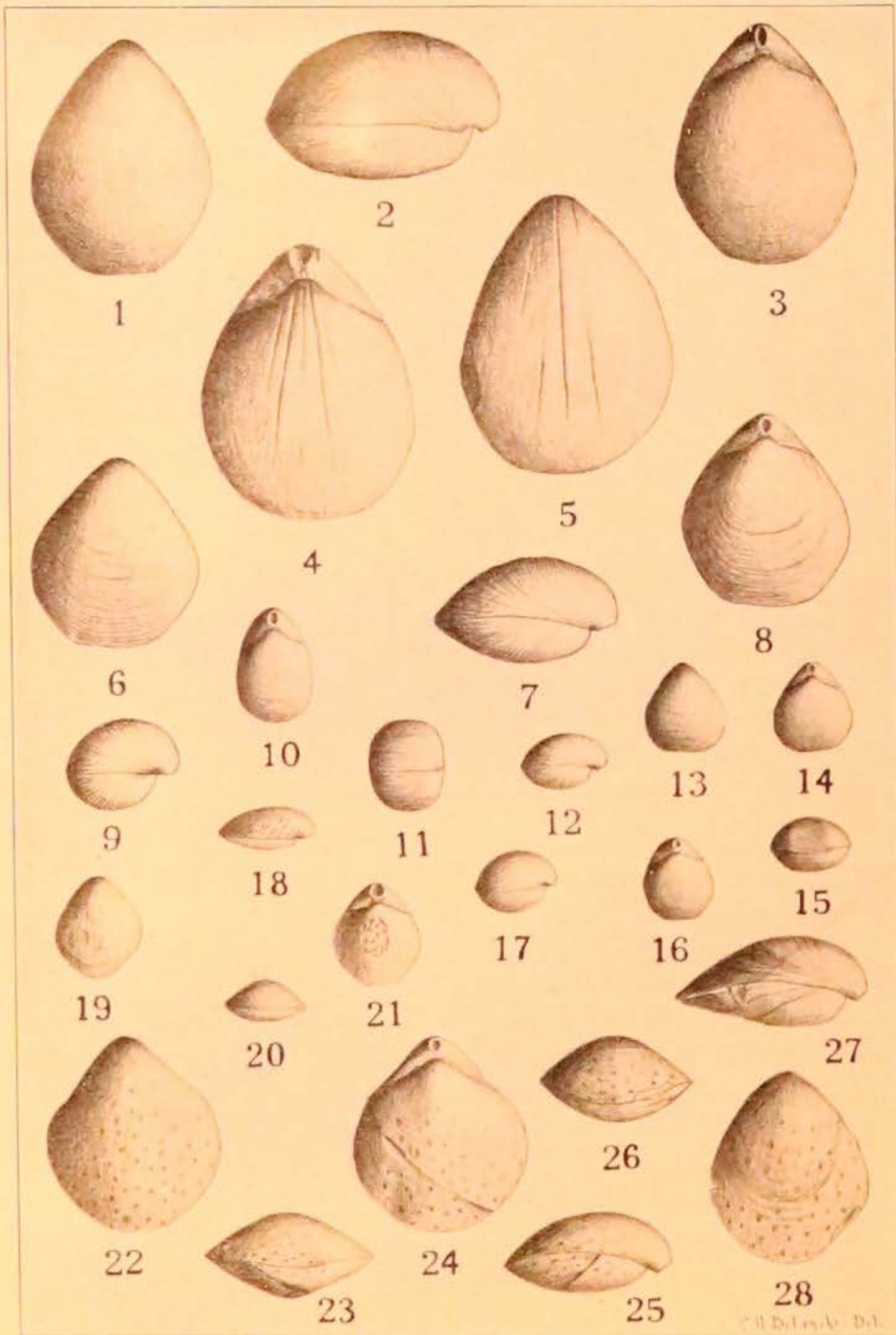


PLATE II

FIGURES

