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# The Fuana of the State Quarry Beds

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# THE FAUNA OF THE STATE QUARRY BEDS

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The State Quarry beds of Johnson county, Iowa, comprise a very local but decidedly interesting limestone formation of Upper Devonian age. In spite of its restricted distribution the formation has been the subject of some investigation, first because of the abundant fish remains found in certain beds, and secondly because other horizons furnished large blocks suitable for building purposes.

The first published account of the rocks of this formation appeared in White's GEOLOGICAL SURVEY OF THE STATE OF IOWA,[1] in which work he gave the location of the State Quarries and a short description of the rocks outcropping there but did not recognize them as a distinct formation. In one of the early reports of the Iowa Geological Survey Samuel Calvin wrote a rather complete description of the formation as a part of his report on the geology of Johnson county[2] and in the same year he published a somewhat similar description in the *Proceedings* of the Iowa Academy of Science.[3] Calvin had previously published a list of the fossils of Johnson county which included some of those of the State Quarry formation.[4] In the survey volume which contains the Johnson county report appears a short article by Charles R. Eastman[5] dealing with the Devonian fishes of Iowa, in which specimens from the State Quarry beds are figured and discussed. In a later work, an admirable monograph on the same subject,[6] Eastman carefully described and figured twelve species of fishes found in this formation. In 1917, Eastman, in a paper on some fishes in the United States National Museum, described and illustrated a part of the armor plate of a *Dinichthys* found by Thomas in the old State Quarries.[7] Savage, in an unpublished

1 White, Charles A., Report on the Geol. Surv. of the State of Iowa, vol. II, pp. 308-309. 1870.

2 Calvin, Samuel, Geol. of Johnson County, Iowa, Ia. Geol. Surv. vol. VII, 1897.

3 Calvin, Samuel, The State Quarry Limestone, Proc. Ia. Acad. Sci. vol. IV, p. 16-21 1897.

4 Calvin, Samuel, History of Johnson County, Iowa, p. 557-560. 1883.

5 Eastman, Charles R., On the Occurrence of Fossil Fishes in The Devonian of Iowa Ia. Geol. Surv, vol. VII. 1897.

6 Eastman, Charles R. Devonian Fishes of Iowa Ia. Geol. Surv. vol. XVIII. 1908.

7 Eastman, Charles R. Fossil Fishes in the Coll. of the U. S. Nat. Mus., Proc. U.S.N.M. vol. 52, No. 2177, p. 248. 1917.

manuscript on the Devonian formations of Johnson county, Iowa,[8] discussed the State Quarry beds and their fauna at some length. In the same year Thompson prepared a similar paper on the geology and paleontology of Johnson county[9] in which he briefly describes the outcrops and the commoner fossils of the State Quarry beds. Recently a short paper has appeared in which one of the State Quarry brachiopods is described[10] and Thomas, in his Echinoderms of the Iowa Devonian,[11] has quoted Wachsmuth and Springer[12] on a crinoid found in the State Quarry beds.

In addition to the above, mention should be made of McGee's description of the "Old State House" dolomite as he called the State Quarry beds.[12a]

It is, therefore, not the aim of the present paper to discuss in any detail the general relations of the formation nor to attempt to add anything to what is already known of its vertebrate fauna. Since the fish remains are so unusual it was only natural that they claimed the attention of early workers, and as a result the invertebrate fauna has been somewhat neglected. Invertebrate remains are extremely abundant but good specimens of any sort are exceedingly rare. Calvin noted seven forms, five of which are brachiopods. The Savage and Thompson lists are considerably longer and more nearly approach the collections made by the presen writers.

*Distribution.*

As far as is known the State Quarry beds are limited to Johnson county, Iowa, where they outcrop in a few localities in the northeast quarter of the county. The main outcrop, whose exact distribution has been described by Calvin,[13] occurs in sections 5 and 8 of Penn township, less than two miles northeast of the town of North Liberty. This is the area in which the old State quarries were operated and from which Eastman obtained his fish remains. This locality also yielded practically all of the fossils

8 Savage, T. E. Unpub. thesis, Geol. Lib., S.U.I. 1898.

9 Thompson, G. F. Unpub. thesis, Geol. Lib., S.U.I. 1898.

10 Thomas, A. O. and Stainbrook, M.A., Status of Certain Rhynchonellid Brachiopods from the Devonian of Iowa, Proc. Ia. Acad. Sci. vol. XXIX, p. 92-99. 1922.

