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DREPANASTER WRIGHTI, A NEW SPECIES OF BRITTLE-STAR FROM
THE MIDDLE DEVONIAN ARKONA SHALE OF ONTARIO

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DREPANASTER WRIGHTI, A NEW SPECIES OF BRITTLE-STAR FROM THE MIDDLE DEVONIAN ARKONA SHALE OF ONTARIO

ROBERT V. KESLING

ABSTRACT—A new species of brittle-star from the Arkona Shale of Ontario is assigned to *Drepanaster* of the oegophiuridan family Protasteridae. It is characterized by a small disk bearing only a few spines and by well-developed adambulacral plates bearing oral (groove) spines set in a deep cleft and long, subconical distal (vertical) spines.

INTRODUCTION

ON THE LAST DAY OF JULY IN 1945, the late Edward Pulteney Wright found a little brittle-star in the Arkona Shale. Mrs. Wright supplied details of the discovery from her field notes.

The Wrights' vacation at their summer cottage had come to an end that year and their fossil-hunting gear was packed away. On their way home to Grosse Pointe Farms, Michigan, they stopped for a final goodbye at the home of the late Charles and Annie Southworth in Thedford. Charlie said that the day before he had noticed slumped strata containing crinoid remains at Hungry Hollow a short distance downstream from the bridge [the old iron bridge, recently replaced by a concrete bridge upstream]. As the last field outing of their vacation, the Wrights decided to examine this exposure. Their collecting equipment being back at the cottage, they shopped for digging tools in Thedford and purchased the only suitable implement available—an axe.

At the slump site, Mr. Wright began digging out chunks of the shale, soft from recent rains, which soon yielded nicely preserved crinoids and pelecypods: 12 *Arthroacantha carpenteri* (Hinde) (one with attached arms), 1 pathologic specimen of *Corocrinus ? calypso* (Hall), 2 *Actinopteria boydi* (Conrad), and numerous *Leiopteria*. Then, upon splitting a slab of the shale, he was astonished to see a little brittle-star. Part of it lay on the lower piece of the slab and part lay on the upper. Carefully replacing the two pieces together, he packed the unusual find to take it home. It was the first brittle-star ever known from the Arkona Shale.

Unfortunately, in his anxiety to see the rare fossil, a friend accidentally dropped it. Some small fragments were irretrievably lost. Mr. and Mrs. Wright presented the brittle-star to

our Museum of Paleontology in the middle 1950's. There it was cleaned, partly restored, and put aside for study at another time.

Recently, in examining the numerous brittle-stars found by Dr. G. Denis Thorn at a nearby site in 1968, I compared them with the specimens discovered by my late friend "Put" Wright. They are separate species. Although belonging to the same family, they differ in so many characters that they cannot be assigned to the same genus. Hence, after a delay of many years, I have decided to publish my observations. There is no reason to expect additional discoveries.

Mr. Karoly Kutasi assisted in photographic work, Mrs. Gladys Newton typed the final draft and helped read proof, and Professors C. A. Arnold and E. C. Stumm offered helpful suggestions. They have my sincere thanks for their kind assistance.

LOCALITY

Middle Devonian Arkona Shale, about 27 feet below the top of the formation; soft, uniform, finely laminated shale exposed about 3 feet above water level in July, 1945, on the north bank of the Ausable River, about 100 yards downstream (west) of the old iron bridge (shown in the Parkhill 40P/4 West Half Sheet, Canada, Army Survey Establishment, 3d ed., 1956), about 1¼ miles east-northeast of Arkona, in Williams Township, Middlesex County, Ontario, Canada.

SYSTEMATIC DESCRIPTION

Subclass OPHIUROIDEA Gray 1840

Most of arm cavity filled with ossicles of axial skeleton (Ambb). Admm developed as side shields.

Order OEGOPHIURIDA Matsumoto 1915

Cups for tube-feet shared by Ambb and Admm. No dorsal or ventral arm plates. Mouth frame composed of a single pair of radial components per ray. Ambb ossicles separate, not fused into vertebrae. M not strongly calcified, lateral to oral in position. No oral or radial shields.

