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A NEW SPECIES OF *POROCRINUS* FROM THE MIDDLE
ORDOVICIAN KIMMSWICK LIMESTONE OF MISSOURI

BY

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VOLUME 24

A NEW SPECIES OF *POROCRINUS* FROM THE MIDDLE ORDOVICIAN KIMMSWICK LIMESTONE OF MISSOURI

ROBERT V. KESLING

ABSTRACT—*Porocrinus petersenae*, a new crinoid from the Kimmswick Limestone of north-eastern Missouri, has more highly developed ridges on the cup than does any previously described species of the genus. Some ridges between radial and basal plates bifurcate to form double ridges. Other thick and somewhat irregular ridges tend to be present on basals and radials parallel to the usual ridges normal to each side of a plate; hence, a junction of three plates may be surrounded by two triangles, one inside and concentric to the other, in various degrees of delineation. The hydropore is large and strongly elevated; it appears to have multiple openings.

INTRODUCTION

A FINE SPECIMEN of *Porocrinus* presented to our Museum of Paleontology by Mrs. Marguerite B. Petersen, of 335 Mapleawn S.E., Kentwood, Michigan 49508, provided a pleasant surprise. It is a new species, possessing a set of cup ridges more complex and irregular than that in any other known species of the genus. Thus, Mrs. Petersen joins the ranks of talented non-professionals who have added valuable material to our collection and contributed to our knowledge of rare Paleozoic invertebrates.

In the holotype and only specimen, the goniospires are extensively weathered, permitting very little cleaning by Airdent abrasion. Most of the reddish residue of the matrix was removed with a thin dissecting needle.

The specimen is complete in most respects from the proximal 10 mm of the column to the top of the calyx, but the arms are missing, the B of the AB interray is crushed and turned, and the X plate is lost. Some other plates are somewhat distorted. In preparing plate diagrams (text-figs. 3-7), I decided to use actual photographs of individual plates rather than camera lucida drawings; in this way, the actual surface of each plate can be shown instead of a restoration.

In addition to Mrs. Petersen, I must thank Karoly Kutasi, Helen Mysyk, and Gladys Newton, who have given their usual excellent services in photography, typing, and proofreading. The specimen is catalogued and deposited in the Museum of Paleontology as number 60449.

LOCALITY

Middle Ordovician Kimmswick Formation exposed in a roadcut on the east side of US 61, about 1¼ miles north of New London, and 0.4

mile north of Salt River, NE¼ SW¼ sec. 25, T 56 N, R 5 W, Ralls County, northeastern Missouri (text-figs. 1, 2).

Mrs. Petersen, who found the specimen while on a combined vacation and collecting trip, recorded in her field notes:

Fossil was found at the right of a small alluvial fan [of weathered debris] from the limestone cliff, about half or two-thirds way up the cliff. This weathering produces fine red material. At this point the lower part of the cliff is very hard limestone. About half way up, the cliff is a more porous formation with many small cavities eroding out (these are about the size of your finger and larger) . . . Fossil was found in one of the small cavities in area just above hammer, about 4 feet from top [see text-fig. 2].

SYSTEMATIC DESCRIPTION

Family POROCRINIDAE Miller & Gurley
Genus POROCRINUS Billings

POROCRINUS PETERSENÆ n. sp.
Text-figs. 3-8; pls. 1, 2

Calyx.—Obovate. Plates in the number and general shape of those in other species of the genus. IBB forming a nearly cylindrical cirlet, expanding only slightly at the top; each IB wider than high, about one-third of its area devoted to goniospire (pl. 2, fig. 2; text-fig. 3). BB forming subconical cirlet, expanded at the top; each B more than twice as high as IB plates, its subtriangular goniospire areas at the corners sharply incised below level of ornamented central portion.

RA small, quadrangular and nearly square, its diagonals slightly exceeding the height of the IBB. X missing, its dimensions approximated (text-fig. 3) from edges of adjoining plates (pl. 1, fig. 3).

RR large, set on the shoulders of the obo-



TEXT-FIG. 1.—Road cut along US 61 in Ralls County, Missouri. Arrow indicates spot where holotype of *Porocrinus petersenae* was found. From photograph (Kodachrome slide) taken by Mrs. Petersen.