11 Thomas, A. O., Echinoderms of the Iowa Devonian. Ia. Geol. Surv. vol. XXIX, p. 438-439. 1919.

12 Wachsmuth and Springer. Crin. Cam. No. Amer. vol. I. p. 300. 1897.

12a McGee, W. J., Tenth Census U. S., vol. 10, pp. 261-262, 1883.

13 Calvin, Samuel, Geol. of Johnson County, Iowa. Ia. Geol. Surv. vol. VII, p. 76. 1897.

described in the present paper. Other outcrops are found immediately south and west of the town of Solon, about four miles northeast of the State Quarries. Additional localities reported by Calvin,[14] Savage,[15] and Thompson,[16] are, with one possible exception, not referable to the State Quarry formation. The exception referred to lies near the southwest corner of section 20 of Graham township. Here slabs resembling the upper phase of the State Quarry formation are found in some abundance in a shallow side gully on the left bank of Rapid creek on the farm of Mr. Dingleberry. The beds here are darker in color and somewhat harder than typical State Quarry stone and contain an unusual amount of crinoidal material. It is entirely possible that they are part of a similar zone in the Cedar Valley limestone which underlies the *Acervularia davidsoni* coral reef in many places.

*Sections and Stratigraphic Relations.*

A careful survey of the area surrounding the old State Quarries and the outcrops near Solon leads to the conclusion that the State Quarry formation consists of two rather distinct phases, a thinly bedded, comparatively fine-grained, basal member; and an upper member which is composed chiefly of massive shelly beds. These two members are strikingly different. Previously only the beds herein called the upper phase have been referred to the State Quarry formation, the age of the basal member having been doubtful and so tentatively referred by field class instructors to the Pennsylvanian, of which there is a small outlier nearby. However, undoubted Devonian fossils were found in these basal beds and in several places their stratigraphic relations to the upper phase are easily made out, as the following sections show.

(1). Section ¼ mile south of the State Quarries, bed of a small tributary to Iowa river.

| | Feet | Inches |
|---|---|---|
| 6 Shelly State Quarry beds, weathering into thin layers one to four in. in thickness. Highly fossiliferous..... | 5 | |
| 5 Hard granular fossiliferous gray to yellow limestone.. | 2 | 6 |
| 4 Covered ..... | 5 | 8 |
| 3 Hard blue limestone, few fossils..... | 2 | 6 |
| 2 Yellow sub-dolomitic thinly bedded layers of basal State Quarry member..... | 2 | |
| 1 Yellow Cedar Valley beds containing characteristic fossils ..... | 1 | |
| Total..... | 18 | 8 |

14 Calvin, Samuel, loc. cit. pp. 76-77.
15 Savage, T. E. loc. cit.
16 Thompson, G. F. loc. cit.

(2). Section in small south-north gully immediately south of State Quarries. Cedar Valley limestone exposed at elevation of mouth of gully three rods to the east.

| | Feet | Inches |
|---|---|---|
| 7 Typical massive shelly limestone, partially covered..... | 6 | |
| 6 Covered. Many blocks of shelly limestone, some of which may be in place..... | 5 | |
| 5 Typical shelly beds, weathered into thin layers near the top ..... | 6 | |
| 4 Partially covered but containing at the bottom a foot or more of rock similar to number 1. Gray, earthy, few fossils ..... | 5 | |
| 3 Typical shelly limestone in layers 3 to 4 in. in thickness. | 2 | 6 |
| 2 Covered ..... | 3 | |
| 1 Hard sub-dolomitic beds, gray to blue in color, weathering to yellow. Few fossils..... | | 4 |
| Total..... | 27 | 10 |

In the above section it should be noted that the upper and lower members *seem* to be interbedded.

In the bed of a small east-flowing creek in the northwest ¼ of Sec. 8, T. 80N, R.6W typical basal beds carrying a number of Devonian brachiopods are exposed. Directly across the creek the lithographic horizon of the Cedar Valley limestone outcrops at a higher elevation. The erosional unconformity between the two formations is clearly shown. The shelly beds have all been removed by erosion at this locality.

