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TWO NEW MIDDLE DEVONIAN SPECIES
OF THE STARFISH *DEVONASTER* FROM
SOUTHWESTERN ONTARIO

BY

ROBERT V. KESLING and JEAN D. WRIGHT



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VOLUME XX

1. Upper Devonian and Lower Mississippian Pectinoid Pelecypods from Michigan, Ohio, Indiana, Iowa, and Missouri, by Thomas W. Hutchinson and Erwin C. Stumm. Pages 1-48, with 7 plates.
2. Two New Middle Devonian Species of the Starfish *Devonaster* from Southwestern Ontario, by Robert V. Kesling and Jean D. Wright. Pages 49-61, with 4 plates.

TWO NEW MIDDLE DEVONIAN SPECIES OF THE STARFISH
DEVONASTER FROM SOUTHWESTERN ONTARIO

BY

ROBERT V. KESLING and JEAN D. WRIGHT

ABSTRACT

Fossil starfish from the Middle Devonian Hamilton Group strata in Ontario are classified as two new species of *Devonaster*. *D. triradiatus* from the Arkona Shale, based on numerous specimens, is characterized by relative small size, supramarginals set nearly above intramarginals, and a triradiate madreporic plate—the last an unusual and unique feature. *D. southworthi* from the Hungry Hollow Formation, based on one incomplete and weathered specimen, is characterized by large size, inframarginals wider than adambulacral, and unusual shape of its second inframarginals.

CONTENTS

Introduction 49
 Localities 50
 Previous references to Devonian starfish of Ontario 50
 Systematic descriptions 51
 Literature cited 57
 Plates (after) 57

INTRODUCTION

ALTHOUGH fossil starfish from Middle Devonian rocks of the Thedford-Arkona region of Ontario have been noted in literature since 1898, they were at first misidentified as *Palaeaster eucharis* Hall and later as *Devonaster eucharis* (Hall). Our recent investigations of specimens from this region leads us to conclude that they represent two new species, one from the Arkona Shale and one from the overlying Hungry Hollow Formation.

We are grateful to Dr. Fred Hall of the Buffalo Museum of Natural Science for arranging the loan of specimens from his museum. Helpful comments were made by Professor Chester A. Arnold and Professor Lewis B. Kellum. Mrs. Helen Mysyk typed the final draft of this paper.

Mr. Karoly Kutasi assisted with photography. All deserve our warm appreciation.

Specimens illustrated and mentioned are deposited in the Buffalo Museum of Natural Science (BMNS) and in the Museum of Paleontology of The University of Michigan (UMMP).

LOCALITIES

All localities are in West Williams Township, Middlesex County, Ontario.

LOCALITY

1. East bank of Ausable River north of the dam at Rock Glen, about $\frac{3}{4}$ mile north and about $\frac{7}{8}$ mile east of the center of the village of Arkona. Arkona Shale.
2. North bank of Ausable River west of the bridge at Hungry Hollow (formerly Bartlett's Mills, Marsh's Mill, or Marshall's Mill), about 2 miles east and about $\frac{1}{4}$ mile north of the center of Arkona. Arkona Shale and Hungry Hollow Formation.
3. South bank of Ausable River about $\frac{3}{4}$ mile east of Hungry Hollow. Arkona Shale.
4. North bank of Ausable River on farm of the late Robert Fraser, about 3 miles east of Arkona and about 1 mile north of the road leading east from Arkona. Arkona Shale.

PREVIOUS REFERENCES TO DEVONIAN STARFISH OF ONTARIO

The first published notice of Devonian starfish in this region was by J. F. Whiteaves (1898, p. 376), who wrote under the heading "PALAEASTER EUCHARIS, HALL":

'At Bartlett's Mills, Mr. Kernahan found and gave me a ray of *Palaeaster eucharis*, Hall. It is from the Lower third of my section.' C. Schuchert, in a letter to the writer, dated July 6, 1897.

Since Schuchert wrote that letter to Whiteaves, geographic, taxonomic, and stratigraphic names have changed considerably. "Bartlett's Mills" is now known locally as Hungry Hollow, the mills having long since disappeared. It is a gorge cut by the Ausable River about two miles northeast of Arkona, Ontario, which provides the best exposure of the fossiliferous rocks in the vicinity (Stumm and Wright, 1958, pp. 84-85). *Palaeaster eucharis* Hall was subsequently made the type species of *Devonaster* by Schuchert (1915, pp. 98-101). The "Lower third" of Schuchert's section is the Arkona Shale (Cooper and others, 1942, p. 1745; see also Stumm and Wright, 1958, Table I). It is perhaps of interest to add that Mr. Kernahan was a storekeeper in Thedford, an amateur collector who acted on occasion as guide to visiting geologists.

Hervey W. Shimer and Amadeus W. Grabau (1902, p. 184) said of this starfish that it was "recorded by Schuchert (Whiteaves' list)" from the "Lower shales, bed 1" in the "Thedford Region."

