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THE UNIVERSITY OF MICHIGAN

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A REDESCRIPTION OF THE CYSTOID *LIPSANOCYSTIS TRAVERSENSIS* EHLERS AND LEIGHLEY (RHOMBIFERA: CALLOCYSTITIDAE)

BY

C. R. C. PAUL

MUSEUM OF PALEONTOLOGY

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VOLUME XXI

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8. Evolution of the Fern Genus *Osmunda,* by Charles N. Miller, Jr., pages 139–203, with 4 plates and 9 figures.
9. A Redescription of the Cystoid *Lipsanocystis Traversensis* Ehlers and Leighley (Rhombifera: Callocystitidae), by C. R. C. Paul, pages 205–217, with 2 plates and 10 figures.

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A REDESCRIPTION OF THE CYSTOID *LIPSANOCYSTIS TRAVERSENSIS* EHLERS AND LEIGHLEY (RHOMBIFERA: CALLOCYSTITIDAE)

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ABSTRACT

Previously *Lipsanocystis* was thought to be characterized by a periproct almost completely surrounded by one thecal plate (L5). Study of eleven specimens of the type species, *L. traversensis* Ehlers and Leighley, shows that from one to four plates may surround the periproct. Sutures bearing pectinirhombs are relatively long, possibly allowing greater respiratory exchange for a given thecal volume. The spacing of pectinirhomb dichopores is remarkably constant but the spacing of facets varies with growth.

CONTENTS

PAGE
Introduction 205
Systematic Paleontology 207
References 214
Plates ..... (*after*) 215

INTRODUCTION

Lipsanocystis traversensis Ehlers and Leighley, type species of the genus *Lipsanocystis*, is one of the last known cystoids, occurring in the Middle Devonian Traverse Group of Michigan. It was first described on the basis of a single specimen from Partridge Point, Thunder Bay, Michigan. Ehlers and Leighley (1922) regarded this specimen as belonging to a new genus principally because the periproct was almost entirely surrounded by plate L5, a situation unknown in any other genus of Callocystitidae. Stumm (1955) added to the original description of *L. traversensis* using several

additional specimens subsequently collected from the type locality, and described three new species of *Lipsanocystis* from other formations in the Traverse Group. Unfortunately Stumm did not mention the nature of the periproct in the additional specimens available to him and it has become accepted that the periproct is always almost completely surrounded by L5. Re-examination of the specimens in the Museum of Paleontology of The University of Michigan (UMMP) and study of two other specimens not previously available, one kindly loaned by Professor L. R. Laudon of the University of Wisconsin (and now deposited in the Museum of Paleontology, The University of Michigan) and the other by Mr. Leo Nieman of Detroit, indicates that the arrangement of plates around the periproct is variable and any number of plates from one to four may contribute to the border.

Other aspects of the plating arrangement are variable. In particular there appears to be a tendency, present in other Devonian callocystitids, for rhomb-bearing sutures to lengthen at the expense of adjacent sutures. This eventually results in a more unstable plating arrangement where four plates meet at a point (Fig. 1; Pl. I, Figs. 7–9). For a constant thecal size, such an arrangement allows larger pectinirhombs than the arrangement found in older genera, and assuming pectinirhombs were respiratory in function, it may have been beneficial in allowing a greater amount of respiratory exchange.

Lipsanocystis also exhibits another interesting feature, along with the co-eval *Strobilocystites* White, in that the hydropore (madreporite of Ehlers and Leighley 1922, and Stumm 1955) opens exteriorly in two oval or subcircular structures, each provided with a raised rim within which the surface is minutely porous (Pl. I, Fig. 2). In most other callocystitid genera the hydropore opens as a curved slit across the common suture of O1 and O7. In some species the ends of the slit expand giving rise to a dumb-bell-shaped structure. In *Lipsanocystis* the two ends no longer show their original connection. There is also some evidence of an evolutionary trend from a simple slit to a porous, madreporite-like structure. Single porous structures are known in at least two other Devonian genera. A comparative study of the structure of the hydropore throughout the family, or superfamily, would probably provide most interesting results.

The author is indebted to Professor L. R. Laudon and to Mr. Leo Nieman for the loan of specimens. This research was completed during the tenure of a post-doctoral fellowship, under a program of systematic and evolutionary biology financed by the National Science Foundation (Grant No. GB-3366) which is gratefully acknowledged.