A small quarry lying one quarter of a mile southwest of Solon shows the upper phase of the State Quarry abutting against the *Megistocrinus* beds of the Cedar Valley limestone. The basal phase does not appear at this place but it does outcrop in a nearby quarry where it underlies typical shelly beds containing abundant specimens of *Pugnoides solon.*

The above facts are probably to be explained by the unconformable relations existing between the Cedar Valley and the State Quarry formations and may be interpreted as follows. The sea which deposited the State Quarry limestone advanced over the deeply eroded surface of the Cedar Valley, occupying the low places first and depositing there the basal layers. Eventually such places were filled and as the sea continued to advance it covered even the higher areas and laid down the massive shelly beds everywhere. Evidently there was relatively little residual material on the old Cedar Valley surface because the basal beds are never conglomeratic but are remarkably uniform in texture. Where the shelly beds overlie the Cedar Valley directly, included

fragments of *Acervularia davidsoni* and other typical Cedar Valley fossils are sometimes encountered.

## *FAUNAL LIST AND DESCRIPTIONS OF NEW FOSSILS*

### *CORALS AND THEIR NEAR RELATIVES*

*Alveolites* sp.?

A number of coral fragments were collected all of which were poorly preserved. One specimen is probably to be referred to this genus.

*Stromatoporoid*

A species probably referable to this genus occurs in the outcrop near Solon, as mentioned by Calvin,[17] but no specimens good enough for specific description were collected.

### *CRINOIDS*

*Melocrinus calvini* Wachmuth and Springer

1883 *Melocrinus solonensis* Calvin. History of Johnson County, Iowa, Notes on the Fossils p. 559 (no description).
1897 *Melocrinus calvini* W. and Sp. Crin. Cam. N. Amer. vol. I., p. 300, pl. 22, fig. 6.
1919 *Melocrinus calvini* Thomas. Echin. Ia. Dev., Ia. Geol. Surv. vol. XXIX., p. 438-439, plate XXXVII, figs. 6-8.

This species is also mentioned as occurring near Solon.[17] In the uppermost beds exposed in the State Quarries crinoid stem segments are abundant, some of which are doubtless of this species.

### *BRYOZOANS*

At least one bryozoan species occurs in the State Quarry outcrops. This form is especially abundant north of the main quarries.

### *BRACHIOPODS*

*Schizophoria striatula* (Schloth.) var.

Plate I, Fig. 1.

Specimens of this form, while not rare, are always of dissociated and broken valves which are so poorly preserved as to render more than mere reference to the species impossible. Apparently the complete shell was of medium size with a sinus but little developed. The costae are notably fine and numerous, yet distinct. The characters that can be made out are not sufficient to delimit this form from the others of the Iowa Devonian.

*Horizon*: State Quarry limestone, upper phase.

*Localities*: Not uncommon at the Solon exposure, rarer at the State Quarries near North Liberty, Iowa.

*Strophеodonta* sp.

Poorly preserved as an impression of the exterior of the pedicle valve. This measures 1.6 inches in length and 1 inch in width, being strongly convex. The costae are numerous, rather angular, and divide several times.

*Horizon*: State Quarry limestone, basal member.

*Locality*: Near State Quarries, North Liberty, Iowa.

*Schuchertella altirostris* sp. nov.

Plate I, Figs. 2-4.

Known only from disarticulated valves. Pedicle valve subpyramidal, suboval in outline, about as wide as long; hingeline less than greatest width, highest at the umbo, the surface sloping rapidly and uniformly to the anterior and lateral margins; beak always broken, due, perhaps, to attachment; area very high and narrow, delthyrium covered completely by a convex deltidium. The surface marked by numerous small costae radiating from the beak. Heavy growth indentations at wide intervals. Dimensions of one of the cotypes: length 0.7 in., width 0.7 in., thickness 0.35 in. Interior unknown.

Brachial valve transversely ovate, moderately convex, highest at the umbo, thence the surface curving strongly to the margins but more strongly to the hinge line. Anterior median portion slightly depressed. Surface marked by small radiating costae.

17 Calvin, Samuel. loc. cit. p. 78.

Internally the cardinal process is short, stout, only slightly projecting, gently curved, and with a small triangular dental depression on either side. Measurements of one of the cotypes: length 0.85 in., width 0.95 in., thickness 0.3 in.