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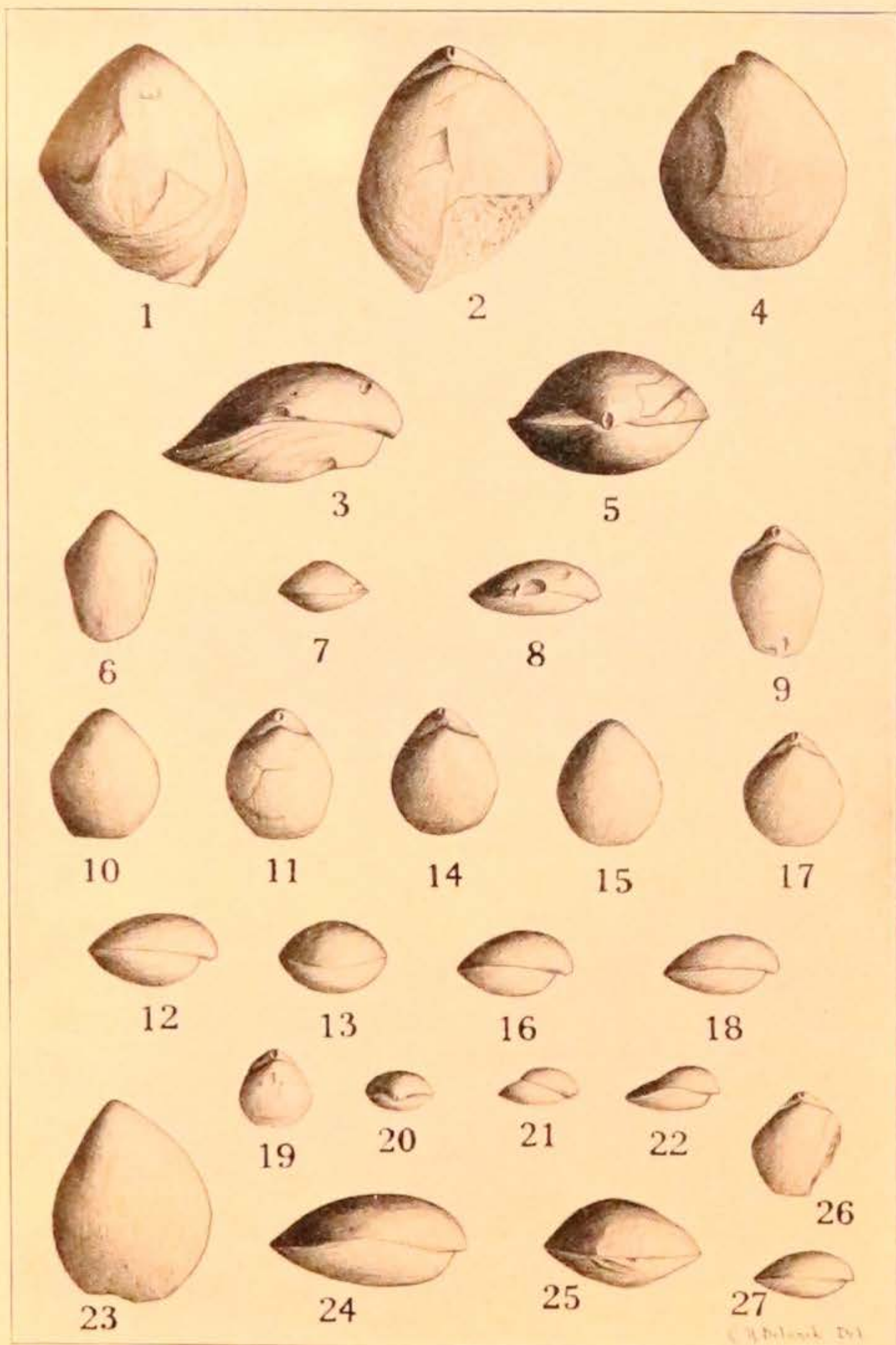