Suborder LYSOPHIURINA Gregory 1896

Ambb of left and right sides alternating except very near mouth.

Family PROTASTERIDAE S. A. Miller 1899

Admm forming side shields on arms. No strong marginal frame in disk. Oral edges of Ambb with narrow adradial ridges, typically "boot-shaped." Admm with distal (vertical) spines, many also with oral (groove) spines.

According to the *Treatise* (Spencer & Wright, 1966, p. 87), the family includes *Protaster* Forbes 1849 (= *Eugasterella* Schuchert 1914), *Aulactis* Spencer 1930, *Bohemura* Jaekel 1903, *Drepanaster* Whidborne 1898, *Mastigophiura* Lehmann 1957, *Palaeophiura* Stürtz 1890, and *Taeniaster* Billings 1858 (= *Alepidaster* Meek 1872, *Protasterina* Ulrich 1878, *Bundenbachia* Stürtz 1886, and *Palaeophiomyxa* Stürtz 1890).

Genera within the Protasteridae are not clearly defined. Some of the descriptions are at variance. For example, in his continued monograph Spencer wrote in 1934 (p. 484) that *Taeniaster* has "cups for tube-feet large." Six years and 17 pages later (1940, p. 501), however, he stated that "*Bundenbachia* has narrow cups for the tube-feet, which suggests relationship with the *Taeniaster-Drepanaster* group rather than with *Bohemura*."

Many of the type species are in need of re-examination. Stürtz' interpretation of *Palaeophiura simplex* (1890, pl. 31, fig. 39) shows Ambb alternating with Admm on the same side of the arm. Such an arrangement has no evolutionary history among brittle-stars; it is highly dubious, as must also be his interpretation of spines from the abradial centers of the Admm side shields.

In 1934 (p. 450), Spencer offered a key to four genera of the family. *Protaster* was separated from the other genera by its blunt oral edges of Admm, without prominent oral spines; of the remainder, *Bohemura* was distinguished by its wide ambulacral groove. *Taeniaster* and *Drepanaster*, both with sharp oral edges of Admm, prominent oral spines, and relatively narrow ambulacral grooves, were differentiated

by the stout Ambb "boots" in the latter. Spencer also said (1934, p. 493) that the Admm spines in *Drepanaster* are much longer and more pointed than is "customary in *Taeniaster*."

In 1966 (p. 87), Spencer & Wright referred to a different set of criteria. *Aulactis* differs from the other genera by a wide shallow median groove on the aboral side of its Ambb; and *Palaeophiura* differs from the others by a spinelike ridge projecting outward from each Adm. The remaining genera are divided into two groups: *Protaster* (including *Eugasterella*) and *Bohemura* have weakly developed depressions for attachment of dorsal arm muscles on the aboral side of the Ambb, whereas *Drepanaster*, *Mastigophiura*, and *Taeniaster* (including *Alepidaster*, *Protasterina*, *Bundenbachia*, and *Palaeophiomyxa*) have deep, strongly developed depressions. *Protaster* has the "nose" of each Adm near the oral edge, whereas *Bohemura* has the "nose" distant from the oral edge. *Drepanaster* has very long and narrow arms, which separates it from *Mastigophiura* and *Taeniaster* with "arms not conspicuously narrow" (Spencer & Wright, 1966, p. 87). *Mastigophiura* differs from *Taeniaster* only in the large disk spines; Spencer & Wright (1966) suggest that it may be only a specific difference.

In classification of new brittle-stars, there are no hard-and-fast guidelines for distinguishing arms which are long and narrow from those which are "not conspicuously" narrow. The depth of the aboral depressions between Ambb cannot be determined in well-preserved specimens because of the covering of integument studded with tiny calcareous bodies (forming the papillae and spine bases). Hence, the characters are not exposed in some specimens and are subject to interpretation in others.