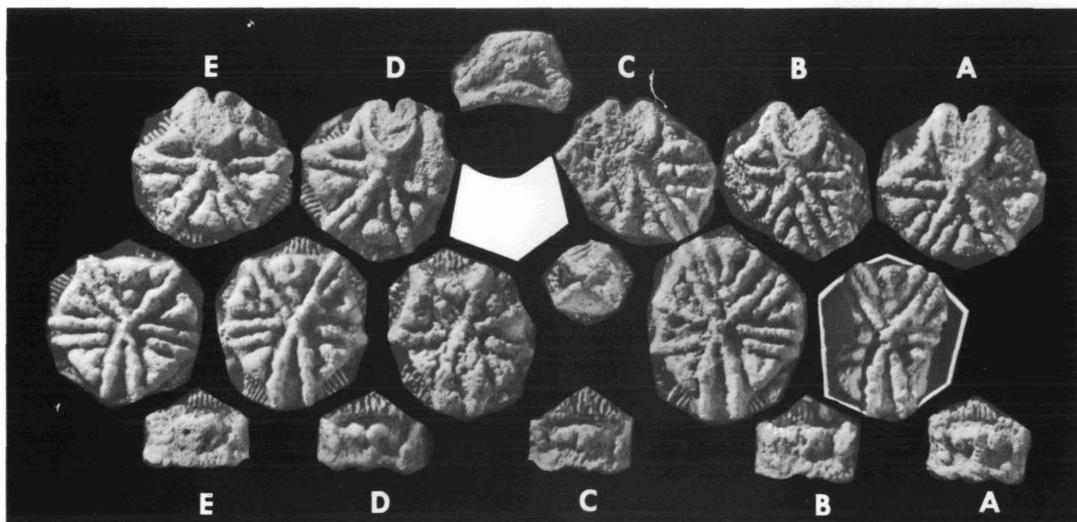
TEXT-FIG. 2.—Close-up of locality where holotype of *Porocrinus petersenae* was found; arrow indicates exact spot. From photograph (Kodachrome slide) taken by Mrs. Petersen.

vate calyx; each R about as large as adjacent BB (pl. 1, figs. 1, 3; pl. 2, figs. 1, 3). Arm facets large, each occupying about one-third the height and one-third the width of the R. Periproct not exceptionally large for the genus, its greatest width about one-fourth that of the calyx.

OO fairly small but thick (text-fig. 4). O of the CD (posterior) interray with a large subcentral protuberance interpreted as the hydrospire, apparently containing several irregular vertical slits as openings (pl. 1, fig. 2; text-fig. 8). Mouth opening ellipsoidal.

Goniospires.—Large and well developed, except those around RA; those at corners of OO not much smaller than those at corners of BB. Goniospires at B-IB-B and B-R-B junctions distinctly subtriangular, those at R-O-R junctions more nearly subcircular, and those at corners of RA subcircular. Areas nearly flat, not pyramidal. Each third of a large goniospire containing about ten troughs (slits), all equally spaced.

Ridges.—All ridges irregular and strongly elevated (text-figs. 3-7). Each IB plate de-



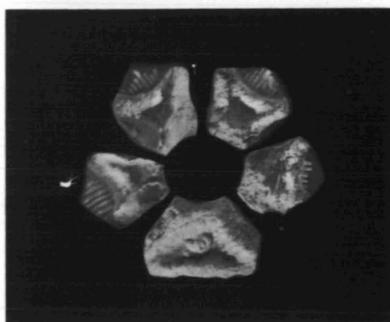
TEXT-FIG. 3.—*Porocrinus petersenae*. Plate diagram of cup, constructed of photographs of individual plates. X reconstructed from dimensions of adjacent plates; similarly, outline of B of AB interray largely restored. Approximately $\times 4$.

pressed alongside its junction with adjacent IBB, with a submarginal ridge at each side continuous with a ridge leading to the center of the adjacent B (pl. 1, figs. 1, 3; pl. 2, figs. 1, 3; text-fig. 3); basal edge of IB thick, with three irregular scallops, not fitted well against fluted sides of column; central area just below goniospire elevated in irregularly confluent knobby processes to form a sort of T or Y (pl. 1, figs. 1, 3; pl. 2, fig. 3; text-fig. 3).