This species is quite unlike any other *Schuchertella* in the Iowa Devonian and may prove to be a new genus. The narrowness and the height of the area are characteristic. In this respect it is similar to *S. coloradensis* Kindle of the Ouray limestone. In that species, however, the area is much higher and the shape is slightly different. Previous workers on the State Quarry limestone referred the species here described to the genus *Orthotetes* recognizing it as an undescribed form.

*Horizon*: Abundant in the upper phase of the State Quarry limestone.
*Locality*: State Quarries near North Liberty, Iowa.
*Cotypes*: No. 6-600 U.I.C.

*Schuchertella* sp.

A small sub-rectangular form belonging to this genus occurs in the basal member of the formation. The poorly preserved molds are marked by numerous small costae. Apparently quite similar to an undescribed Cedar Valley form.

*Pugnoides solon* Thomas and Stainbrook

Plate I, Figs. 5-6

1921 *Pugnoides solon* Thomas and Stainbrook, Science, New Series, vol. LIV., p. 308.
1922 *Pugnoides solon* Thomas and Stainbrook, Proc. Ia. Acad. Sci. vol. XXIX, p.. 93-98, pl. 1, figs. 17-32.

This species which is unusually abundant in the Solon outcrops has been described and fully illustrated in the papers referred to immediately above.

*Cranaena depressa* sp. nov.

Plate I, Fig. 7.

Known only from dissociated valves. Medium in size, sub-elliptical in outline. Pedicle valve convex, strongly curved transversely and longitudinally, highest a little posterior to the midpoint, slightly depressed anteriorly, umbo rather gibbous, beak large, foramen subterminal. Lines of growth and punctae numerous. Measurements of one of the cotypes: length 0.9 in., width 0.9 in., thickness 0.25 in. Two short dental lamellae appear in one specimen.

Brachial valve oval, gently convex, highest in the umbonal region where the surface slopes gently to the lateral and anterior margins and more strongly to the anterolateral margins; beak small. Markings similar to those of pedicle valve. Interior unknown. Measurements of one of the cotypes: length 0.6 in., width 0.6 in., thickness 0.15 in.

As with most of the brachiopods of this formation the valves are separated and broken in most cases. The condition of the material is such that specific determination is difficult. However, the State Quarry form differs from the common Cedar Valley species in that its pedicle valve is gently depressed anteriorly and the brachial is more acute posteriorly.

*Horizon*: State Quarry limestone, upper phase.
*Locality*: State Quarries near North Liberty, Iowa.
*Cotypes*: No. 6-601 U.I.C.

*Atrypa reticularis* var. *rugatula* var. nov.

Plate I, Figs. 8-9.

The *Atrypa* found in these beds is of medium size or below, biconvex, the brachial valve being a little more convex than the pedicle, suborbicular in outline, front margin gently sinuous due to the slight depression in the anterior median portion of the pedicle valve and to the suggestion of a broad low fold in the brachial valve. The pedicle valve is strongly convex in the umbonal region, with the beak acute and the foramen subterminal.

Brachial valve highest at the midpoint whence the surface curves with nearly equal rapidity to the margins. Costae small, numerous, close-set, bifurcating once or twice. A characteristic feature of this variety is the development of numerous crowded growth laminae which are especially noticeable in young specimens.

Measurements of the holotype: length 0.85 in., width 0.85 in., thickness 0.55 in.
*Horizon*: State Quarry limestone, upper phase.
*Localities*: Common in the outcrops at the State Quarries near North Liberty and also found near Solon, Iowa.
*Holotype*: No. 6-602 U.I.C.

*Spirifer* sp.

A small poorly preserved species of *Spirifer* occurs in the basal phase of the formation near the State Quarries. The specimens average less than an inch in width and are a little more than half as long. The plications are large and rounded, numbering about eight on either side of the fold. The latter is broad and depressed anteriorly by a short median sinus.

*Cyrtina* sp.

Plate I, Fig. 10.

In the collection at hand is a single incomplete pedicle valve of which enough is present for generic determination. The valve is strongly convex both transversely and longitudinally. The sinus is deep, broad, rather angular at the bottom, sharply defined at the sides. The beak is small, acute and turned to the right. The area is high and rather narrow. Lateral slopes each marked by four or five strong simple angular costae.

