

tabular, thickened, approximately polygonal; radial size gradually diminishing distally on arm until next-distalmost radial. Proximalmost four preserved radials with very short, stout spines; next two (three?) lacking spine; next-to-distalmost enlarged, forming part of stout arm tip, with medial spine base; distalmost radial comparatively very small, spine lacking. One lateral ossicular row on each side of radial series, these series terminating lateral to enlarged radial; form of laterals obscure but of smaller size than that of adjacent radials. Spines on abactinals small, cylindrical, numerous, not closely spaced; smaller spine bases domal.

Ossicles of marginal series paired, thickened, somewhat bulbous, irregular; lateral outline approximately square, ossicles of both series overlapping proximally; fascioles lacking. Superomarginals smaller than corresponding inferomarginals; inferomarginals form ambitus at ventral surface, ossicular margin somewhat angular, therefore arm tip transverse outline approximately triangular; ossicles of both series with enlarged medial spine, smaller columnar spinelets similar to spines of preserved proximal radial series; length of large inferomarginal spine approximately 1 mm.

Actinals in single series; actinals rectangular, elongate, closely abutted, each actinal abuts two adambulacrals, actinal spine arrangement probably similar to those of marginal series.

Adambulacrals stout, rectangular in ventral outline, transversely elongate, upright in arm, closely spaced; side faces probably similar so that ossicles are approximately bilateral across radial plane; with two or three larger subambulacrals spines in transverse series, perhaps also smaller spinelets; furrow edge straight, probably with furrow row of smaller spinelets on notched edge, allowing closure of furrow. Ambulacrals robust, with broad radial water-canal groove; podial pores biserial. Terminal lost but articular surface small.

Remarks.—Although only an arm tip remains, the oreasterid affinities are clear. Marginal ossicles of the Goniasteridae typically are tabular, and the ossicles of the two series are similar, whereas those of the fossil are oreasterid-like in that they are globular and irregular. In many oreasterids, marginals of the two series are somewhat dissimilar, and the fossil is consistent with that pattern in that the inferomarginals are somewhat enlarged, and they protrude laterally beyond the superomarginals. Differentiated, somewhat irregular and domed radial ossicles, with an enlarged representative proximal to the tip, are oreasterid-like, as are the enlarged medial spines on both marginals and radials. The flattened adradial margin of the adambulacrals allowed the adambulacrals to be pulled together, closing the furrow and protecting the tube feet.

Although very fragmentary, the form of the marginals appears unlike that of described genera, as is the arrangement of spines. There are two groups of oreasterids, the first including genera such as *Goniodiscaster* and *Anthenea* that are goniasterid-like, with flattened dorsal surfaces and limited differentiation of abac-

tinal ossicles, and the second including genera such as *Oreaster* that are thickened in body cross section with a more complexly differentiated, somewhat open, abactinal network. The fossil is very incomplete and distorted, but the rather simple, flat form of the dorsals suggests the former group.

Material.—One well-preserved arm tip fragment from locality 86.4; the tip is approximately 12 mm long, 7 mm in width. Proportions suggest a specimen of radius of at least 40 mm, but it could have been derived from a much larger individual. Hypotype, USNM 490418.

Order PAXILLOSIDA Perrier, 1884
Family ASTROPECTINIDAE Gray, 1840
CTENOPHORASTER DOWNEYAE
Blake and Zinsmeister, 1979
Figure 7.6

Ctenophoraster downeyae BLAKE AND ZINSMEISTER, 1979, p. 1150, pl. 1; 1988, p. 494, fig. 3.1.

Remarks.—Most available specimens of *Ctenophoraster downeyae* appear to have had comparatively short, triangular arms rather than the long, slender arms typical of living species. Great variability of arm form has been recognized in *Astropecten* (e.g., Döderlein, 1917), but taxonomists have not sought to subdivide the genus, and arm shape should not be stressed in *Ctenophoraster*.

Material.—Many largely fragmentary specimens are available, see locality index, Blake and Zinsmeister (1979, 1988).

Superorder FORCIPULATAEA Blake, 1987
Order FORCIPULATIDA Perrier, 1894
Family ZOROASTERIDAE Sladen, 1889
Genus ZOROASTER Thomson, 1873
ZOROASTER aff. *Z. FULGENS* Thomson, 1873

Zoroaster fulgens THOMSON, 1873, p. 153.

Zoroaster aff. *Z. fulgens* Thomson, 1873. BLAKE AND ZINSMEISTER, 1979, p. 1151, pl. 2; 1988, p. 495, figs. 3.7–3.10, 4.1–4.4.

Remarks.—Downey (1970) found the Atlantic living species of *Zoroaster* to be only weakly demarcated, and synonymized them under *Z. fulgens*, pending future studies. Blake and Zinsmeister (1979) found strong similarities between the Seymour specimens and living *Z. fulgens*. There are minor differences (Blake and Zinsmeister, 1979), and the fossils appear robust as compared to living representatives, with arms that are short and blunt. Nevertheless, Downey (1970) noted a range of shapes among living representatives, and blunt-armed individuals with robust arms likely would be taphonomically favored; recognition of a new species is not warranted at this time.

Material.—Many largely fragmentary specimens are available, see locality index and Blake and Zinsmeister (1979, 1988).

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FIGURE 4—1–5, *Tesselaster clarki*, new species, both loc. 86-04; 1–4, holotype, USNM 490429; 1, 2, overall dorsal and ventral views, $\times 1.5$; 3, dorsal view shows form of superomarginals with few accessory ossicles present on superomarginals in life and enlarged granules occur along intermarginal edge of inferomarginals to left, $\times 3$; 4, ventral view shows form of inferomarginals with enlarged granules near lateral edge of inferomarginals and stout adambulacrals spines, $\times 3$; 5, ventral view of wind-abraded specimen, adambulacrals are transversely elongate and closely spaced, $\times 3$, paratype USNM 490430. 6–13, *Sclerasterias zinsmeisteri*, new species, proximal and medial arm fragments with distal to top of page, all loc. 86-05; 6, 7, 12, paratype, USNM 490431; 6, 7, dorsal and ventral views show general arrangement and form of ossicles, $\times 1.5$; 12, dorsal view with superomarginals to right, arrangement of spine bases, laterals adjacent to superomarginals, radials at midline of arm, $\times 3$; 8, 9, paratype, USNM 490432; 8, dorsal view with superomarginals to left and right, and intermediate ossicular rows largely squeezed together to center; 9, ventral view showing arrangement of adambulacrals and ambulacrals, funnel-shaped podial pores, $\times 1.5$; 10, 11, 13, paratype USNM 490433. 10, form of superomarginals to left, 11, ambulacrals to left, adambulacrals, actinals, inferomarginals, both $\times 1.5$; 13, specimen rotated about longitudinal axis from 11, some broken superomarginals to right, inferomarginals at center, actinal row at left center, adambulacrals to left $\times 3$.