Clinton R. Stauffer (1915, p. 158) listed *Palaeaster eucharis* Hall as occurring in the "Olentangy shale," which is now the Arkona Shale (Stumm and Wright, 1958, Table I), at "Marsh's Mill," a later name for Bartlett's Mills, now Hungry Hollow.

In his revision, Schuchert (1915, p. 101) stated of *Devonaster eucharis* (Hall):

Two separated rays of apparently this species were found by the writer in the lower third of the Hamilton near Bartlett's Mills, south of Thedford, Ontario. Two other fragments from the same locality are in the University of Toronto (Walker collection, No. 1610H)

H. W. Shimer and Robert R. Shrock (1944, p. 211) gave the following data, "D. eucharis (Hall) . . . Hamilton: Ont.; N.Y."

SYSTEMATIC DESCRIPTIONS

Class ASTEROIDEA

Order PHANEROZONIDA

Family Promopalaeasteridae Schuchert, 1915

Subfamily Mesopalaeasterinae Schuchert, 1915

Genus *Devonaster* Schuchert, 1915

Type species.—By designation of Schuchert, 1915, p. 98, *Palaeaster eucharis* Hall, 1868, p. 287, Pl. 9, Figs. 3-3a, ?4.

Devonaster triradiatus, sp. nov.

(Figs. 1-2; Pl. I, Figs. 1-4; Pl. II, Figs. 1-3; Pl. III, Figs. 1-9; Pl. IV, Figs. 1-8)

Description.—Stellate, relatively small. Disk large. Rays tapering gradually in proximal half, then more strongly; their sides, therefore, convex. Each ray terminated by *O* (ocular or terminal plate), distinctly larger than adjacent *R* (radial).

Aboral side of disk (Fig. 1*a-b*) confluent with rays, consisting of central group of *d*'s (disk plates), surrounded by an irregular circlet of 5 *R*₁'s (first radials) alternating with 5 *Sm*₁'s (first supramarginals), and bordered by 5 *R*₂'s and 10 *Sm*₂'s; each ambitus bearing a small, subcircular *amb* (ambital plate). *Sm*₁'s noticeably smaller than *R*₁'s; both types smaller than adjacent plates in their respective ranges, subcircular to subelliptical. *R*₂'s subquadrate in immature specimens, elliptical in adults. *Sm*₂'s large, subtriangular, the longest side of each adjacent to the corresponding plate of the adjoining ray (Fig. 1*a*). *M* (madrepore plate) triradiate, set below *Sm*₁ and between two *Sm*₂'s, modifying the bordering plates little if any;

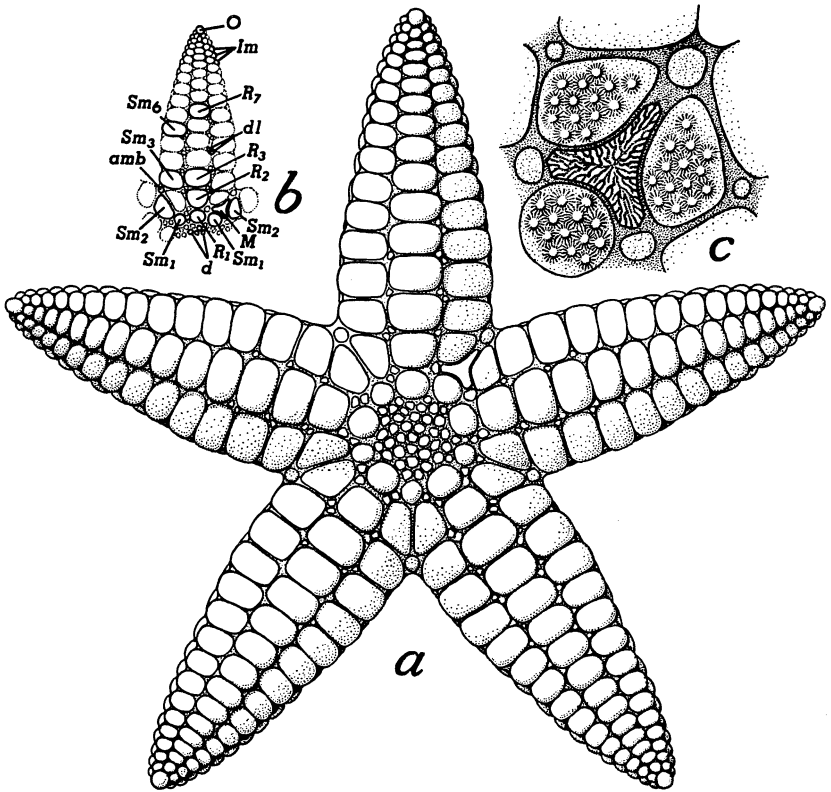


FIG. 1. *Devonaster triradiatus*, sp. nov. *a*. Aboral view of immature specimen. *b*. Labeled diagram of selected plates, including madreporite. Plate abbreviations as follows: *amb*—ambital plate, disk ambital; *d*—disk plates; *dl*—dorsolateral plates, radial accessories; *Im*—inframarginal; *M*—madreporite plate, madreporite; *O*—ocular, terminal plate; *R*—radial; *R₁*—first radial, proximal radial; *Sm*—supramarginal; *Sm₁*—first supramarginal, proximal supramarginal. *c*. Enlargement of madreporite area, with ornamentation indicated on *Sm₁* and *Sm₂*'s.

