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Some Unique Niagaran Cephalopods

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SOME UNIQUE NIAGARAN CEPHALOPODS.

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Among the paleontological collections at the State University of Iowa are some unique cephalopod remains. It is the purpose of this paper to call attention to a few of them and it is hoped that at some later time the rich Niagaran fauna of which these are a part shall receive more extensive treatment.

The specimens at hand consist chiefly of the siphuncles of several orthoceracone species. They are of the nummuloidal type and are usually strongly silicified. They occur at nearly all horizons in the Niagaran but most frequently in the Hopkinton or Delaware stage. Specimens are never abundant.

The beautiful and rare pearly nautilus of our modern seas is the nearest living relative of these extinct species. From our study of zoology it will be recalled that the coiled shell of the nautilus is divided by transverse partitions (the septa) into chambers. The septa are concave, their concave surfaces facing the opening or aperture of the shell. The animal lives in the body chamber, a cuplike cavity above the last septum. An extension of the body, known as the siphon, passes backward from the body chamber through perforations in the septa. In the modern nautilus the perforation in the last septum is but a millimeter or two in diameter and becomes gradually smaller as it is traced back through earlier and earlier septa. On the convex or posterior surface of each septum the shell substance is built out into a short tube around the siphonal perforation. This series of disconnected tubes is called the siphuncle. In the modern nautilus each segment of it extends only about one-third the distance across the air chamber into which it projects.

The Niagaran cephalopods which are here considered were straight-shelled tapering forms much as our coiled pearly nautilus would make were it possible to uncoil it into the form of a straight cone. Curved, loosely coiled, and even closely coiled species were contemporaries of the straight-shelled ones but a few of the straight species only will be discussed in this paper.

The slender discontinuous siphuncle of the pearly nautilus is but a vestige of the large continuous siphuncle of its extinct Niagaran ancestors. Moreover, it is quite likely that the siphon

occupying the large siphuncle of the Niagaran cephalopod played a far more important function in the life of the animal than does the slender remnant in the nautilus, the real function of whose siphon is not known with certainty.

Fragments of these large siphuncles constitute the chief part of the record left by the straight nautiloids which thrived in the Niagaran seas of east-central Iowa. In rare cases a part of the shell and a few of the septa have been preserved with the siphuncle; more commonly it is a cast of the shell that is found. Such specimens show the relation of the siphuncle to the shell and septa but several of the species are known only from a few segments of the siphuncle alone. The occurrence of such remains in Iowa has been noted by Calvin[1] in the Dubuque and in the Delaware county reports and also by Savage[2] in the Jackson county report. Some of the specimens described in this article were doubtless collected during the prosecution of the field work in the counties named.

A paleogeographic map[3] of North America during the Niagaran epoch shows that the rocks of this age in Iowa are but a part of a series of disconnected outcrops extending east into Illinois then north along the west shore of Lake Michigan then east again in the upper peninsula of Michigan and across the north end of Lake Huron into Ontario and on into New York.

The Niagaran outcrops just pointed out have yielded several species of these interesting cephalopods and they have been known to scientists for nearly a century. As early as 1823, Dr. John J. Bigsby read before the Geological Society of London a paper entitled "Notes on the Geography and Geology of Lake Huron."[4] This paper, published the following year at London, contains a description and figures of several species of straight-shelled cephalopods from Drummond and Thessalon islands in the north end of the lake. Of one genus Bigsby had only the siphuncles and it is not surprising that their actiniform lamellae led him to describe them as species of corals having "in their general appearance a considerable resemblance to vertebrae". Mr. Charles Stokes, a fellow of the Geological Society, undertook to name the supposed corals for Bigsby. He gave then the

[1]Iowa Geol. Surv., Vol. X, p. 454, also Vol. VIII, pp. 152 and 158.
[2]Iowa Geol. Surv., Vol. XVI, p. 616.
[3]See Chamberlin and Salisbury, "Introductory Geology," 1914, p. 390 or Charles Schuchert, "Paleogeography of North America," Bull. G. S. A., 1910, Plate 67.
[4]Trans. Geol. Soc. London, second series, Vol. i, pt. ii, pp. 175-209, Plates xxv, xxvi, xxviii, xxx.

generic name, Huronia, and assigned specific names to the five species which Bigsby had separated on "variations of external form". Stokes recognized the other cephalopods in Bigsby's paper as "Orthocerae", but no names were suggested.