*Horizon*: State Quarry limestone, upper phase.
*Locality*: State Quarries near North Liberty, Iowa.

*Eumetria ? subtrigonalis* sp. nov.

Plate I, Fig. 11.

Pedicle valve small, subtriangular in outline, gently convex, highest at the midpoint, the surface sloping gently thence to the anterior and lateral margins, gently to the beak, but strongly from the umbonal region to the postero-lateral margins. Beak small, pointed, opening subterminal. Surface marked by fairly strong rounded plications which bifurcate once or twice in extending from the beak to the margin. Growth lines numerous, crowded near the margin, occasionally laminated.

There are at hand five valves, only one of which is complete. This specimen measures: length 0.5 in., width 0.45 in., thickness 0.1 inches.

The genus can only be surmised from the exterior of the pedicle valve. It seems very similar to an *Eumetria*.

*Horizon*: State Quarry limestone, upper phase.
*Localities*: In the State Quarries near North Liberty and also near Solon, Iowa.
*Holotype*: No. 6-603 U.I.C.

*Athyris simplex* sp. nov.

Plate 1, Figs. 12-14.

Shell small, subtriangular in outline, biconvex, a little wider than long, front margin sinuous. Pedicle valve moderately convex, highest in the umbonal region, strongly arched from beak to front, the curvature being greater posteriorly, anterior median portion depressed by a shallow sinus with a concave bottom which originates at the midpart and expands rapidly toward the front; lateral slopes rounded; umbo gibbous; beak strong, projecting beyond and curving over that of the opposite valve; foramen concealed.

Brachial valve not so convex as the pedicle but more strongly curved transversely, deepest at the midpoint, the surface sloping with moderate rapidity to the posterior and lateral margins; anterior median portion gently elevated into a broad low fold which originates in front of the midpoint; beak small, incurving beneath that of the opposite valve.

Surface of both valves marked by one or two coarse lines of growth and numerous fine ones. Measurements of the holotype are: length 0.45 in., width 0.5 in., thickness 0.35 in.

This species differs from *A. vittata* Hall in averaging a smaller size, in having a less transverse shell, in the lesser prominence and distinctness of the fold and sinus, in the shortness of the fold and sinus, in the lack of distinct growth lamellae, and in the slightly curved hinge line.

*Horizon*: State Quarry limestone, upper phase.
*Localities*: In the State Quarries near North Liberty and also near Solon, Iowa.
*Holotype*: No. 6-604 U.I.C.

*PELECYPODS*

*Conocardium* sp.

A form belonging to this genus occurs in the shelly beds exposed in the State Quarries. It resembles the Cedar Valley form in many respects but may prove to be a new species.

*Paracyclas* cf. *elliptica* Hall

Plate I, Fig. 15.

1885 *Paracylas elliptica* Hall. Pal. N. Y. vol. V, Pt., 1, Lamellibranchiata 2, p. 440, pl. LXXII, Figs. 23-33, pl. XCV, Fig. 18.
(For more complete bibliography see Branson, E. B., Devonian of Missouri, Mo. Bur. Geol. and Mines, vol. XVII, Second Series, p. 115. 1922.)

Only one specimen, an internal mold, has been found which can be referred to this species; and since, due to poor preservation, it fails to show all the necessary characteristics, the identification is doubtful. In general shape and proportions it checks with Hall's description and figures. This species has been reported recently from certain Middle and Upper Devonian horizons in Missouri. The genus is common in all the Devonian horizons of Iowa.

*Horizon*: State Quarry limestone, upper phase.
*Locality*: State Quarries near North Liberty, Iowa.

*GASTROPODS*

*Bellerophon* sp.

At least two species of *Bellerophon* occur in the State Quarry formation but their mode of preservation is such as to render more than generic reference impossible at the present time. Both of the specimens at hand are small and fragmentary but are obviously not of the same species as the general shape and proportions of the specimens are notably different. Both are internal molds.

*Spiroraphe planivolvis* sp. nov.

Plate I, Figs. 18, 19.