lower apex of *M* acuminate, each of the lateral apices somewhat truncate and modified by a small *dl* (dorsolateral) plate inserted in the *R₁*–*Sm₁*–*R₂*–*Sm₂* interstice (Fig. 1c); surface of *M* slightly convex, marked by irregular, anastomosing, partly dendritic, partly radiating grooves, more pronounced on weathered plates. Immature specimens with a few inconspicuous little *dl* plates between *R* and *Sm* ranges; adult specimens with numerous *dl* plates inserted between large plates of the disk, continuous with the central *d* plates, separating not only the ranges of plates but also

R_1 and Sm_1 from their respective ranges, and thereby disrupting the plate arrangement to a considerable degree.

Oral side of disk (Fig. 2*a-b*) with a rather flat surface, composed of 5 Im_1 's (first inframarginals), 10 Im_2 's (second inframarginals), 4 or 5 proximal Ad 's (adambulacrals) in each half-ray, and about 4 proximal Am 's (ambulacrals) in each half-ray, hence about 95 to 105 plates in all within the boundaries of the disk; no accessory plates on oral side. Each Im_1 subcircular, set well within the disk in interradial position, bordered by about 6 Ad 's and 2 Im_2 's. Each Im_2 large, kite-shaped, with short sides facing Im_1 and Ad 's, a long concave side facing Im_3 , and a long straight

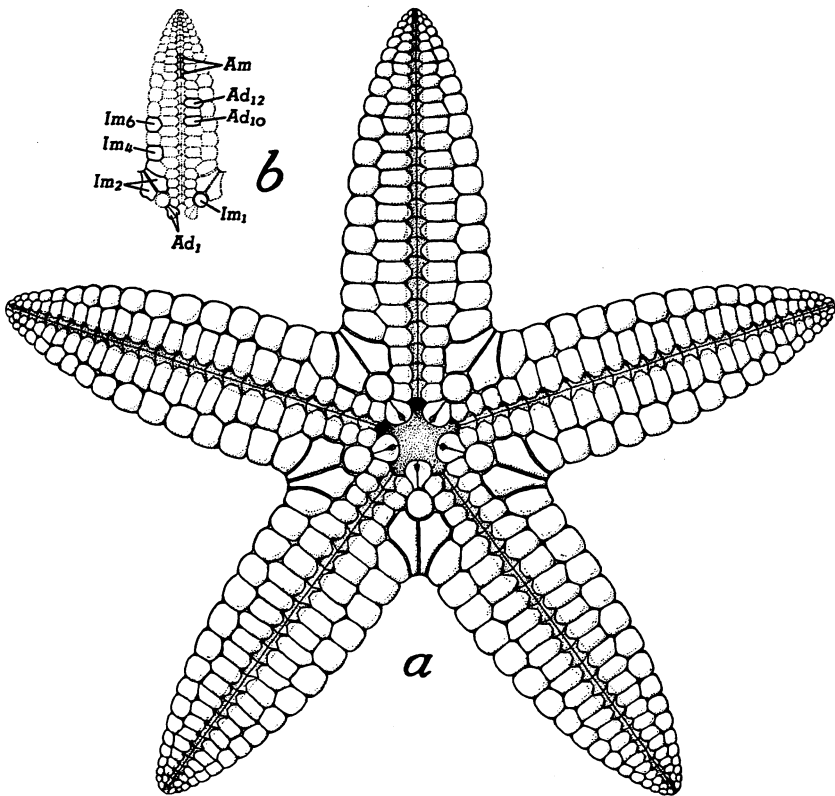


FIG. 2. *Devonaster triradiatus*, sp. nov. a. Aboral view of immature specimen. b. labeled diagram of selected plates. Plate abbreviations as follows: Ad —adambulacral; Ad_1 —first adambulacral, oral armature; Am —ambulacral; Im —inframarginal; Im_1 —first inframarginal, axillary interbranchial; Im_2 —second inframarginal, “proximal inframarginal” of Schuchert (1915, p. 97).

side facing the Im_2 of the adjoining ray (Fig. 2a), its acuminate distal end attaining border of disk. Ad_1 's forming oral armature; each plate subsphenoid, its proximal end high and extending upward into mouth cavity, its distal end acuminate toward Im_1 . Ad_2 's to Ad_5 's rather small, displaced inward around Im_1 and Im_2 's, subsquare (variously modified), tapering and truncate toward center of ray. Am 's like those in ray. Ambulacral groove narrow, about the same width as in the ray.