SYSTEMATIC PALEONTOLOGY

Superfamily Glyptocystitida Bather 1899

Family Callocystitidae Bernard 1895

Hitherto, *Lipsanocystis* Ehlers and Leighley has been attributed to the subfamily Apiocystitinae. However, within the Apiocystitinae as currecently accepted (Kesling, 1963) two distinct groups of genera can be recognized. Genera like *Apiocystites* Forbes and *Jaekelocystis* Schuchert have ambulacra developed in channels within the thecal plates, very small facets, and rhombs which are highly compressed; they generally have less than 10 dichopores. On the other hand, *Tetracystis* Schuchert, *Lovenicystis* Regnéll, and *Lipsanocystis* Ehlers and Leighley, have relatively prominent ambulacra developed on smooth bands on the thecal plates, large facets, and large angular pectinirhombs with many dichopores. Because it shares these characters with *Staurocystis* and *Pseudocrinites*, Paul (1967) transferred *Tetracystis* from the Apiocystitinae to the Staurocystinae. This placement may be equally unsatisfactory, however. *Lipsanocystis* is apparently a Middle Devonian descendant of the Upper Silurian-Lower Devonian *Tetracystis*, and its subfamily assignment will await a complete revision of the Callocystitidae at present in progress.

Genus *Lipsanocystis* Ehlers and Leighley 1922

Type species:—*Lipsanocystis traversensis* Ehlers and Leighley, 1922.

1922 *Lipsanocystis* Ehlers and Leighley, p. 155.
1945 *Lipsanocystis* Ehlers and Leighley. Regnéll, pp. 89, 91.
1955 *Lipsanocystis* Ehlers and Leighley. Stumm, p. 98.
1963 *Lipsanocystis* Ehlers and Leighley. Kesling, p. 111.

Diagnosis.—A genus of Staurocystinae with four unbranched ambulacra, with double hydropore, and with 1–4 thecal plates surrounding periproct.

Among all described genera of Callocystitidae only *Lipsanocystis* and *Strobilocystites* White have a double hydropore. The latter may be distinguished from *Lipsanocystis* by its branched ambulacra and globular thecal shape.

Range.—*Lipsanocystis* is only known from the Traverse Group (Middle Devonian) of Alpena County, Michigan.

Lipsanocystis traversensis Ehlers and Leighley, 1922

(Figs. 1–10; Pl. I, Figs. 1–11; Pl. II, Figs. 1–9)

?1876 *Lepadocrinus* Rominger, p. 41.
1922 *Lipsanocystis traversensis* Ehlers and Leighley, p. 157, Pl. 10, Figs. 1–5, text-figs. 4–6.

1943 *Lipsanocystis traversensis* Ehlers and Leighley. Bassler and Moodey, pp. 64, 174.

1955 *Lipsanocystis traversensis* Ehlers and Leighley. Stumm, p. 99, Pl. 1, Figs. 7–11; Pl. 2, Fig. 2.

Diagnosis.—A species of *Lipsanocystis* with subquadrate theca and finely ornamented thecal plates.

Holotype.—UMMP 5414.

Horizon and locality.—Traverse Group, Thunder Bay Ls. (M. Devonian); Partridge Point, Thunder Bay, Michigan.

Material available.—Holotype and 10 other specimens.

Description.—The theca is ovate to subquadrate with four undivided ambulacra running down the sides and usually reaching the stem cicatrix. The mouth, double hydropore, and gonopore are apical; the anus is lateral. A stem is present.

There are twenty-six thecal plates arranged according to the usual glyptocystitid formula 4BB, 5ILL, 5LL, 5RR, and 7OO. The arrangement of the plates of the first four circlets is more variable than is usual in the Callocystitidae. The arrangements in two specimens are shown in Figures 1 and 2. The modification of the arrangement of thecal plates is associated with enlargement of the pectinirhombs. The sutures B2:IL2, L4:R3, and L1:R5 are relatively long. This arrangement allows larger rhombs without materially increasing the size of the theca at the same time.

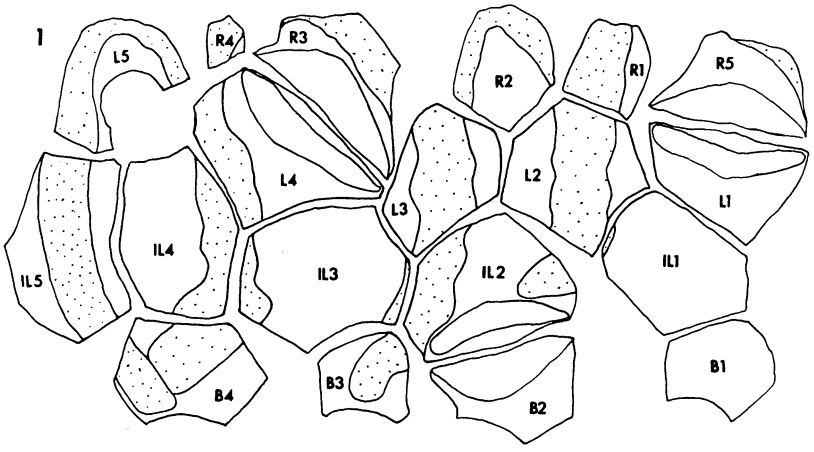


FIG. 1. Diagram of the arrangement of thecal plates of the first four circlets of *Lipsanocystis traversensis* Ehlers and Leighley. Based on camera lucida drawings of the individual plates of UMMP 26422. BB1–4, basals; ILL1–5, infralaterals; LL1–5, laterals; RR1–5, radials.