It may be of interest at this point to recall that Drummond Island was formerly the site of a British garrison and fossil remains were first collected there by a Mr. White of the Army Medical Staff. By the treaty of Ghent the island was ceded to the United States and the British garrison was withdrawn. Dr. Bigsby, an ardent Englishman, laments in his paper, page 202, that "as it will not be held as a military post by its present owners, it will be long, probably, ere its fossils again become the object of research." Fourteen years, however, after the reading of Bigsby's paper, Stokes read an article before the same society "On some Species of Orthocerata"[5] in which he corrected his former view as to the coral nature of Huronia and interpreted the fossils as the siphuncles of orthoceracones.

It would extend this paper to an unwarranted length were the writer to mention, even briefly, the work of later geologists and paleontologists who have contributed to our knowledge of the Niagaran cephalopods. Reference will be made to a few of them in the descriptions which follow but no attempt will be made to give a complete bibliography of each species.

For the sake of taxonomic clearness it may be stated here that Hyatt[6] makes Huronia a sub-genus of Actinoceras while Eastman in the second edition of Zittel's Textbook of Paleontology, 1913, page 609, treats it as a genus of equal rank with Actinoceras in the family Actinoceratidae. The latter will be followed in this paper.

DESCRIPTION OF SPECIES.

Huronia vertebralis Stokes.

Plate XXXIII, figure 1; Plate XXXIV, figure 5.

1824. *Huronia vertebralis* Stokes. Trans. Geol. Soc. London, second series, Vol. i, pt. ii, p. 202, Pl. xxviii, fig. 2.

1851. *Huronia vertebralis* Hall. Rept. on the Geol, of the Lake Superior Land Dist., by Foster and Whitney, part ii, p. 221, Pl. xxxiv, fig. 1.

1857. *Orthoceras canadense* Billings. Rept. of Progr. Geol. Surv., Canada, p. 321.

[5]Trans. Geol. Soc. London, second series, Vol. v, pt. iii, pp. 705-714,Pls. lix, lx.

[6]Proc. Boston Soc. Nat. Hist., Vol. xxii, 1884.

Shell straight, gradually tapering, slightly elliptical in transverse section. Surface of the shell and character of the septa not preserved in the material at hand.

Siphuncle smooth, conspicuously segmented, sub-central in position, and round in cross-section. Each joint or segment fits down a short distance into the swollen and deflected summit of the one next older; the proximal edge of the septum passed between this expanded top and the contracted base of the joint above; the groove for its reception is very narrow and it extends inward for a distance of about one-fifth the radius of the segment's base. Fragments of the septa still remaining in the grooves are very thin. The plane of contact between two segments is more or less oblique to the longitudinal axis of the siphuncle; the amount of obliquity depends on the eccentricity of the siphuncle,—in the specimens at hand the large siphuncular fragments show the greatest obliquity.

Endosiphuncle central, its diameter about one-sixth that of the smaller end of the segment; in some of the specimens it is open and in others filled with foreign matter. Between the endosiphuncle and the inner surface of the segments radiate vertical lamellae which in cross-section resemble the septa of some cyathophylloid coral. At the constrictions between the segments the lamellae seem to be replaced by short cylindrical rings arranged concentrically between the endosiphuncle and the base of the septal groove.

Measurements: specimen (a) diameter, greatest, 33 mm., least, 26 mm.; length, 31 mm.; obliquity, 97°.

Specimen (b) three successive segments; diameter, greatest, 30.2, 29.9, 27.0 mm.; least, 26.0, 25.2, 25.0 mm.; length, 25 mm. each; obliquity 92°.

Specimen (c), four successive segments; diameter, greatest, 20.1, 20.1, 19.0, 18.5 mm.; least, 17.3, 16.5, 16.0, 15.2 mm.; length, 16.0, 16.0, 15.5, 15.2 mm.; obliquity, 92°.

One very fine specimen in the university museum lies in a slab of cherty dolomite; only a cast of the shell remains, while dolomitization has entirely effaced all traces of the septa. On being removed from the quarry the slab was broken in such a way as to show the siphuncle in its relation to the original shell or conch. Seventeen segments are present. The specimen is ninety millimeters in diameter at the larger end and fifty at the smaller, and is approximately 420 mm. long. The rate of tapering indicates that it was at least twice this length

when whole. The thirteen posterior segments average twenty-two millimeters in length. It was obtained at the Farley Quarry, North Farley, Dubuque county.

Occurrence and Locality: In Niagaran dolomite at Hopkinton, Delaware county, and at Farley, Dubuque county, Iowa. In collection of the State University.

Huronia obliqua Stokes.

Plate XXXIII, figure 2.

1824. *Huronia obliqua* Stokes. Trans. Geol. Soc. London, second series, Vol. i, pt. ii, p. 203, Pl. xxviii, fig. 4.