Aboral side of each ray with a median range of R 's and lateral ranges of Sm 's, continuous with ranges on disk. Each ray and adjacent sector of the disk containing about 15 R 's in small specimens and about 20 R 's in large specimens. In immature specimens, proximal R 's of the ray subquadrate, middle R 's elliptical, and terminal R 's subcircular, with intermediate gradations; in adults, proximal R 's also elliptical and middle R 's narrower. Sm 's about same size as adjacent R 's, slightly narrower. In young specimens, ranges in contact; with increasing age and size, dl plates inserted progressively out along ray to infiltrate and separate R from Sm ranges, but never extending into distal quarter of ray.

Oral side of each ray (Fig. 2a) bordered by Im 's, subsquare but variously modified to fit closely against adjacent Ad 's, about as numerous as overlying Sm 's. Ad 's wider, shorter, and more numerous than Im 's, occurring in a ratio from 3/2 to 7/5. Each Ad subquadrate, its sides parallel but its inner end tapered and truncate and its outer end modified to fit closely against adjacent Im or Im 's. Am 's normally somewhat obscured in ambulacral groove, but more fully exposed in distorted specimen (Pl. II, Fig. 1), about as numerous as Ad 's and presumably wider.

Ornamentation distinctive. Central parts of R 's, Sm 's, Im 's, and Ad 's ornamented with coarse tubercles; each tubercle subcircular, centrally bare, buttressed by numerous fine radiating descending ridges; some ridges extending to nearby tubercles, others discontinuous; grooves between ridges minutely rugose (Fig. 2c). Marginal areas of these plates

TABLE I

MEASUREMENTS			
Spec. No.	Pl.	Figs.	Max. diam. arm (mm.)
UMMP 30518a	I	1-2	4.5
UMMP 25580	II	3	5.0
UMMP 30518b	I	1, 3	7.4
BMNS E14550a	III	7	9.0
UMMP 51299	IV	3-4	9.0
UMMP 26489	III	1-2	12.5
BMNS E8243	IV	5-6	19.0

bearing a fine meshwork of low fila, as seen under high magnification. Ad_1 's, Im_1 's, and Im_2 's with a few pustules, radially elongate and apparently directed orad. Row of small circular pustules along inner margin of Ad 's. Accessory plates (d 's, dl 's, and amb 's) smooth.

Spines incomplete, rarely preserved, a few associated with oral surface. Each spine with large base, tapering sharply near base, then gradually; length uncertain; longitudinally striate.

Remarks.—Hall (1868, p. 287) described his *Palaeaster eucharis* as "rather large" and "robust . . . the largest individual being one inch and seven-eighths from the center of the body to the extremities of the rays." *Devonaster triradiatus* is consistently smaller.

In the same paragraph, Hall stated:

All the marginal plates [Sm 's and Im 's] are visible from the upper side, and usually appear as an additional range of plates on each margin of the ray, making five with the three properly belonging to the upper surface.

His illustrations (1868, Pl. 9, Figs. 3–3a) show this arrangement clearly. In aboral view of *Devonaster triradiatus*, on the other hand, Im 's are practically concealed by the Sm 's in mature specimens; they are visible in the distal parts of the arms in immature specimens, where they extend only slightly beyond the Sm ranges.

M is remarkably different in the two species. Hall based his species on specimens having an oval M . Ruedemann (1916, pp. 33–36, Pls. 8–9) described specimens found later at Saugerties, N. Y., as "*Devonaster eucharis*"; one of these was examined by the senior author, who found that its M is nearly triangular. Our *D. triradiatus* has a triradiate M , by reason of which we name the species.

The ultimate shape of the M plate is apparently determined very early in the ontogeny. In *Devonaster eucharis*, the growing M expanded at the expense of bordering Sm 's, which developed deep concavities to accommodate the subcircular M ; in *D. triradiatus*, by contrast, the Sm 's maintained their shape with growth, limiting M to the interstice amid the three of them and forcing it to assume the distinctive triradiate form; in "*D. eucharis*" from Saugerties, the pattern seems to have been intermediate, with Sm 's and M all yielding some during ontogeny and by compromise producing a triangular M . In young specimens of *D. triradiatus* (Pl. I, Fig. 4), M is nearly triangular and, as the starfish increases in size, seems to become more attenuated.

Occurrence.—Arkona Shale, Middle Devonian Hamilton Group. Localities 1 to 4.

Most specimens are found embedded in limestone lenses of the formation, which lie approximately 25 feet below the Hungry Hollow Formation, incomplete specimens of this starfish have been discovered weathered out, evidently from soft shaly strata at about the same position.

Devonaster southworthi, sp. nov.

(Pl. II, Fig. 4)

Description.—Known from incomplete specimen, part of oral surface exposed on weathered slab, the only starfish found in the Hungry Hollow Formation.

Stellate, large. Im_2 large, its proximal end greatly expanded, kite-shaped, its distal end thin and tapered, spindle-like; definite bend near middle of plate, the proximal end sloping in toward the mouth cavity. Im range wider than adjacent Ad range. Each Im subquadrate, thick at distal border. Each Ad subquadrate with sculptured oral surface, sloping outward from ray to elliptical crest around elongate depression.