Each B plate with four main ridges radiating from its center: two close-set ridges leading to the submarginal ridges of the adjacent IBB and two strongly divergent ridges leading to the adjacent RR; the latter ridges tending to bifurcate to form two subparallel ridges (pl. 1, fig. 1; pl. 2, fig. 3; text-figs. 3, 5, 6), but some secondary ridges failing to join the primary ridge and others undeveloped. B-B ridges undivided, not quite reaching the centers of adjacent BB (text-fig. 6); B-RA ridges similar (text-fig. 7).

R-R ridges single. R areas next to O forming an irregular subtriangular process next to goniospire, one end of the process continuous with submarginal ridge of the O (pl. 2, fig. 3; text-fig. 5). OO plates with ridges delineating central sublunate depression and lateral troughs along the O-O sutures (ambulacra), being developed around the borders of the mouth and goniospires and forming the sides of the ambulacral troughs.

B-R-B and R-B-R junctions thus surrounded by triangles of ridges (text-figs. 5, 6). Within these triangles, other ridges tend to develop parallel to the primary ridges to form inner and concentric triangles; secondary ridges parallel to the primary B-B ridges most consistently developed (pl. 2, fig. 3); many other secondary ridges incompletely developed and fused with other secondary ridges to form ir-



TEXT-FIG. 4—*Porocrinus petersenae*. Plate diagram of OO plates, constructed of photographs of individual plates. Approximately $\times 4$.

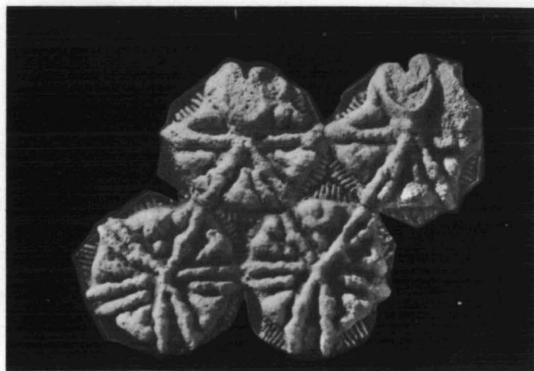
regular subtriangular elevations, largely filling the remainders of the plate sectors adjacent to the goniospires. RA with simple ridges to each side, forming a letter X (pl. 1, fig. 3; pl. 2, fig. 1; text-fig. 7).

Column.—Large, distally flared and nearly confluent with large IBB circlet (pl. 2, fig. 2). Column fluted with longitudinal grooves, with additional grooves intercalated toward the proximal end to maintain the same spacing between grooves in the expanded section (pl. 1, fig. 1; pl. 2, figs. 1, 3). In the preserved part of the column, columnals equally thin, their distal edges slightly flared and scalloped to produce an overall imbricate sculpture.

Remarks on the framework of calyx ridges.—The ridges in *Porocrinus* formed a rigid geodesic girder system. In *P. petersenae*, some of the thick ridges bifurcated and secondary ridges were added alongside certain of the primary ridges to further strengthen the calyx, which was weakened by the large and extremely thin goniospires.



TEXT-FIG. 5—*Porocrinus petersenae*. RR and some adjacent OO and BB, arranged to show size of goniospire areas. A ray at center of diagram. Approximately $\times 4$.



TEXT-FIG. 6—*Porocrinus petersenae*. RR of C and D rays and BB of CD and DE interrays, arranged to show continuity of ridges in this area. Approximately $\times 4$.



TEXT-FIG. 8—*Porocrinus petersenae*. Enlargement of top of holotype, showing hydropore. $\times 16$.



TEXT-FIG. 7—*Porocrinus petersenae*. R of C ray, RA, BB of BC and CD interrays, and IB of C ray, arranged to show continuity of ridges in this area. Approximately $\times 4$.