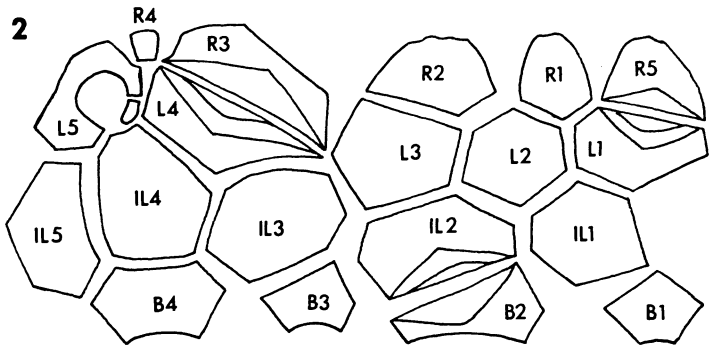


FIG. 2. Sketch of the arrangement of thecal plates of the first four circlets of *Lipsanocystis traversensis* Ehlers and Leighley. UMMP 56222. Symbols as in Figure 1.

There is considerable variation in the paths of the ambulacra. If the periproct is posterior, there are four interambulacral areas of which the anterior and posterior are regularly narrower than the left and right. This correlates with the increased size of the upper pair of rhombs which lie in the larger (left and right) interambulacral areas. In most specimens

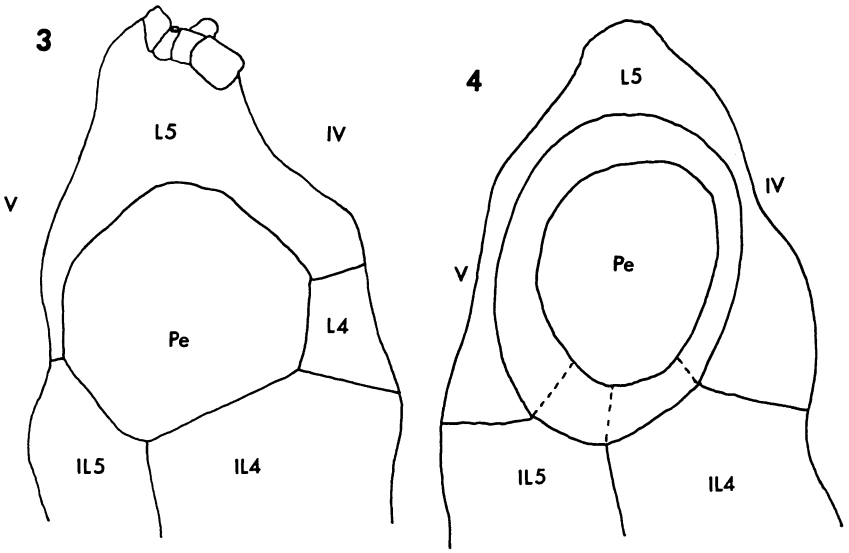


FIG. 3. Camera lucida drawing of UMMP 33310 showing four plates around the periproct. ILL4–5, infra-laterals; LL4–5, laterals; Pe, periproct; R4, radial; IV and V, ambulacra IV and V.

FIG. 4. UMMP 33311 showing three plates around the periproct and the inner and outer margins of these plates.

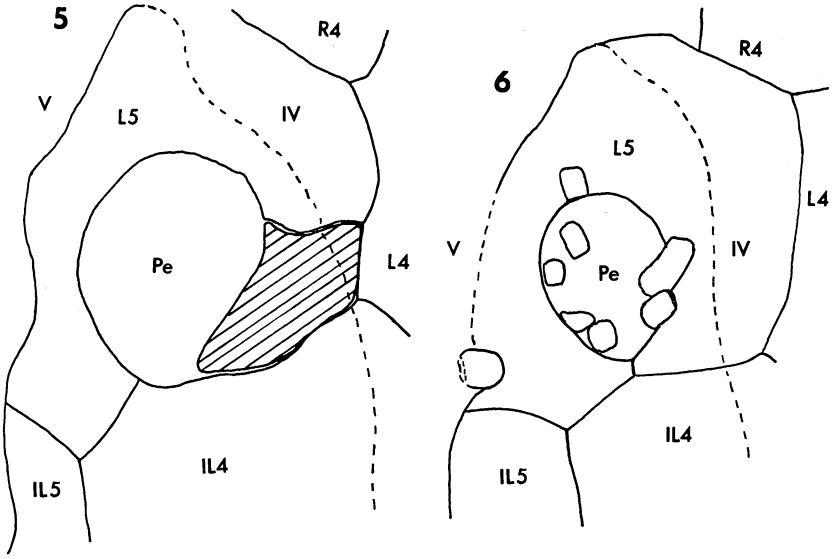


FIG. 5. The holotype, UMMP 5414, showing two plates surrounding the periproct. The shaded area is interpreted as part of L5, separated by a crack, not a suture.