Plates considerably weathered, but apparently originally ornamented with tubercles.

Remarks.—Although incompletely preserved, the holotype can be differentiated from other species of *Devonaster*. Its Im_2 , with median angulation and thin tapered shank, can scarcely be confused with the flatter and more robust Im_2 of *D. eucharis* or *D. triradiatus*. In addition, *D. southworthi* has Ad ranges narrower than Im ranges, the reverse of the situation in *D. eucharis* and *D. triradiatus*.

Inasmuch as only one specimen has been discovered in years of intensive collecting in the Thedford-Arkona region, we reluctantly concede that it is likely the only specimen to be found in our time and, therefore, describe and name it.

The species is named in honor of Mr. Charles Southworth of Thedford, Ontario, because he not only found the holotype but has contributed to paleontology through many decades of careful and ardent collecting in the region.

Occurrence.—Hungry Hollow Formation (in older works called the Coral Zone), Middle Devonian Hamilton Group. Locality 2. Mr. Charles Southworth told the junior author (September 17, 1964) that in the seventy-odd years he has collected in the region, he has never heard of another starfish found in the Hungry Hollow Formation.

Type.—Holotype, BSNS E14549.

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EXPLANATION OF PLATE I

	PAGE
<i>Devonaster triradiatus</i> , sp. nov.	51
FIG. 1. Surface of limestone block, a lens in the Arkona Shale, showing aboral views of small complete specimen, UMMP 30518 <i>a</i> , and larger incomplete specimen, UMMP 30518 <i>b</i> . Locality 1. $\times 1$.	
FIG. 2. Aboral view of paratype UMMP 30518 <i>a</i> . $\times 4$.	
FIG. 3. Aboral view of paratype UMMP 30518 <i>b</i> . $\times 4$.	
FIG. 4. View of madreporic plate (<i>M</i>) of UMMP 30518 <i>a</i> . $\times 20$.	