Shell turreted, slightly wider than high; volutions four, — perhaps more in complete shell, — flattened above and sharply rounded immediately above suture which is strikingly deep. Whorls semielliptical or subquadrangular in cross-section, enlarging gradually from apex to last whorl whose periphery is proportionally farther from the axis of the shell than the periphery of preceding whorls. Umbilicus present and apparently deep but not broad. Markings of shell unknown since the only specimen found to date is an internal mold. Measurements of the holotype: diameter 2.25 in., height 1.75 in.

This species differs from *S. arata* Hall chiefly in that the spire is higher and the whorls more distinctly flattened above the periphery. In this latter feature it also differs from *Pleurotomaria plena* Hall.

Since no specimens have been found showing the markings of the shell, there may be some question as to the generic reference. It may possibly belong to Perner's genus *Pseudotectus* which contains some species identical with certain Pleurotomarioids save that they show no slit band on the peripheral keel.

*Horizon*: State Quarry limestone, upper phase.
*Locality*: State Quarries near North Liberty, Iowa. Collected by Mr. L. P. Elliott.
*Holotype*: No. 6-605 U.I.C.

*Platyceras* sp.

Plate I, Figs. 20, 21.

Like most of the molluscs found in the formation, this form is very poorly preserved, so poorly in fact that the fragments at hand cannot be confidently referred to any known species, nor are their characteristics such as to warrant the formation of a new species in this very variable genus.

Gastropod — undet.

Plate I, Fig 16.

The most abundant of the molluscs is a low-spired umbilicate gastropod of medium size. It is invariably found as an internal mold, preserving none of the original shell nor markings of any sort. Specimens are frequently flattened and otherwise distorted, but others showing the true outline are sometimes obtained; the one figured is the best of a large collection. This form is very abundant in certain beds in the outcrops near Solon.

*CEPHALOPODS*

Plate I, Fig. 22.

Extremely fragmentary and entirely unsatisfactory cephalopod remains have been found. The one figured is an *Orthoceras*. Other fragments at hand may be referable

to other genera. Of particular interest are some large fragments of an orthoceratite occurring in the quarry one quarter mile southwest of Solon. These specimens measure 2.5 in. in diameter and frequently show crowded septa, as many as 3 or 4 in one quarter of an inch. Rarely do any of these specimens exceed one inch in length.

*FISHES*

The following species of fishes have been identified by Eastman in the State Quarry formation:

*Ptyctodus calceolus* Newb. and W.
*Ptyctodus compressus* Eastman
*Ptyctodus ferox* Eastman
*Dinichthys pustulosus* Eastman
*Dinichthys (?) tuberculatus* Newberry
*Dipterus costatus* Eastman
*Dipterus digitatus* Eastman
*Dipterus mordax* Eastman
*Dipterus pectinatus* Eastman
*Conchodus variabilis* Eastman
*Synthetodus trisulcatus* Eastman
*Synthetodus calvini* Eastman

PALEONTOLOGICAL LATORATORIES,
STATE UNIVERSITY.

## PLATE I.

Fig. 1. *Schizophoria striatula* (Schloth.) var.

Figs. 2-4. *Schuchertella altirostris* Stainbrook and Ladd.
2. Pedicle valve.
3. Side view of pedicle valve showing thickness of shell and height of cardinal area.
4. Cardinal area on end, beak on left broken as is invariably the case due, perhaps, to attachment.

Figs. 5-6. *Pugnoides solon* Thomas and Stainbrook.
5. Pedicle view.
6. Anterior view showing thickness of shell and sinuous front margin.

Fig. 7. *Cranaena depressa* Stainbrook and Ladd. Pedicle view.

Figs. 8-9. *Atrypa reticularis* var. *rugatula* Stainbrook and Ladd.
8. Pedicle view of holotype.
9. Brachial view of young individual.

Fig. 10. *Cyrtina* sp. Incomplete pedicle valve.

Fig. 11. *Eumetria? subtrigonalis* Stainbrook and Ladd. Pedicle view, note triangular outline which gives species its name.

Figs. 12-14. *Athyris simplex* Stainbrook and Ladd.
12. Pedicle view.
13. Brachial view.
14. Anterior view showing depression in pedicle valve.

Fig. 15. *Paracyclas* cf. *elliptica* Hall

Fig. 16. Gastropod — undet. This form is the most abundant of all the molluscs.

Fig. 17. *Bellerophon* sp. A view of the larger of the two forms found.