FIG. 6. Laudon's specimen, UMMP 56406, showing the periproct entirely enclosed by plate L5.

ambulacrum II is strongly curved to pass around one side of rhomb L4:R3 and the other side of rhomb B2:IL2. In the holotype ambulacrum II terminates against rhomb B2:IL2 whereas in UMMP 56221, ambulacra II and IV meet distally due to their curvature. In UMMP 26422 ambulacrum I terminates against rhomb B2:IL2 (Pl. I, Fig. 5). The basals unite to form a circular cicatrix reaching 7 mm in diameter (Pl. 2, Fig. 1). The plates around the periproct are variously arranged. *Lipsanocystis* is supposed to be characterized by having the periproct almost entirely enclosed by L5. This is so in most specimens; however the remaining portion of the border not formed by L5 may be formed of 1–3 plates and in Laudon's specimen (UMMP 56406) L5 entirely surrounds the periproct. Representative arrangements are shown in Figures 3–6 (Pl. II, Figures 2–4, 7).

The radial circlet is open, L5 being inserted between R4 and R5, as is usual. The thecal plates are not very strongly ornamented but most show traces of radiating ridges and weak irregular tubercles. The orals have small tubercles on the portions exposed between the ambulacra. The ambulacra are developed on smooth flat bands on the thecal plates and

faint traces of the arrangement of the ambulacral flooring plates can be seen in well-preserved examples (Fig. 9; Pl. II, Fig. 8). Three disjunct pectinirhombs are developed, as is usual. These are B2:IL2, L1:R5, and L4:R3. All three are angular, depressed in outline, and have many dichopores. Half-rhombs IL2, L1, and L4 have closed vestibule rims, whereas B2, R5, and R3 have no vestibule rims at all. The spacing of the dichopores is almost constant in all rhombs (See Table I.)

B2:IL2 (UMMP 56223) is slightly asymmetrical and measures 9.8 mm (width) by 5.2 mm (length). There are 55 dichopores, the longest

TABLE I

SPACING OF DICHOPORES IN THE PECTINIRHOMBS OF *Lipsanocystis traversensis* EHLERS AND LEIGHLEY

The values for spacing are derived by measuring the width of 10 dichopores and 10 inter-dichopore spaces, dividing by 10 and expressing the result as width between centers of slits.

Specimen	B2:IL2	L1:R5	L4:R3
Holotype UMMP 5414	0.1515 mm.	0.1510 mm.	0.1515 mm.
UMMP 26422	....	0.1530 mm.	0.1520 mm.
UMMP 33311	....	0.1530 mm.	0.1540 mm.
UMMP 56222	....	0.1540 mm.	....
UMMP 56223	0.1525 mm.	0.1520 mm.	0.1520 mm.
UMMP 56224	....	....	0.1515 mm.
UMMP 56406	0.1515 mm.	....	0.1510 mm.

Average, 0.1522 mm. Range, 0.1510–0.1540 mm.

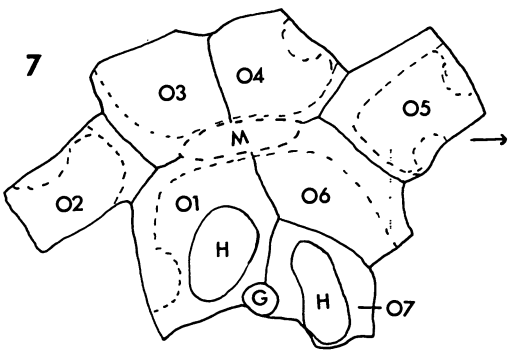


FIG. 7. Camera lucida drawing of the apical region of *Lipsanocystis traversensis* showing the arrangement of the oral plates. UMMP 26422. G, gonopore; H, hydropore; M, mouth; OO1–7, orals. The arrow points to the periproct.

reaching 4.4 mm. The maximum slit length in B2 is 1.5 mm and in IL2, 1.2 mm.

L1:R5 (UMMP 26422) is symmetrical and measures 9.2 mm (width) by 5.3 mm (length). It has 49 dichopores, the longest reaching 4.6 mm. The maximum slit length in R5 is 2.1 mm and in L1, 1.0 mm.

L4:R3 (UMMP 26422) measures 10.0 mm (w.) by 5.5 mm (l.) and is asymmetrical. It has 53 dichopores, 35 in one demi-rhomb and 18 in the other, the longest measuring 4.9 mm. The maximum slit length in R3 is 2.3 mm and in L4, 1.3 mm.