Siphuncle straight, smooth, tapering at the rate of a little over one millimeter for each segment length. Transverse section circular. Segments short in proportion to their lengths—seven having a total length of one hundred millimeters while their average greatest diameter is 37.4 mm. The obliquity of the plane passing through the line of contact of any two joints is 97°. This exceeds the obliquity of any other species of this genus with the exception of some of the gerontic siphuncles of *H. vertebralis.*

Endosiphuncle central and proportionately smaller than in the preceding; the actiniform lamellae well developed.

Occurrence and Locality: The only specimen in the University collection is labelled Niagaran, northeastern Iowa.

Huronia subcylindrica sp. nov.

Plate XXXIV, figure 4.

Siphuncle straight, round in cross section, sides parallel, or nearly so; the specimen consists of seven segments, four of them whole. It shows no appreciable tapering.

The segments are about one-half as long as their average diameter and their nearly parallel sides give them a cylindrical appearance. The anterior end of each segment is partly set off from its main body by a sort of uneven contact which somewhat resembles the epiphyseal surface in the limb bones of young mammals. The contact between two segments is slightly oblique.

The endosiphuncle is six to eight millimeters in diameter, is out of the center by about one-half this amount, and its wall is wrinkled and irregular. The lamellae are strong, more or less convoluted, and are irregularly arranged.

Fragments of the thin proximal edges of the septa are present between all the joints; they enter between them at an angle of nearly 45° from the vertical.

Measurements: Greatest diameter (aver.) 40 mm., least (aver.) 38.1 mm.; length of segments (aver.) 21 mm.; obliquity, 95°.

Occurrence and Locality: The type specimen is in the University collection and is labelled Niagaran, Delaware county, Iowa.

Huronia hopkintonensis sp. nov.

Plate XXXIII, figure 3.

Siphuncle large, straight, tapers very gradually. The type specimen consists of four partly broken segments and a fragment of a fifth segment. Transverse section apparently circular.

The segments are strikingly short and broad and are about two-fifths as long as wide; their sides slope gradually and the upper one-third of each is moderately swollen; the top of each turns abruptly inward then obliquely downward beneath the segment above. The obliquity of the segmental contact is small.

A fragment of the septum between the two lower segments is double; this is an actinoceran character not present, as far as observed, in any other specimen of Huronia at hand.

The endosiphuncle is central and is two millimeters in diameter. The actiniform lamellae are very numerous and more crowded than in any of the other species here described.

This species differs from *H. vertebralis* in its larger size, in the proportions of the segments, and in the much less swollen anterior ring.

Measurements: Greatest diameter, (aver.) 55 mm., least (aver.) 46 mm.; length of segments (aver.) 20.6; obliquity, 93°.

Occurrence and Locality: The type specimen is in the University collection and is labelled Niagaran, Hopkinton, Iowa.

Huronia turbinata Stokes.

Plate XXXIII, figure 4.

1824. *Huronia turbinata* Stokes. Trans. Geol. Soc. London, second series, Vol. i, pt. ii, p. 203, Pl. xxviii, fig. 3.

Siphuncle straight, round, and tapering gradually. Our specimen consists of four segments, the upper and lower imperfect, the two middle ones nearly whole.

The segments are notably turbinate in shape; the swollen part of each is prominent and a circle passing along its greatest periphery is quite well back from the anterior end. The upper half of each segment is convex while the lower half is slightly concave and smoother than the upper. The maximum and mini-

mum diameters of the segments are in proportion of approximately thirteen to nine while the height to the width is about three to five. Two segments meet along a slightly oblique plane. The endosiphuncle is central and small. The lamellae are few and rather obscure in our specimen.

Fragments of the septa preserved with this bit of siphuncle indicate that the septum on emerging from the septal groove turned abruptly upward and adhered to the lower half of the segment; from this position it deflected outward to unite with the conch. The smoothness of the lower half of each segment seems to be due to the fact that it was covered and thus protected from weather and wear for some time after the destruction of the enveloping conch. It is worthy of note that the lower half of the segments in *H. obliqua* also is smoother and strongly suggests, in our material, a similar relation of septa and siphuncle in that species.

Measurements: Greatest diameter, three successive segments, 27.0, 26.0, 25.8 mm.; least diameter, three successive segments, 18.5, 18.0, 17.2 mm.; average length, three segments, 14.5 mm.; obliquity, 95°.

Occurrence and Locality: The only specimen in the University collection is from the Niagaran, "northeastern Iowa."

Discosorus (?) biconoideus sp. nov.

Plate XXXIV, figures 1 and 2.

Compare *Discosorus conoideus* Hall, 1852. Pal. N. Y., Vol. ii, p. 99, Pl. xxviii, figs. 13a, b, c.

Siphuncle of the nummuloidal type, straight, transverse section circular; tapers both posteriorly and anteriorly giving the specimen a biconoid appearance. The anterior cone is the shorter due to more rapid tapering in this direction.