PLATE I

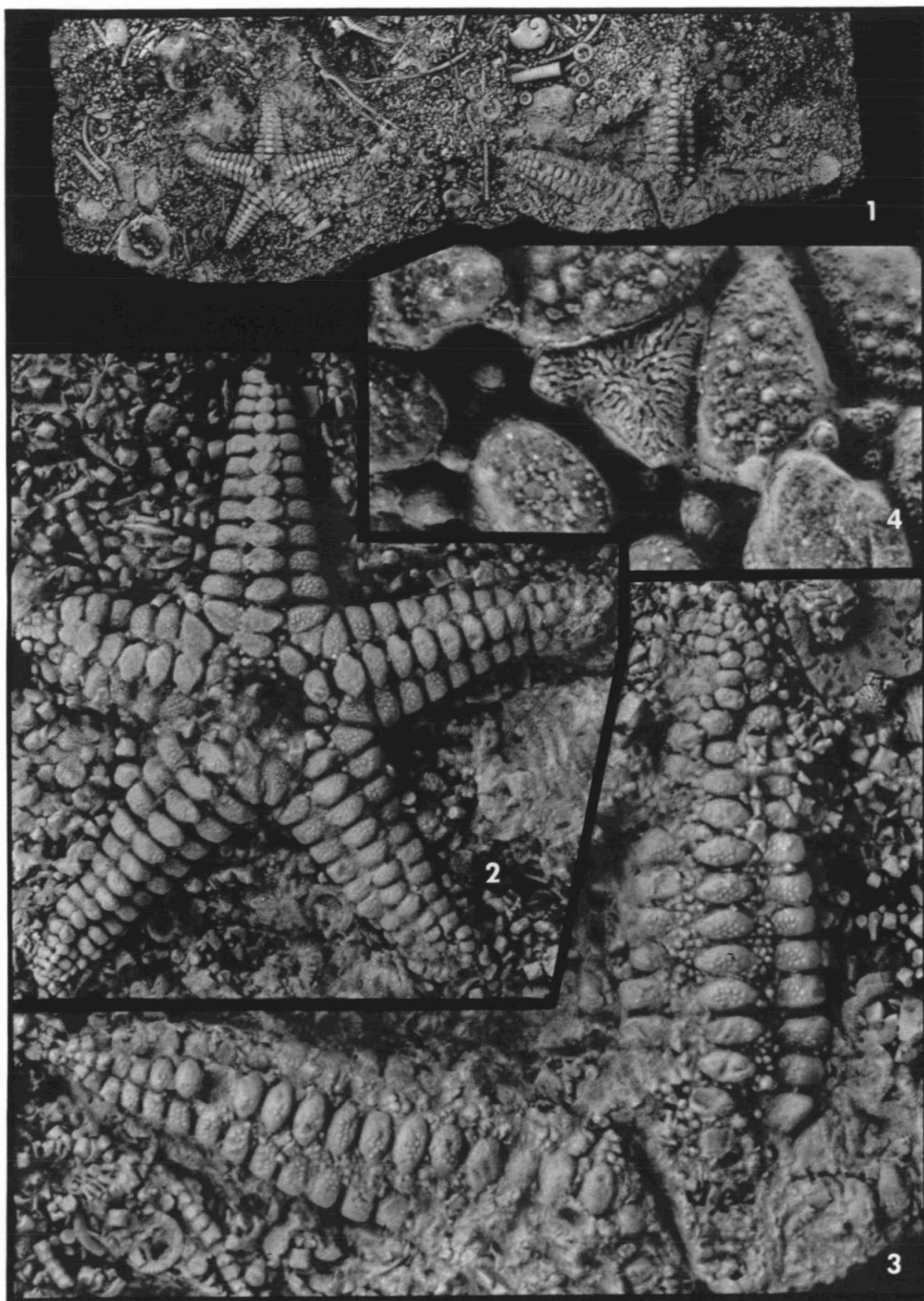
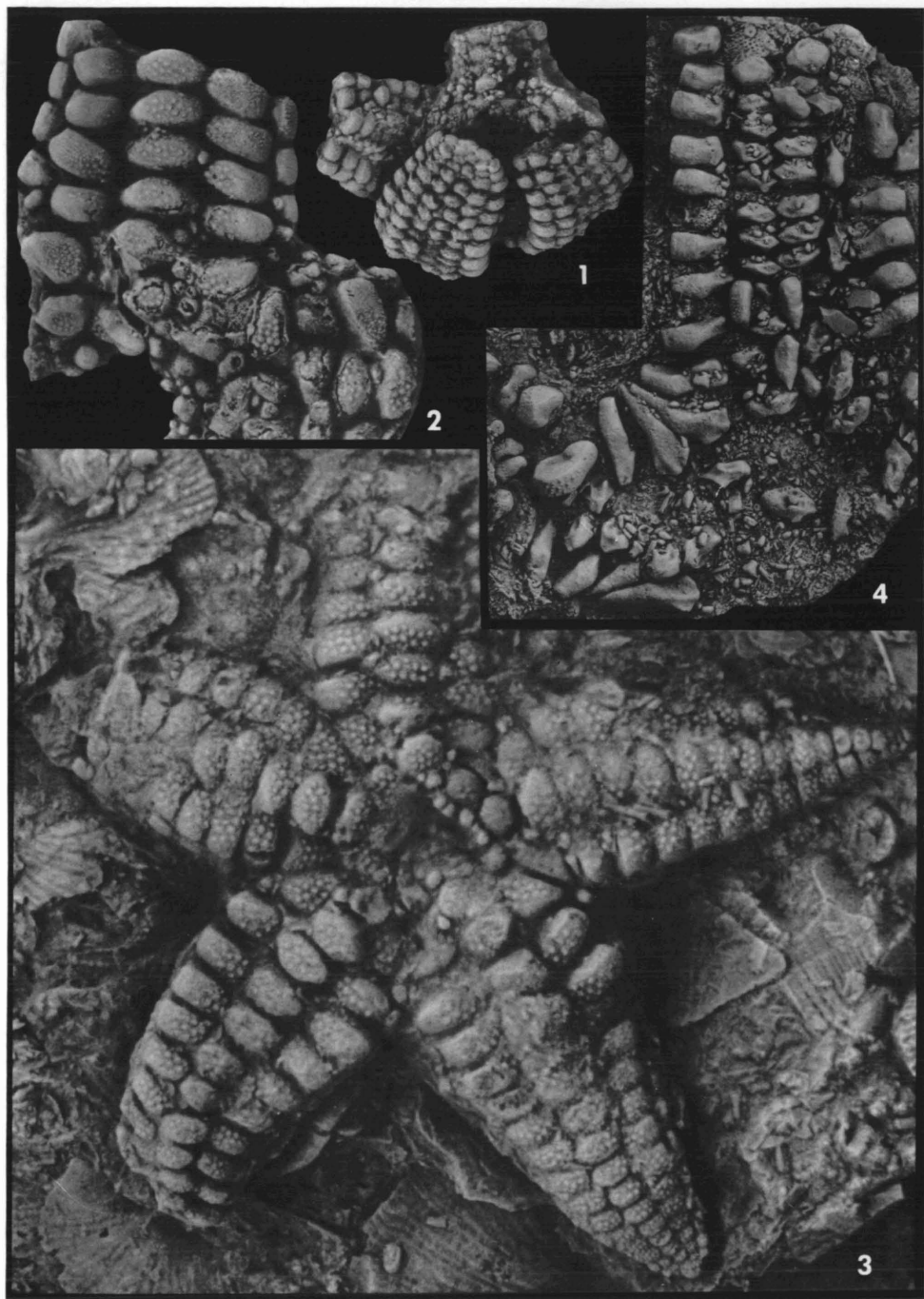


PLATE II



EXPLANATION OF PLATE II

	PAGE
<i>Devonaster triradiatus</i> , sp. nov.	51
FIG. 1. Aboral view of BMNS E14551a, showing two rays compressed and distorted so that six ranges of plates are visible on the oral surface, two each of inframarginals, adambulacrals, and ambulacrals. Locality 1. $\times 1$.	
FIG. 2. Aboral view of paratype UMMP 50563, showing surface of part of one ray with inframarginals visible on both margins. Locality 2. $\times 4$.	
FIG. 3. Aboral view of paratype UMMP 25580, showing madreporic plate (<i>M</i>), in angle formed by central and upper right arms. $\times 6$.	
<i>Devonaster southworthi</i> , sp. nov.	56
FIG. 4. Oral view of holotype BMNS E14549. Locality 2. $\times 2$.	