Genus DREPANASTER Whidborne 1898

Diagnosis.—Long, slender arms with rather narrow ambulacral groove and narrow cups for tube-feet. "Boots" of Ambb slender in median and distal sections of arm. Admm with sharp oral edge, their distal spines longer than succeeding Adm plate; "noses" short and rounded. Proximal and median Ambb with deep aboral depressions for attachment of interambulacral muscles.

Remarks.—The Arkona specimen agrees with this diagnosis except for the last character, which cannot be seen because of the integumental covering. In addition, the oral edges of its Admm are not notably "sickle-shaped," like those of previously described species of *Drepanaster* (Spencer, 1934, p. 492), due to the

deep cleft for bases of the oral spines; nor are the Admm of the proximal and median regions set "vertically to the groove," as described by Spencer (1934, p. 492). In the illustrations given by Spencer (1934) and copied by Spencer & Wright (1966, fig. 75, 1a, 1b), the Admm do not have their long axes perpendicular to the ambulacral groove in *D. scabrosus* or *D. grayae*; instead, the "noses" of the Admm are more or less perpendicular and the remainder of the plate curves distally to overlap the succeeding plate and rest against its edge.

The type species of the genus is *Protaster scabrosus* Whidborne 1896, by designation of Whidborne (1898). It is from the Mississippian rocks of North Devon, England. Also included in *Drepanaster* are *Taeniaster schoharie* Ruedemann 1912, from the Ordovician Schenectady Formation of New York, and *D. grayae* Spencer 1934, from the Upper Ordovician of Girvan, Scotland. Spencer (1934, p. 493) noted that the disk overlaps ten arm segments (Ambb and Admm) in the Ordovician species and only about four in the Mississippian species.

DREPANASTER WRIGHTI n. sp.

Plates 1 and 2

Description.—Only the holotype specimen known. Arms long and tapering, disk exceptionally small; radial radius about 16 mm, interradial radius about 2.7 mm; hence, their ratio about 6/1. Disk subpentagonal, slightly arched aborally and flat orally, distinctly more rigid than normal in brittle-stars of the family (pl. 1, fig. 1). Oral surface of disk irregularly rough, apparently locally thickened by subdermal plates, ornamented with low, effaced papillae (granules) and with few scattered pustular bases for attachment of spines (pl. 2, fig. 1). Papillae extending onto aboral surfaces of arms, becoming more prominent and numerous, a few spine bases extending onto proximal part of arms. Oral surface of disk forming flat triangles in interrays, ornamented with numerous spines from 0.3 to 0.4 mm long. No M plate discernible.

Arms about 1.7 mm wide at junction with disk, tapering (pl. 1, figs. 1, 2), the distal part laterally compressed and subelliptical in cross section (pl. 2, fig. 2). Proximally, aboral surface of arms rounded, suggesting elevation of Ambb above edges of side shields; plate outlines practically obscured by preserved integument studded with numerous papillae, their general extent indicated by creases in the integument (pl. 2, fig. 1). Most papillae small, uniform, about 250 per mm², but a few scat-

tered larger papillae. Distal edges of side shields projecting prominently in aboral view (pl. 1, fig. 1), bearing long spines, some directed laterally (pl. 1, figs. 1, 2) and some directed distally (pl. 1, fig. 4).

Cups for tube-feet decreasing in size distally, in the proximal region subcircular (pl. 2, fig. 3), in the middle region elongate (pl. 2, fig. 2), and in the distal region nearly hidden by the convergence of the side shields. Only three cups in each half-ray situated within boundaries of the disk.

About 25 Ambb in each half-ambulacrum as far as preserved. Ambb with little distal decrease in length but with strong decrease in width; the proximal Ambb about as wide as long, those near the arm tip elongate and more nearly rod-shaped (pl. 1, fig. 1). Ambb adradial ridges forming "boots" on oral surface; "boot-legs" thin throughout arm; proximal expansions of "boots" large in proximal region (pl. 2, fig. 3), becoming narrower in distal region (pl. 2, fig. 2). Junction of left and right Ambb in each arm only slightly sinuous if at all, remarkably straight.