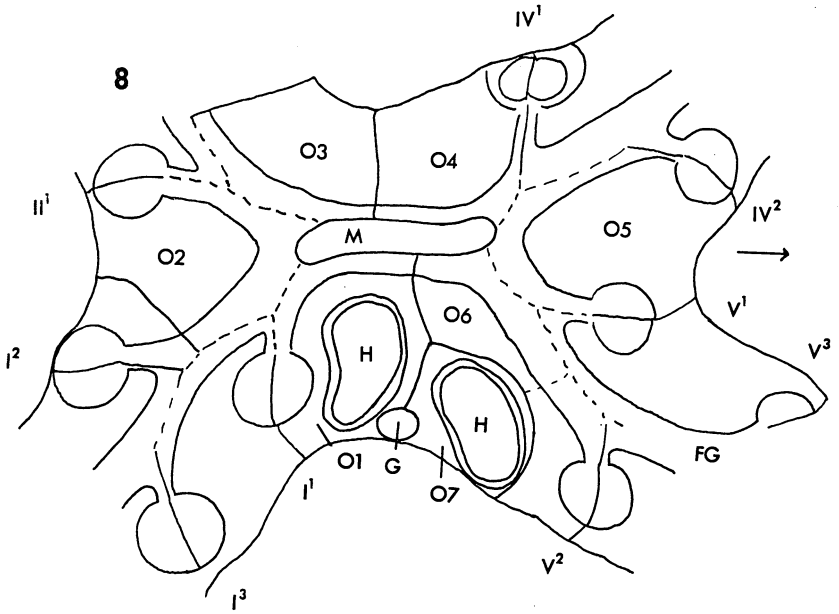


FIG. 8. Camera lucida drawing of the apical region of *Lipsanocystis traversensis* Ehlers and Leighley showing arrangement of food grooves and adapical facets. UMMP 33311. FG, food groove; G, gonopore; H, hydropore; M, mouth; OO1–7, orals; I^1, I^2, etc., adapical facets of ambulacrum I; II^1, II^2, etc., facets of ambulacrum II, etc.

The mouth is apical and oval in outline (see Fig. 8). It was associated with seven oral plates arranged as in Figure 7 (Pl. I, Fig. 3). The ambulacra were developed on four relatively narrow, flat bands on the thecal plates and had between 14 and 20 facets each. The ambulacra taper throughout their length and reach 4 mm in width apically. The impressions of the primary ambulacral flooring plates are about twice the size

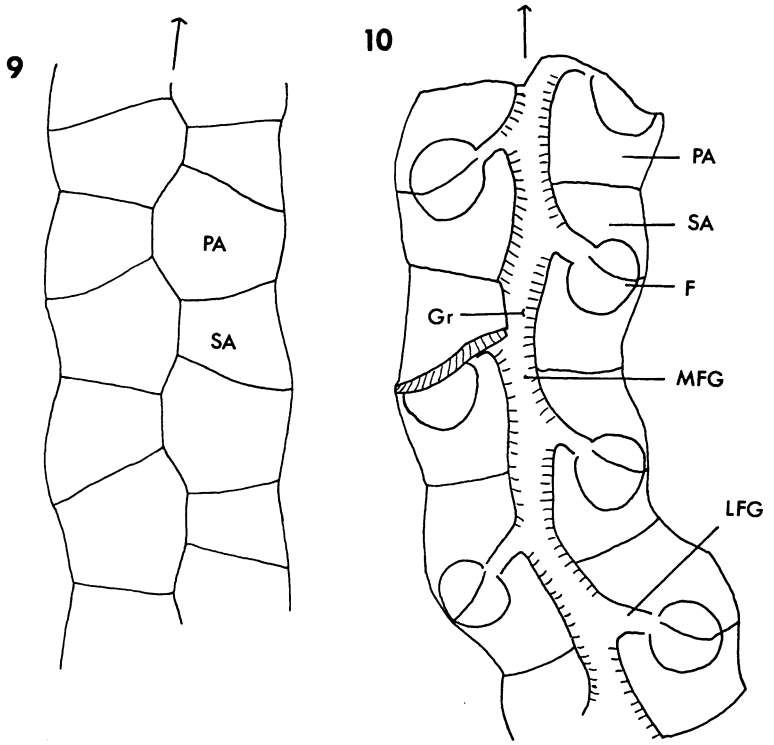


FIG. 9. Camera lucida drawing of the traces of the ambulacral flooring plates on the thecal plates in *Lipsanocystis traversensis* Ehlers and Leighley. UMMP 33311. PA, primary ambulacral flooring plates; SA, secondary flooring plates. The arrow points to the mouth.

FIG. 10. Camera lucida drawing of part of an ambulacrum of *Lipsanocystis traversensis* Ehlers and Leighley. UMMP 33311. F, facet; Gr, grooves for ambulacral cover plates; LFG, lateral food groove; MFG, main food groove; PA, primary ambulacral flooring plates; SA, secondary flooring plates. The arrow points to the mouth.

of those of the secondary ambulacral flooring plates (Fig. 9). The latter reach the ambulacral mid-suture regularly.