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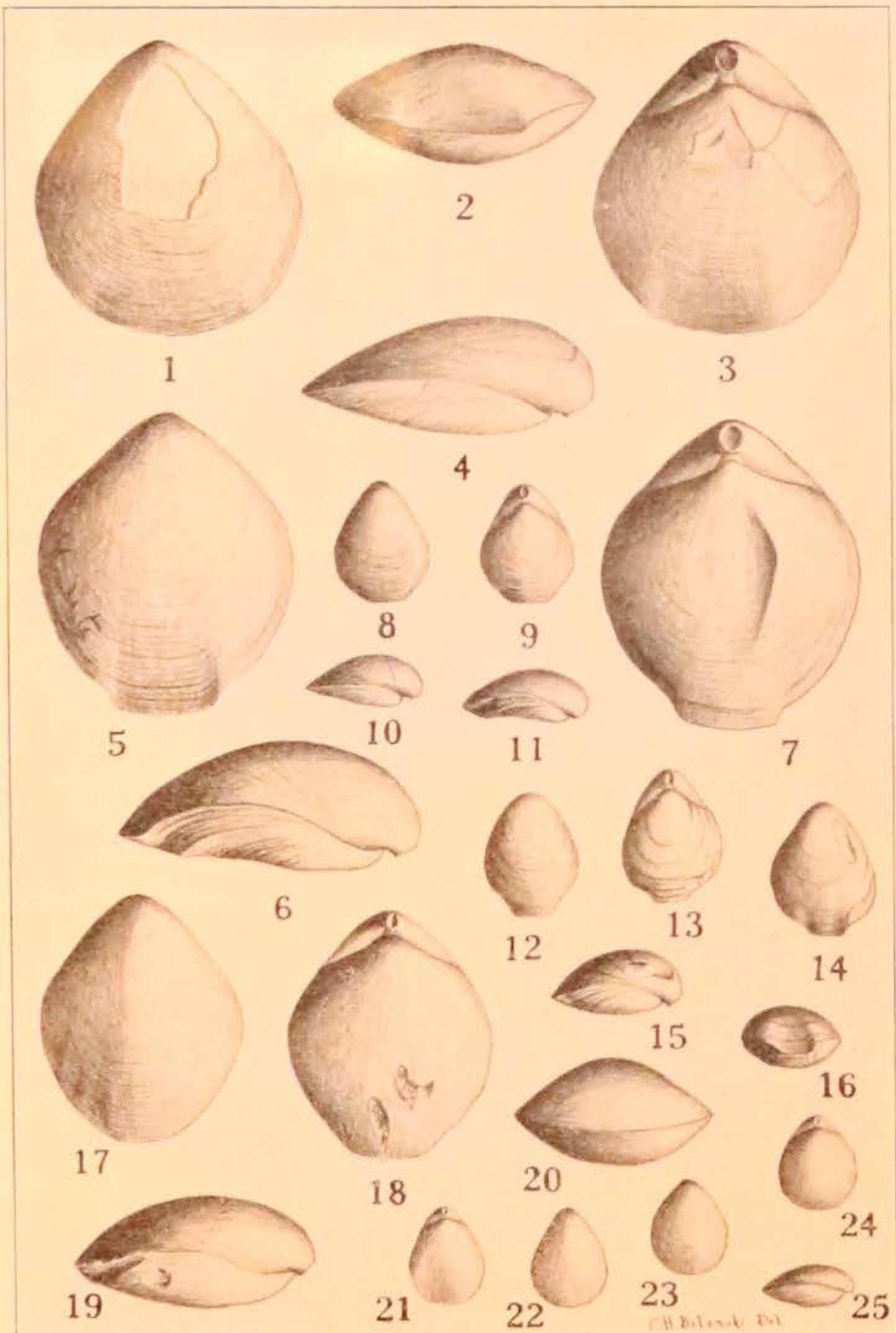