MAPs small, no longer than Ambb₁, about the same shape as those in other species of the family, a pair closely adjoined in each interrayer, convex orally, sloping down to ambulacral groove.

Admm forming large curved side shields around arms. Each plate more nearly sphenoid than convex, with a heavy ridge bearing the distal ("vertical") spines (pl. 2, fig. 1) and a deep cleft or fissure bearing the oral ("groove") spines. Heavy ridge or distal, thickening of plate especially prominent in aboral view (pl. 1, fig. 1), as noted. Oral cleft with flangelike inner face projecting beyond limit of outer face (pl. 2, fig. 2); cleft grading into shallow groove on end of Adm to accommodate bases of distal spines. Oral ("groove") spines thin, subcylindrical, not very rigid and readily distorted, about 5 on each Adm. Distal ("vertical") spines stout, subconical, pointed, with subspherical bases (pl. 1, fig. 4), each spine considerably longer than the succeeding Adm plate (pl. 1, figs. 1, 2; pl. 2, fig. 2); some spines preserved erect, perpendicular to the arm (pl. 1, figs. 1, 2), others lying alongside the next plate (pl. 1, fig. 4).

Each Adm with a broad, short "nose" set slightly away (aboral) from the edge of the plate and articulating with the proximal expansion of the Amb "boot." Oral edge of Adm sharp-edged but not sickle-shaped, its configuration modified by the deep cleft for the oral spines.

Near tip of arm, side shields (Admm) of

opposite sides only narrowly separated orally, practically concealing the Ambb plates in the ambulacral groove. In this region, arm constructed aborally by the narrow, rodlike edges of Ambb and laterally by the curved side shields, thinly covered with integument.

Remarks.—The deep clefts for the oral ("groove") spines of the Admm have not been mentioned or illustrated in *Drepanaster*; they somewhat resemble the shallow channels shown by Spencer (1934, text-fig. 320) in his drawing of *Taeniaster spinosus* (Billings). The articulating "noses" of these plates are more recessed from the oral edge than in other *Drepanaster* species, but not as far as those in *Bohemura*.

In life, the ambulacral groove, including the cups, tapered almost to closure at the arm tip, fringed throughout by the weak oral ("groove") spines of the bordering Admm.

Drepanaster wrighti seems to differ from the poorly understood *D. schohariae* (Ruedemann) in the shape of its Ambb "boots," which are larger in the proximal expansions. It is distinguished from *D. grayae* Spencer (Ordovician of Scotland) by its smaller disk, fewer tube-foot cups within the disk area, and shorter MAPs. The new species is separated from *D. scabrosus* (Whidborne) (Mississippian, England) by its somewhat smaller disk, longer

Admm distal (vertical) spines, larger proximal expansions of Ambb "boots," and, apparently, by the slight aboral extension of Ambb above the level of the side shields.

The species is named in honor of its discoverer, the late Edward Pulteney Wright.

Holotype.—UMMP 57497, parts of disk and arms on two small slabs.

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EXPLANATION OF PLATE 1 Figures $\times 6$, except as noted

Drepanaster wrighti n. sp. Holotype, UMMP 57497. 1, aboral view with fragments of disk assembled in place; note prominent distal edge of Admm projecting outward; some spines on arm at lower left. 2, oral view, before final cleaning of distal ends of arms; some spines preserved along external mold of arms. 3, aboral view, with disk removed to show its impression. 4, part of arm (upper center in fig. 2), showing spines on Admm; $\times 16$.