Segments disc-like, edges rounded, septal groove deep, opposing faces flat and smooth; anteriorly the segments become thinner at the extreme end showing that the air chambers in senility become shallower. The obliquity of the plane passing between the joints is as high as 105° which is greater than in any species of Huronia.

Endosiphuncle central; internal character of the segments obscure but where broken small fragments of crinoid or cystoid stems and hollow molds of minute fossils tend to indicate that

they were empty. Hall in the reference to *D. conoideus,* cited above, mentions similarly included remains.

These siphuncles evidently belonged to some ovoid brevicone type of cephalopod. In the university collection is a fragment of a cast of a conch with part of the siphuncle in place. The siphuncle is broken in such a way that it can not be referred to this species with absolute certainty but the following points can be seen clearly; seven camerae are present on the antisiphonal side; the sutures undulate slightly; the uninjured surface of the specimen preserves impressions of longitudinal ridges; the surface along these ridges is a gently convex curve; the siphuncle is nummuloidal and tapers in both directions.

This species is referred to the genus Discosorus with some doubt. Many fragments of siphuncles in the collection taper in one direction only; these conform to Hall's description of the genus as given in the reference cited at the head of this description, but a redefinition of the genus is necessary in order to include biconoid or doubly tapering siphuncles.

The specific name is also offered with some hesitation, for it may be possible that the siphuncles at hand are but more complete specimens of Hall's *D. conoideus.* However, it seems unlikely that good observers like Bigsby, Hall, Whitfield, Barrande, Hyatt and others should have failed to notice biconoid forms or at least to have suspected the biconoid character of the siphuncle if such was originally the complete form of the specimens they studied.

Occurrence and Locality: Occur as dolomitic casts in the Niagaran at Maquoketa, Jackson county, and also at Hopkinton and vicinity in Delaware county, Iowa. One silicified specimen is labelled Niagaran, Delaware county. State University collection.

Actinoceras cf. richardsoni Stokes.

Plate XXXIV, figure 3.

1840. *Actinoceras richardsoni* Stokes. Trans. Geo. Soc. London, second series, Vol. v, pt. ii, p. 708, Pl. lix, figs. 2, 3.

Siphuncle nummuloidal, straight, round in cross section; the fragment at hand shows little or no tapering.

Segments discoidal, outer edges evenly rounded, surface of upper half curved more abruptly than the lower to which fragments of the septa still adhere as in *H. turbinata.* The obliquity of the segments makes an angle of 105° with the vertical axis.

The internal characters of the siphuncle are wholly obscured by excessive silicification.

The high obliquity of the segments of this fragmentary specimen makes its reference to Stokes' species rather doubtful, while the highly silicified condition of the interior makes even generic determination uncertain.

Occurrence and Locality: The specimen is in the University collection and was found in the Niagaran, Hopkinton, Iowa.

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EXPLANATION OF PLATE XXXIII.

(All Figures Natural Size.)

HURONIA VERTEBRALIS Stokes.

Fig. 1. Two large segments showing unusual obliquity for this species.

HURONIA OBLIQUA Stokes.

Fig. 2. A series of nine segments, the terminal ones imperfect. The greatest obliquity is at right angles to the side shown. Note that the concave surface of each segment is smoother than the convex.

HURONIA HOPKINTONENSIS sp. nov.

Fig. 3. The type specimen. Greatest obliquity not shown.

HURONIA TURBINATA Stokes.

Fig. 4. Portion of the siphuncle showing the obliquity of the segments, also a fragment of the turned up part of the septum adhering to the concave surface of the upper segment. The smoothness of the concave part is not well brought out in the photograph.

EXPLANATION OF PLATE XXXIV.

(All Figures Natural Size.)

DISCOSORUS (?) BICONOIDEUS sp. nov.

Fig. 1. The paratype. A large incomplete siphuncle showing the obliquity of the segments, the amount of their separation, and their thinning toward the anterior end.

Fig. 2. A more complete siphuncle of a smaller individual, the holotype, showing tapering toward each end.

ACTINOCERAS cf. RICHARDSONI Stokes.

Fig. 3. View of a fragmentary specimen showing its nummuloidal character and the septal remnants attached to the posterior surfaces of the segments. Note the high obliquity of the segments.

HURONIA SUBCYLINDRICA sp. nov.

Fig. 4. The type specimen. Shows the nearly cylindrical character of the segments, the low anterior ring, and the narrow septal groove. The view is at right angles to the greatest obliquity.

HURONIA VERTEBRALIS Stokes.

Fig. 5. A typical specimen showing a slight amount of tapering, segments with subparallel sides, and rounded evenly-inflated anterior rings.

PLATE XXXIII.