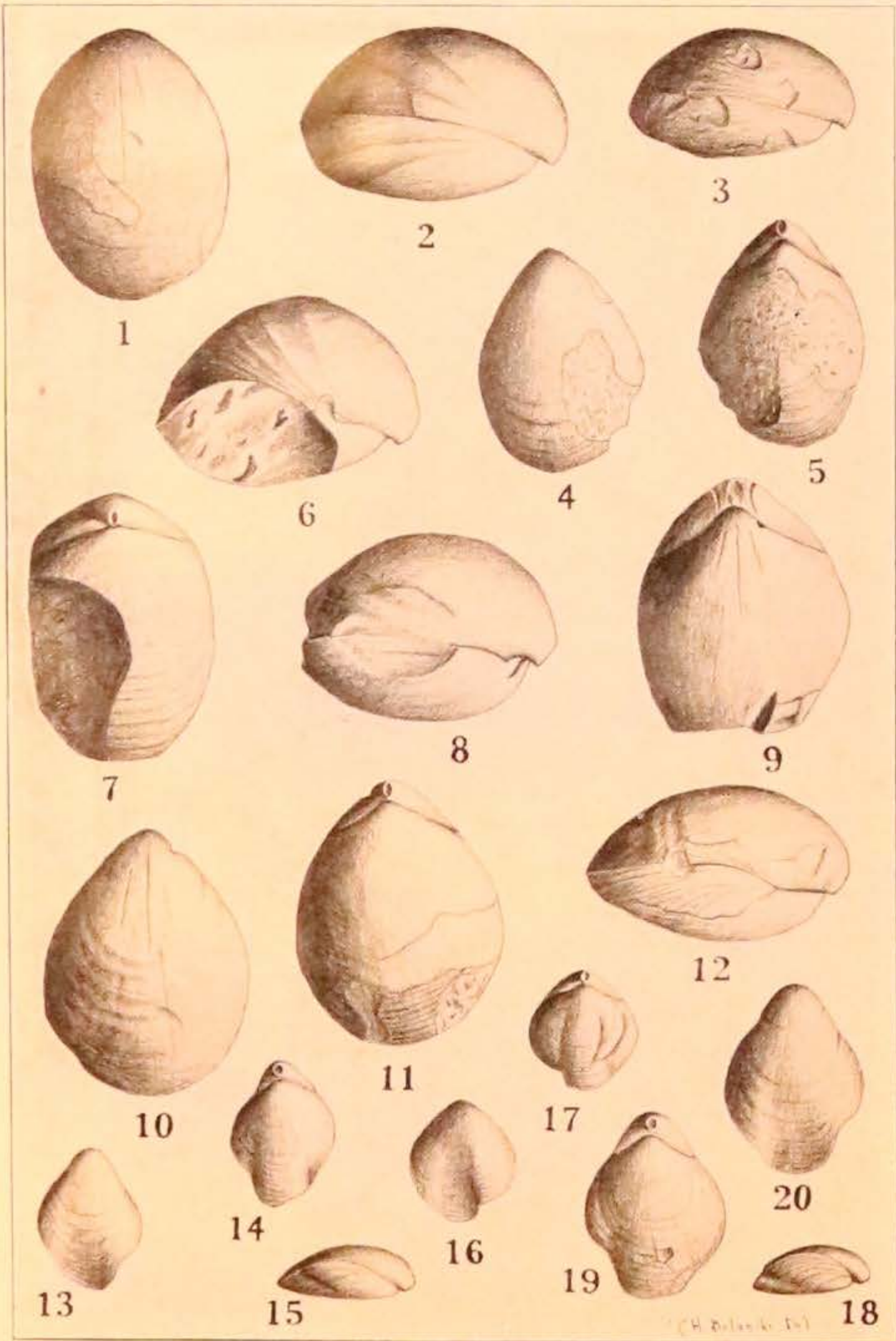


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