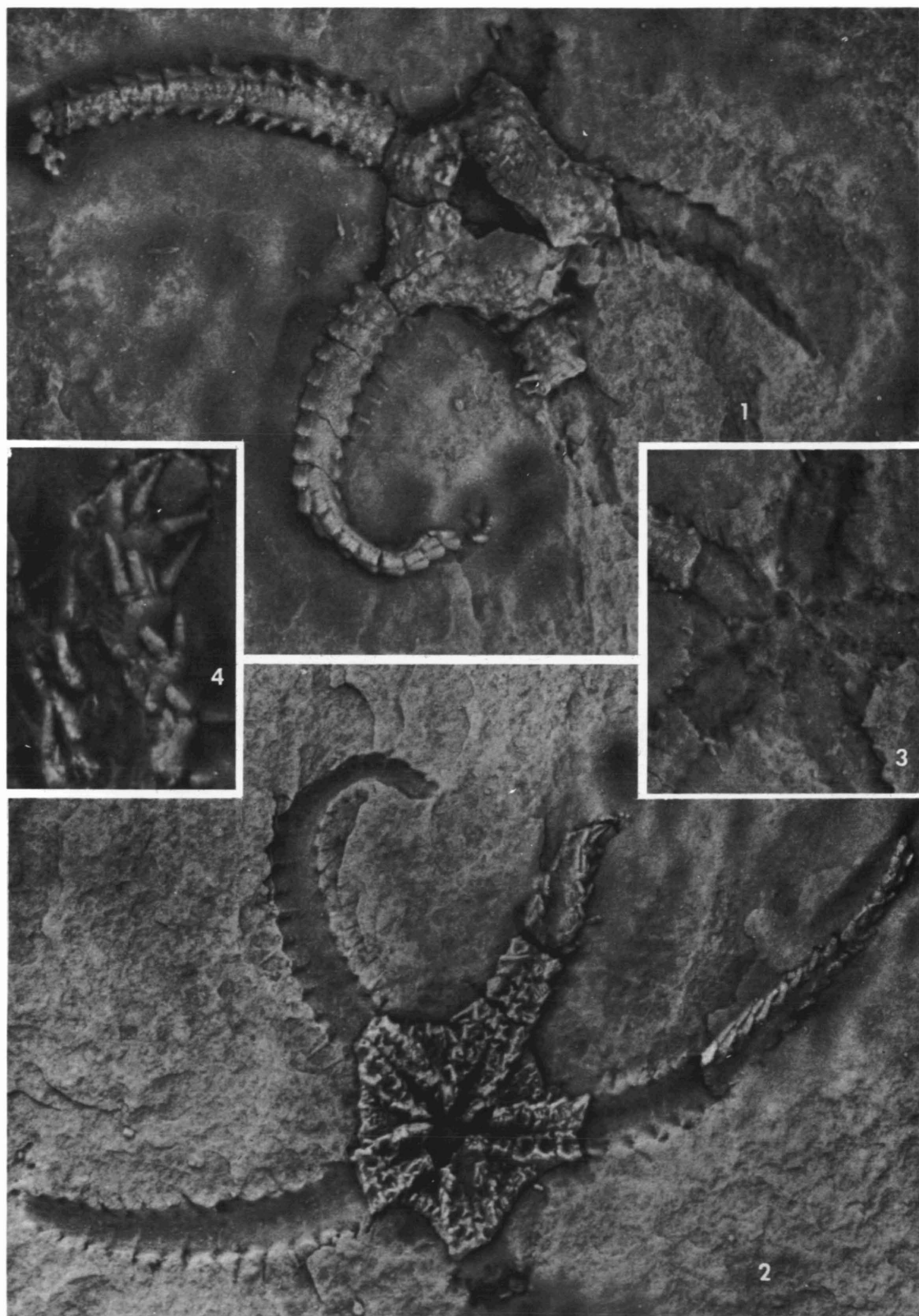


PLATE 1

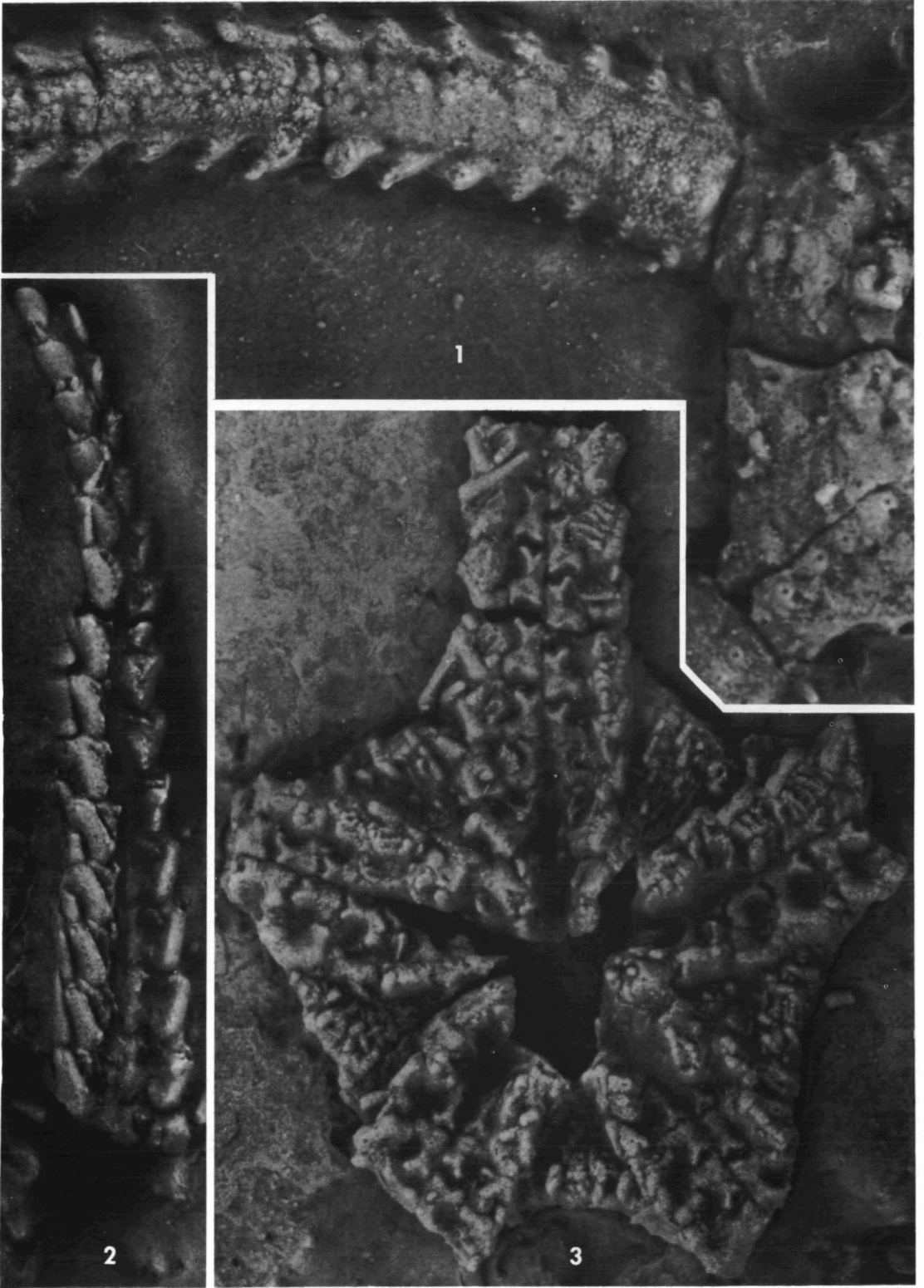


PLATE 2

EXPLANATION OF PLATE 2

All figures $\times 16$

Drepanaster wrightii n. sp. Holotype, UMMP 57497. 1, aboral view of edge of disk and attached arm, showing bases for attachment of disk spines and papillose ornamentation of arm and disk; edges of Admm distally flared outward to form a prominent ridge. 2, distal part of an arm, showing tapering and narrowing of ambulacral groove; deeply recessed groove in Admm for bases of "groove" spines; "vertical" spines well developed. 3, oral view of disk, showing some "groove" spines of Admm; "boots" of Ambb not as elongate in this proximal region as they are in distal part of arms.