The primary food groove is about 0.8 mm wide apically and tapers to 0.5 mm distally. The sides are ridged indicating the positions of the cover plates (Pl. I, Fig. 2; Pl. II, Fig. 4). The lateral food grooves are short, apparently unridged and 0.3–0.4 mm wide. They terminate in fairly prominent circular facets. These are developed on a pair of flooring plates, one primary and one secondary, the latter always forming the adoral portion. The first formed facet in each ambulacrum is branched off to the left

of the ambulacrum as viewed from the apex to the tip. The facets are more closely spaced distally than proximally (Pl. II, Fig. 5). The brachioles are unknown. Presumably both the main and lateral food grooves were provided with cover plates but these have not been preserved in any specimen available. Except for the most adoral the ambulacral flooring plates are not ornamented between the lateral food grooves (UMMP 33311).

The periproct is covered by an anal pyramid of 5 or 6 ornamented plates and a circlet of auxiliaries in UMMP 26422, the only specimen with these plates preserved (Pl. I, Fig. II). There is no periproct hood in L5. There are one to four thecal plates surrounding the periproct.

The gonopore (previously called hydropore) and hydropore (previously madreporite) are both apical and associated with O1 and O7 (Fig. 7). (For the interpretation of these orifices see Paul 1967 and 1967a). The gonopore is a small circular orifice developed across the suture between O1 and O7 (Pl. I, Fig. 7). It is 0.5 mm in diameter in UMMP 33311 and is provided with a pyramid of three small gonals in UMMP 56224. The hydropore opens as two separate structures, each provided with a strong rim and resembling the adjacent facets (Pl. I, Fig. 2). The two portions are developed in O1 and O7 and are provided with numerous small perforations as in the madreporite of an echinoid.

Small portions of the proximal stem are attached to UMMP 56406 and Nieman's specimen. The outer proximals are flanged aborally, the flanges bearing a ring of fine tubercles (Pl. II, Fig. 2). The distal stem is unknown.

REFERENCES

BASSLER, R. S., and MOODEY, M. W. 1943. Bibliographic and faunal index of Paleozoic pelmatozoan echinoderms. Geol. Soc. Amer., Spec. Papers, No. 45, pp. 1–734.

BATHER, F. A. 1899. A phylogenetic classification of the Pelmatozoa. Rep. Brit. Assoc., Vol. 68, pp. 916–23.

BERNARD, F. 1895. *Eléments de paléontologie.* VIII + 1168 pp., 612 text figs. Paris.

EHLERS, G. M. and LEIGHLEY, J. B. 1922. *Lipsanocystis traversensis,* a new cystid from the Devonion of Michigan. Papers Mich. Acad. Sci. Arts, Vol. 2, pp. 155–60, Pl. 10.

JAEKEL, O. 1899. Stammesgeschichte der Pelmatozoen. 1. Thecoidea und Cystoidea. X + 442 pp., 18 pls., 88 text figs. Berlin.

KESLING, R. V. 1963. Key for classification of cystoids. Contr. Mus. Paleont. Univ. Mich., Vol. 18, pp. 101–16.

PAUL, C. R. C. 1967. The British Silurian Cystoids. Bull. Brit. Mus. Nat. Hist., Vol. 13, No. 6, pp 297–356, Pls. 1–10, 44 text-figs.

PAUL, C. R. C. 1967a. The functional morphology and mode of life of the cystoid *Pleurocystites* Billings. Symposia Zoo. Soc. London, No. 20, pp. 105–123, 22 text-figs.

REGNÉLL, G. 1945. Non-crinoid Pelmatozoa from the Paleozoic of Sweden. A taxonomic study. Médd. Lunds geol-min. Instn., Vol. 108, pp. 1–255, Pls. 1–15, 30 text-figs.

ROMINGER, C. 1876. Geology of Lower Peninsular (Michigan). Rep. Geol. Surv. Mich., Vol. 3, pp. 1–150, illus.

STUMM, E. C. 1955. Three new species of the cystid genus *Lipsanocystis* from the Middle Devonian Traverse Group of Michigan. Contr. Mus. Paleont. Univ. Mich., Vol. 12, pp. 97–103, 2 pls.

Submitted for publication January 4, 1967

PLATES

EXPLANATION OF PLATE I
(all specimens coated with ammonium chloride sublimate)

PAGE
Lipsanocystis traversensis Ehlers and Leighley 207

FIG. 1. Anterior lateral stereophoto showing ambulacrum I passing beneath rhomb B2:IL2. UMMP 56222. x1.

FIG. 2. Detail of apical area showing gonopore, double hydropore, mouth, ridged food grooves and tubercles on exposed portions of orals. UMMP 33311. x2.

FIG. 3. Apical stereophoto showing seven orals. UMMP 26422. x1.

FIG. 4. Detail of rhomb B2:IL2 showing strong rim on half-rhomb IL2. (Note four plates almost meet at the point to the right of the rhomb). UMMP 26422. x2.

FIG. 5. Anterior lateral stereophoto showing ambulacrum I terminating against rhomb B2:IL2. UMMP 26422. x1.

FIG. 6. Left lateral stereophoto showing rhomb L1:R5. Holotype, UMMP 5414. x1.