Figs. 18-19. *Spiroraphe planivolvis* Stainbrook and Ladd.
18. View showing height of the spire, flattened volutions, and outline of aperture.
19. View from above, note slightly ventricose body whorl and deep suture.

Figs. 20-21. *Platyceras* sp. Two views.

Fig. 22. *Orthoceras* sp. A fragment to record their occurrence.

(All figures natural size)

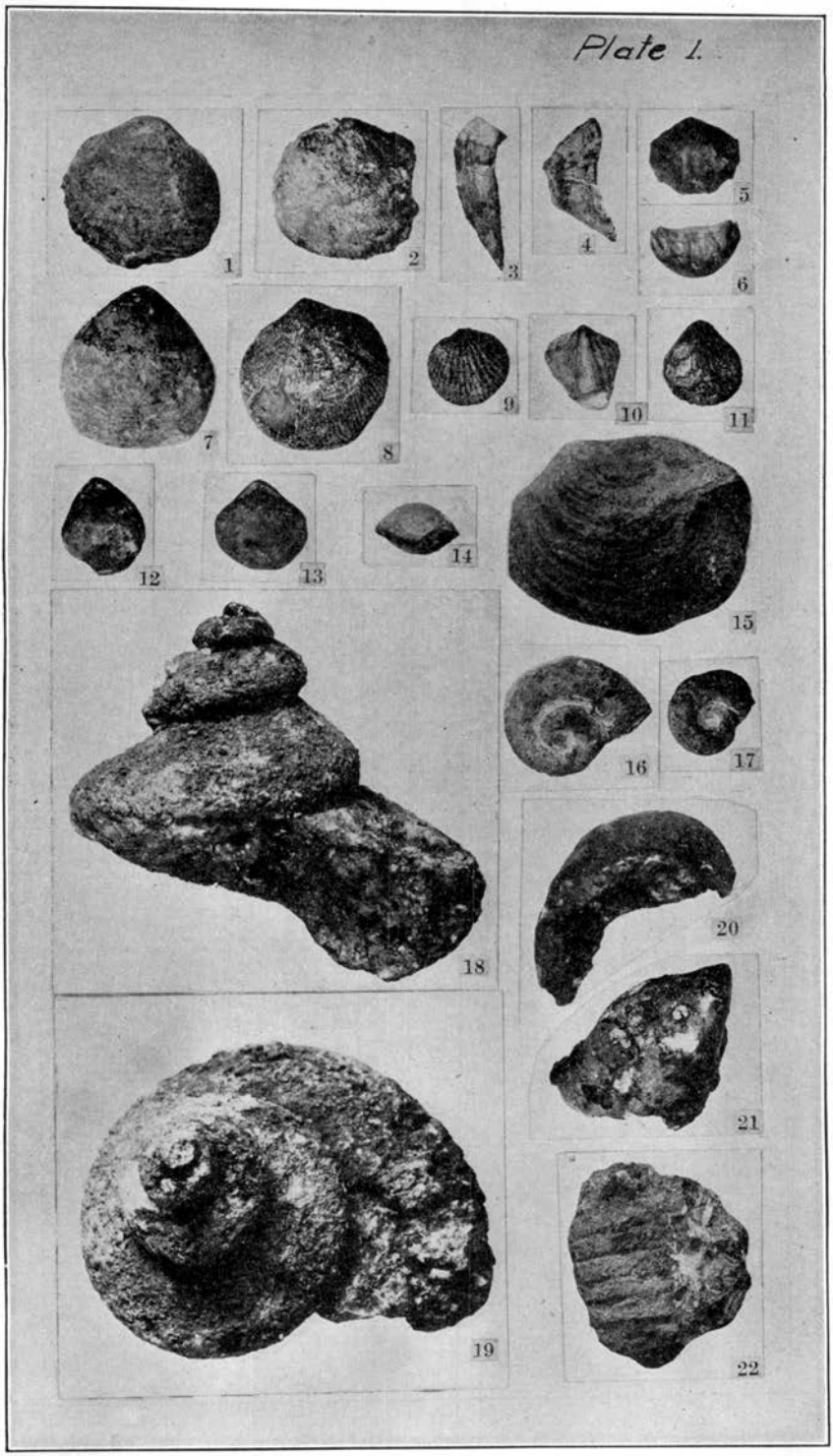
Plate 1.
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