It is not surprising that X is missing in the holotype of *Porocrinus petersenae*, as it is in the holotype of *P. shawi*, inasmuch as this protuberant region below the large periproct is structurally weak and vulnerable to any compression or distortion of the calyx during fossilization. Kesling & Paul wrote (1968, p. 11):

A degree of irregularity and weakness stems from the presence of X and RA. The X plate, set in the circlet of RR, makes the periproct particularly weak. The area is enclosed by the two arms of the

arch [formed by ridges linking the O of the CD interray to adjacent RR] and by the two X-R ridges; thus, the bounding frame forms a quadrangle, a geometric form lacking in rigidity.

Relation to other species.—At present our knowledge of the Porocrinidae is too sketchy to formulate evolutionary trends. *Porocrinus petersenae* lived at about the same time as *P. conicus* Billings (Hull Limestone, Canada; Galena Dolomite, Wisconsin), *P. elegans* Kesling & Paul (Galena Dolomite, Minnesota), *P. smithi* Grant (Hull Limestone, Canada), and *P. shawi* Schuchert (Trenton Group, Baffinland). It is neither the oldest (*P. pentagonius* Meek & Worthen, Platteville Limestone, Illinois) nor the youngest (*P. scoticus* Ramsbottom, Ashgillian Upper Drummuck Group, Scotland) known species of the genus. Instead, *Porocrinus petersenae* evolved during the Trenton Chron in central North America, the time and place of great proliferation in *Porocrinus*. No lineage is known leading to the thick irregular ridges of *P. petersenae*.

The new species shows some similarities to the contemporary *P. elegans* and to the younger *P. pyramidatus* and *P. scoticus* (table 1). In

EXPLANATION OF PLATE 1
All figures are stereograms, $\times 4$

Porocrinus petersenae n. sp. Holotype, UMMP 60449. 1, view centered on B of DE interray; note large IBB circlet and flared top of column. 2, ventral (oral) view; note central papilla on large O, interpreted as the hydropore. 3, lateral view centered on CD interray; missing plate is X, adjacent to and just below the periproct.