FIG. 7. Detail of rhomb LI:R5 showing four plates meeting at points at either end of the rhomb. Note the small gonopore between and below the double hydropore above the rhomb. UMMP 26422. x2.

FIG. 8. Right lateral stereophoto showing rhomb L4:R3. UMMP 26422. x1.

FIG. 9. Detail of rhomb L4:R3 showing four plates meeting at a point to the right. Holotype UMMP 5414. x2.

FIG. 10. Left lateral stereophoto showing ambulacrum V touching rhomb L1:R5. UMMP 33311. x1.

FIG. 11. Detail of periproct showing crushed anal pyramid and auxiliary circlet. Note the anals bear tubercles. UMMP 26422. x2.

PLATE I

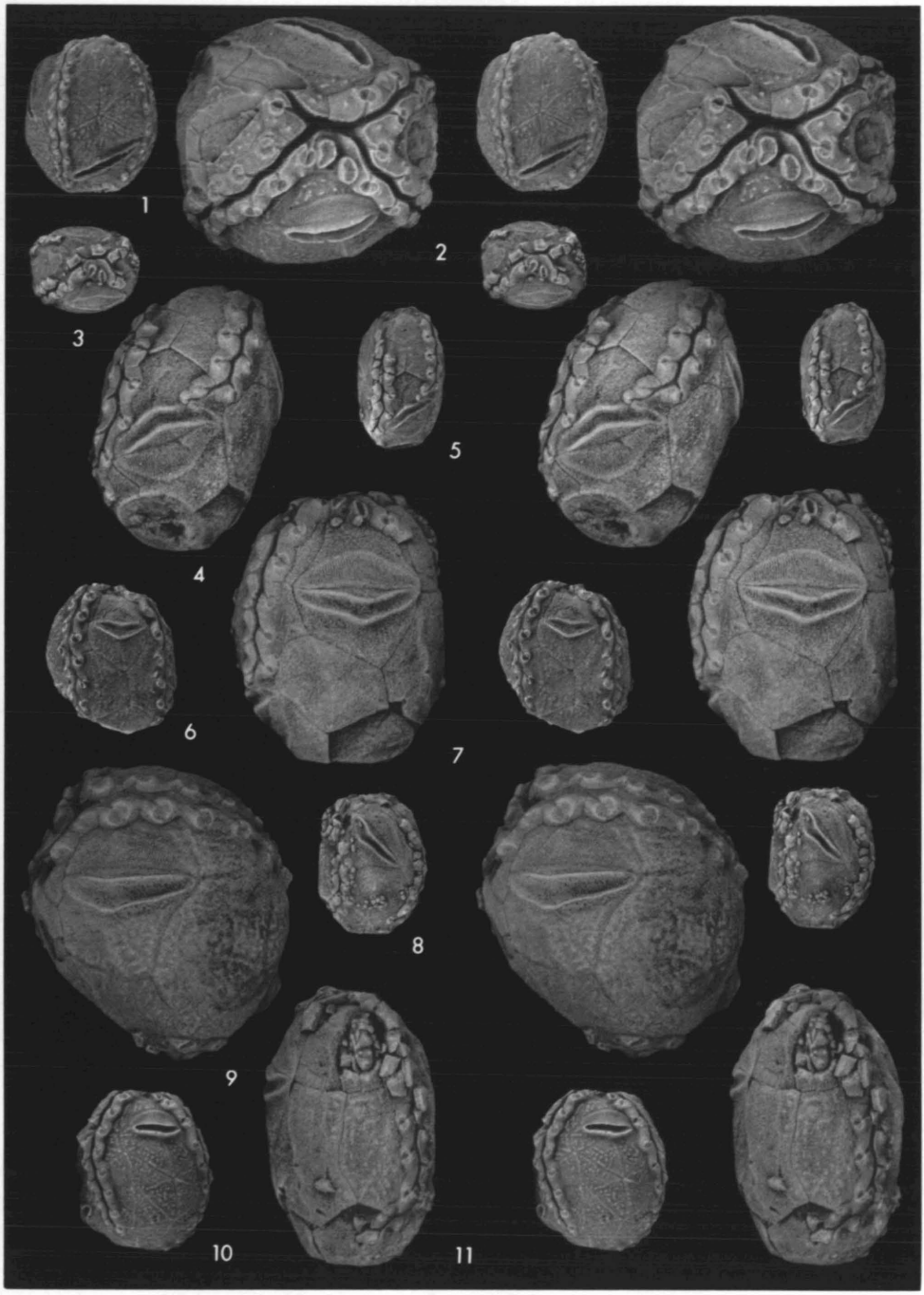
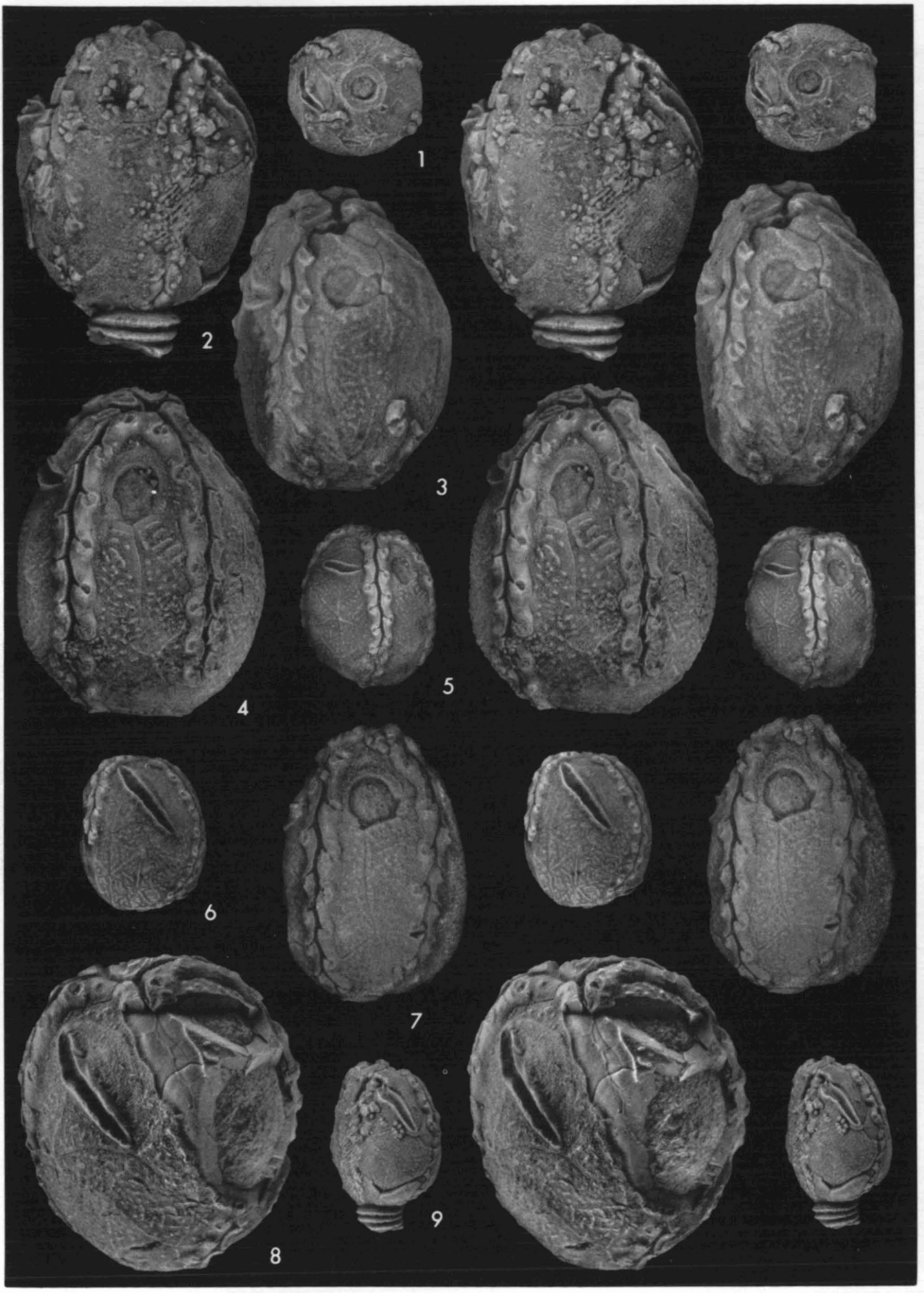