EXPLANATION OF PLATE III

(Figures $\times 10$, except as noted)

	PAGE
<i>Devonaster triradiatus</i> , sp. nov.	51
<p>FIGS. 1-6. Holotype UMMP 26489, Locality 1. Fig. 1, aboral view showing disk plates and numerous dorsolaterals, $\times 2$. Fig. 2, oral view, $\times 2$. Figs. 3-6, views of madre pore plate (<i>M</i>), first inframarginal (<i>Im</i>₁), adambulacrals (<i>Ad</i>'s), and wedge-shaped second inframarginal (<i>Im</i>₂).</p>	
<p>FIGS. 7-9. Paratype BMNS E14550α, Locality 1. Fig. 7, aboral view, showing inframarginals, disk plates, and madre pore plate, $\times 2$. Fig. 8, view of madre pore plate (<i>M</i>), showing its triradiate outline, trilobate ends, and striate surface. Fig. 9, aboral view of portion of ray, showing radials, supramarginals, and infra-marginals at the margins, and dorsolaterals.</p>	

PLATE III

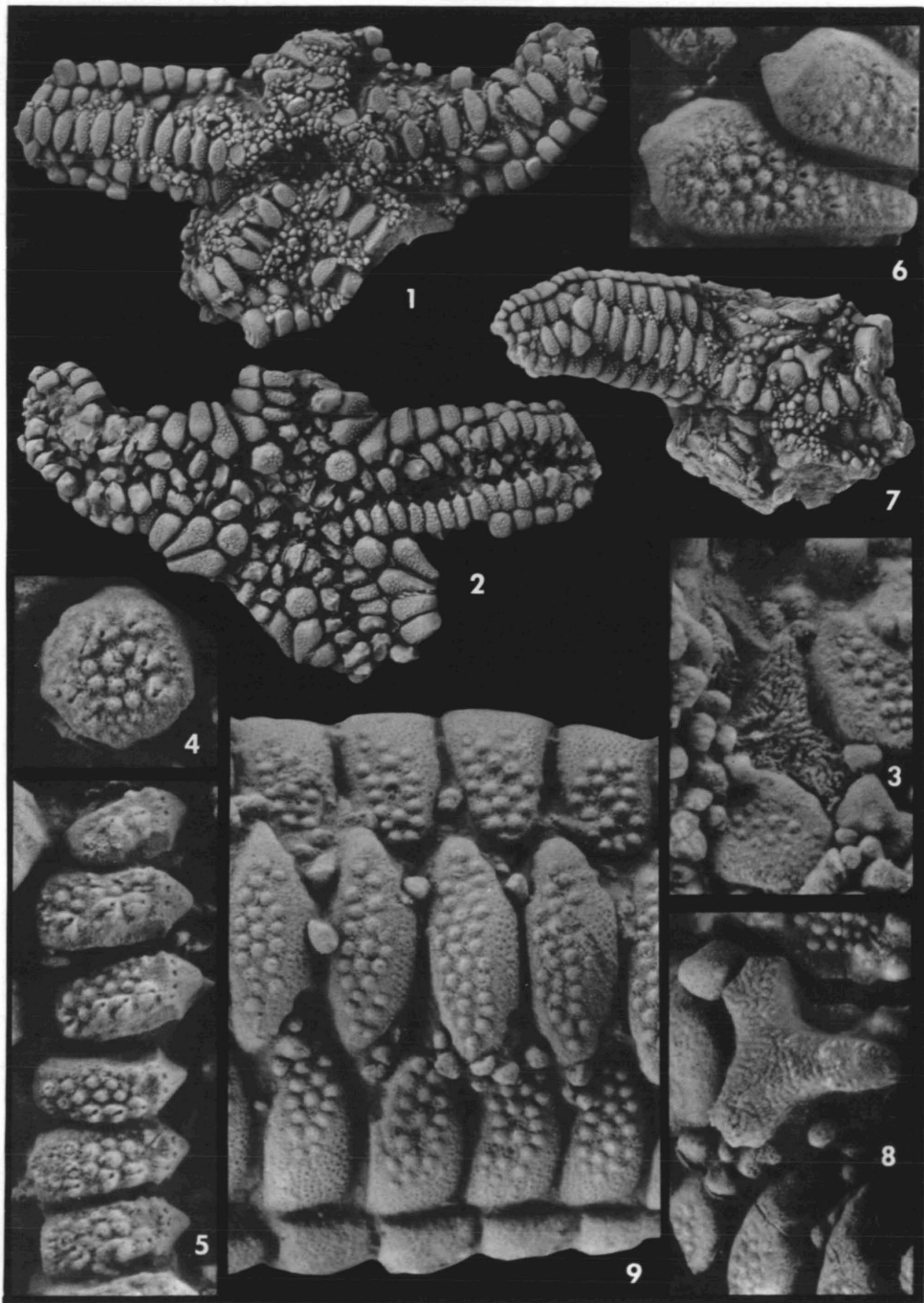
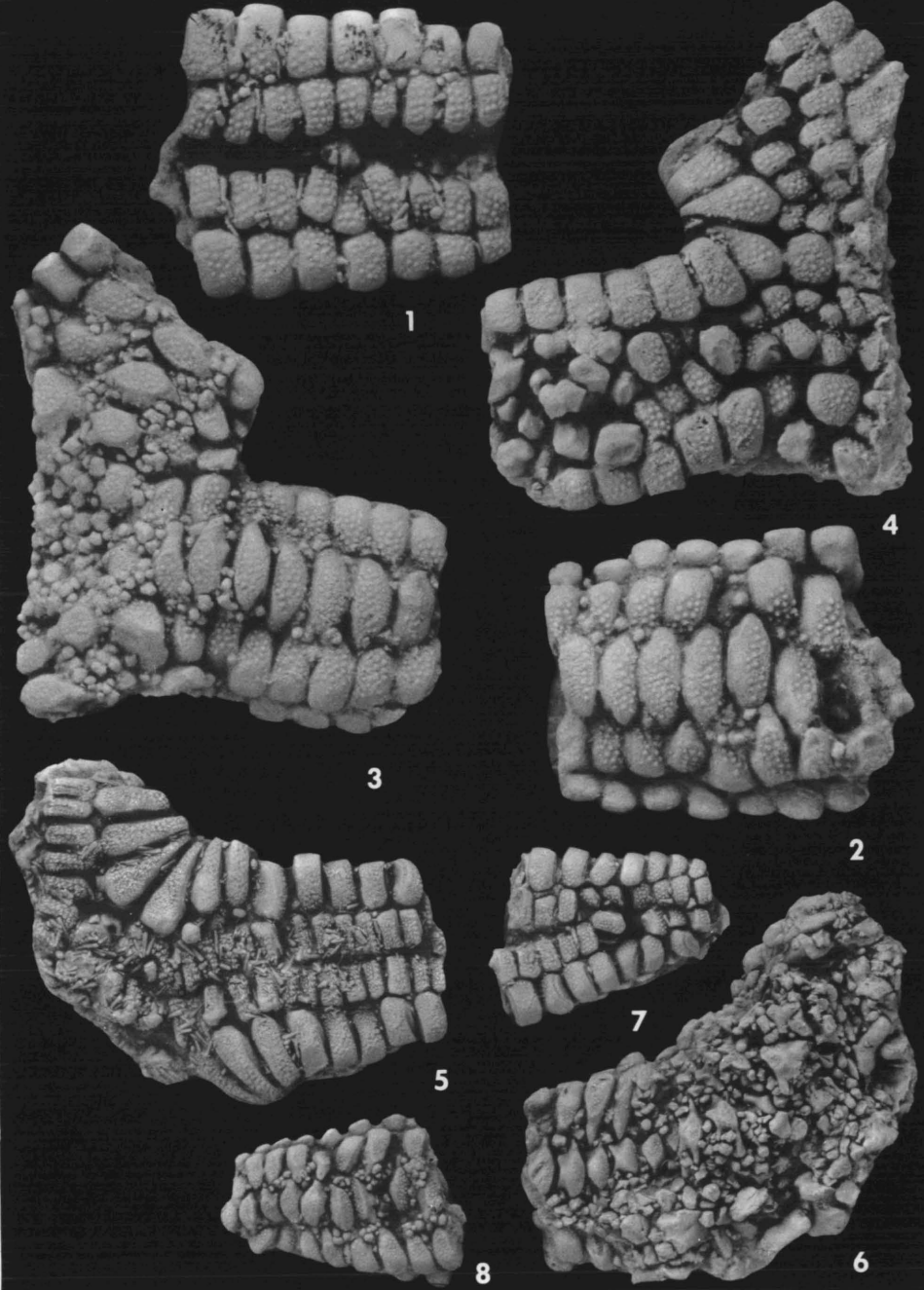


PLATE IV



EXPLANATION OF PLATE IV

PAGE

- Devonaster triradiatus*, sp. nov. 51
- FIGS. 1-2. Oral and aboral views of part of arm, paratype UMMP 51301. Locality 3. \times 4.
- FIGS. 3-4. Aboral and oral views of part of disk and adjoining sections of arms, paratype UMMP 51299. Locality 4. \times 4.
- FIGS. 5-6. Oral and aboral views of part of large disk, paratype BMNS E8243. Several spines attached to oral surface. Locality 2. \times 2.
- FIGS. 7-8. Oral and aboral views of part of arm, paratype UMMP 51300. Locality 3. \times 2.