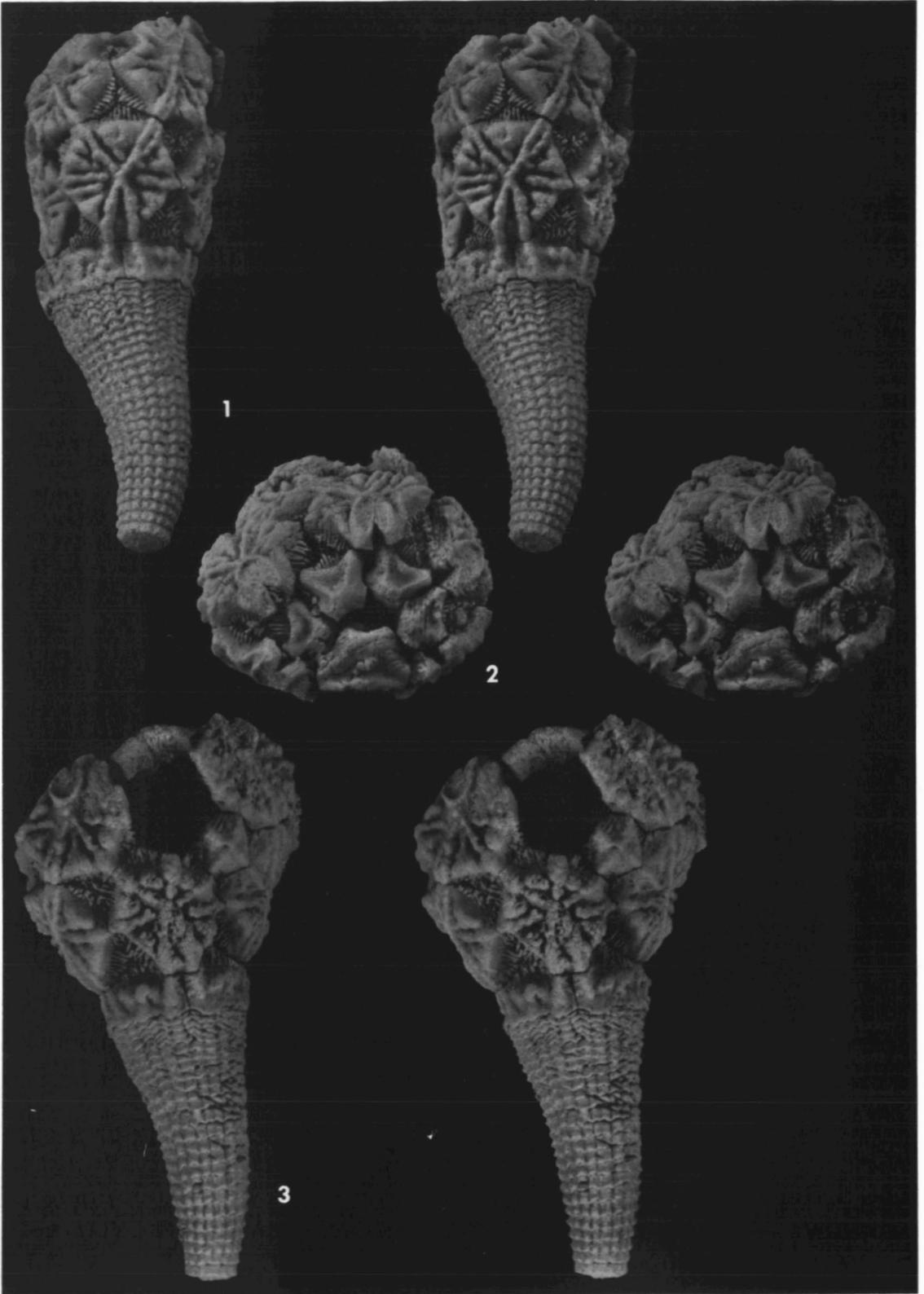


PLATE 1

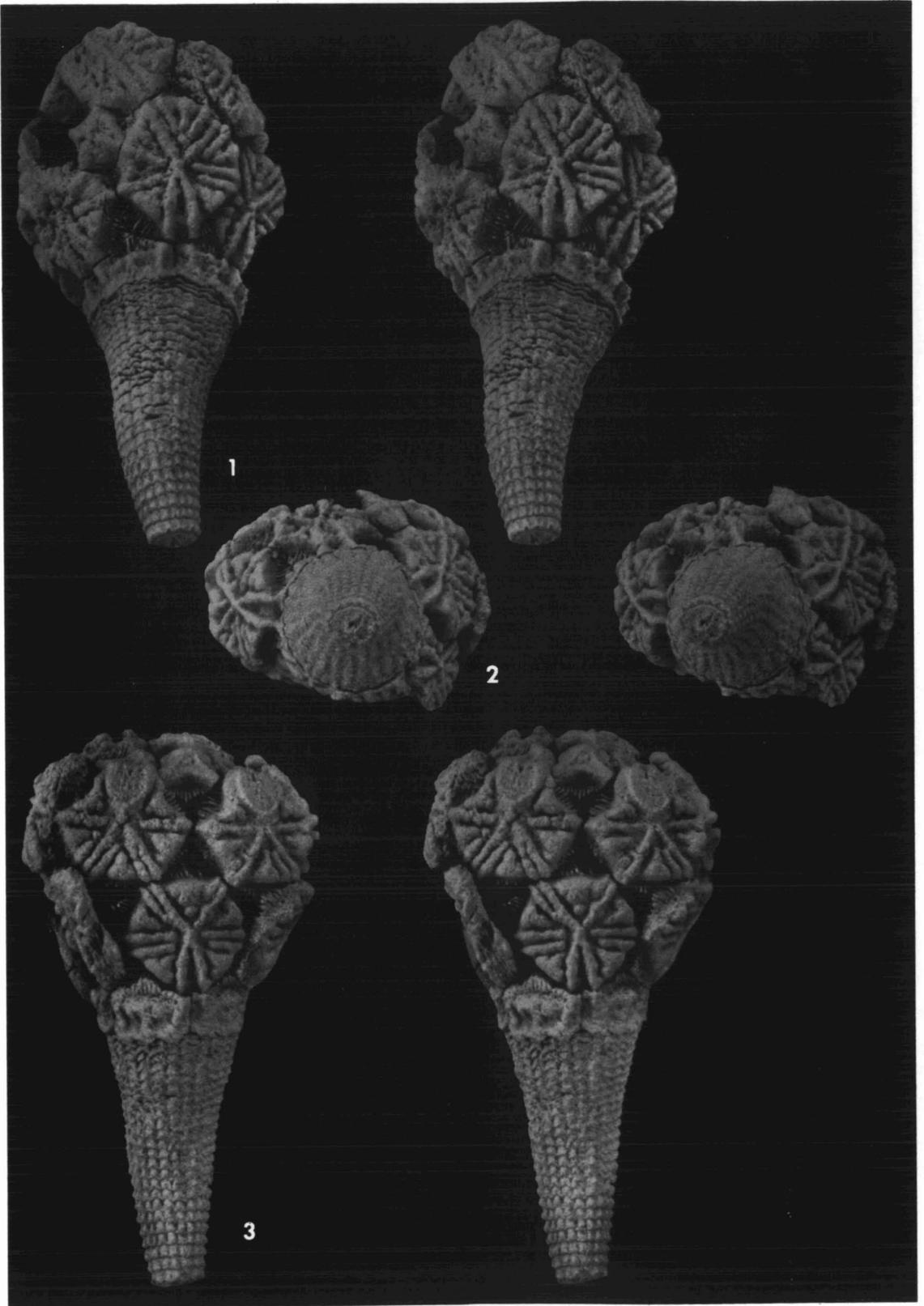


PLATE 2

TABLE 1—COMPARISON OF SELECTED SPECIES OF *Porocrinus*

Character	<i>pyramidatus</i>	<i>elegans</i>	<i>scoticus</i>	<i>petersenae</i>
Age	Richmond, Maquoketa Sh.	Trenton, Galena Dol.	Ashgill, U. Drummuck Gp.	Trenton, Kimmswick Ls.
Locality	Iowa	Minnesota	Scotland	Missouri
Goniospire areas	Subtriangular, protuberant	Subcircular, not protuberant	Subtriangular, not protuberant	Subtriangular, not protuberant
R-R-O goniospire	Large	Small	Rather small	Large
Other goniospires	Large	Medium	Relatively small	Relatively large
IBB	Low	Low	High	Low
Column	Probably little flare	Flared	Very little flare	Strongly flared

the form of its goniospire areas, it is closest to *P. scoticus*, but it can be readily distinguished by its larger goniospires and lower IBB, as well as the strong flare of its column. In the shape and size of its goniospires and in the proportions of its IBB, the new species resembles *P. pyramidatus*, but its goniospires are nearly flat instead of protuberant pyramids. In the flare of the column, low IBB, and obovate calyx, *P. petersenae* is like *P. elegans*, but it differs in the size and shape of its goniospires. From all previous species, *P. petersenae* can be differentiated by its unique calyx ridges.

From our present knowledge of the Porocrinidae, as summarized by Kesling & Paul (1968), it seems that these crinoids were at-

tempting to resolve the structural conflict between rigidity of the calyx and efficiency of the goniospires. In this regard, *Porocrinus petersenae* evidently devoted much of its substance and energy to rigidity; one might be tempted to say that the lavish expenditure of calcium carbonate was unwarranted, for it would appear that higher and thinner ridges would result in larger contact surfaces at the sutures with less weight.

LITERATURE CITED

- KESLING, R. V., & PAUL, C. R. C., 1968, New species of Porocrinidae and brief remarks upon these unusual crinoids: *Contrib. Mus. Paleontology, Univ. of Michigan*, v. 22, no. 1, p. 1-32, 8 pls., 14 text-figs.

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EXPLANATION OF PLATE 2
All figures are stereograms, X 4

Porocrinus petersenae n. sp. Holotype, UMMP 60449. 1, inclined view centered on B of BC interray; missing plate near left side is X; compare ridges on RA against diagram in text-figure 7. 2, dorsal (basal) view, showing flare of the column and its junction with the IBB cirlet; posterior (CD) interray is uppermost in stereogram. 3, lateral view centered on AE interray; note well-developed goniospires at all plate corners in the cup.