PLATE II



EXPLANATION OF PLATE II
(all specimens coated with ammonium chloride sublimate)

PAGE

Lipsanocystis traversensis Ehlers and Leighley 207

FIG. 1. Basal stereophoto showing ambulacra nearly reaching stem cicatrix. UMMP 33311. x1.

FIG. 2. Posterior lateral stereophoto showing periproct completely enclosed by L5. Note the poorly preserved tubercles on the stem flanges. Laudon's specimen, UMMP 56406. x2.

FIG. 3. Posterior lateral stereophoto showing periproct bordered by L5 and IL4. Holotype, UMMP 5414. x2.

FIG. 4. Posterior lateral stereophoto showing periproct bordered by L5, IL4, and IL5. UMMP 33311. x2.

FIG. 5. Lateral stereophoto of ambulacrum V showing facets more widely spaced adorally. UMMP 33311. x1.

FIG. 6. Right lateral stereophoto showing rhomb L4:R3. UMMP 56222. x1.

FIG. 7. Posterior lateral view showing periproct bordered by L5, L4, IL4, and IL5. UMMP 33310. x2.

FIG. 8. Detail of impressions of ambulacral flooring plates on thecal plates. Note flat ambulacral base. UMMP 33311. x2.

FIG. 9. Right lateral stereophoto showing parts of four outer proximal columnals. Laudon's specimen, UMMP 56406. x1.