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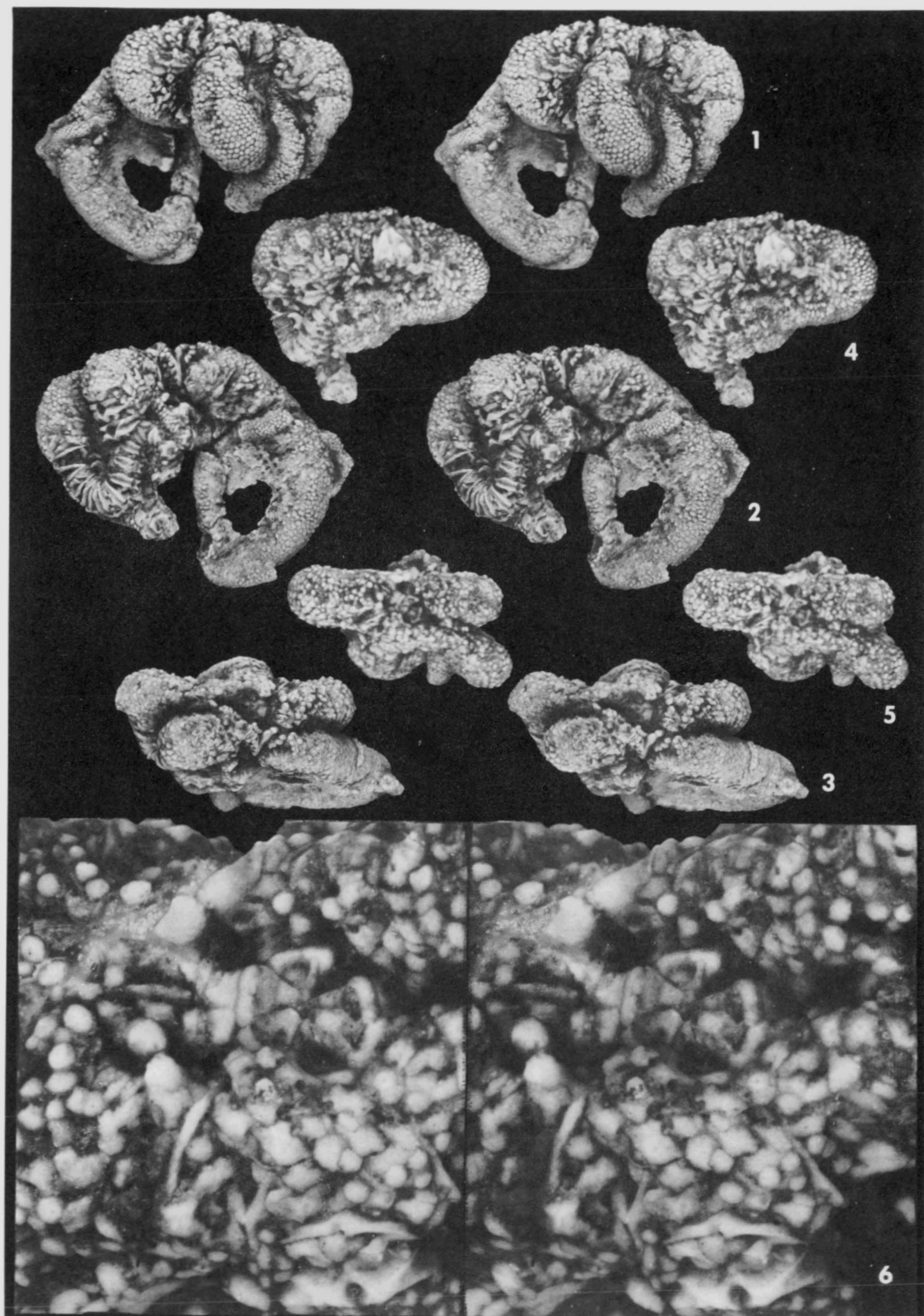
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NEW OPHIUROID FROM CHESTER SERIES
(MISSISSIPPIAN) OF ILLINOIS

BY

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NEW OPHIUROID FROM CHESTER SERIES (MISSISSIPPIAN) OF ILLINOIS

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ABSTRACT—Discovery of a new species of *Onychaster*, *O. strimplei*, in the Golconda Formation of the Chester Series extends the known range of the genus to Upper Mississippian. The new ophiuroid is characterized by a distinctive mouth frame in which the denticles are elevated to form a low dome, the tori are exceptionally short, and the second ambulacrals extend to prominent peaks near the radial suture. The pattern of integumental ossicles also differs from those in *Onychaster barrisi* (Hall) and *O. flexilis*, the two previously established species.

INTRODUCTION

RECENTLY, Mr. Harrell L. Strimple of the State University of Iowa (SUI) discovered a nearly complete specimen of the ophiuroid *Onychaster* in the Golconda Formation in Illinois. He generously allowed us to study it. Because the new specimen extends the range of the genus in North America from Osage to Chester time, we were particularly grateful for the opportunity to investigate this youngest known *Onychaster*. Careful comparison with specimens of the two previously established species, *O. barrisi* and *O. flexilis*, eliminates any doubts that the Golconda ophiuroid is a new species. Its mouth frame is particularly distinctive.

We are indebted to Mr. Strimple for sending

us the specimen for description. Professor Bernhard Kummel of the Museum of Comparative Zoology at Harvard (MCZ) loaned specimens of *Onychaster barrisi* (Hall). Mr. Karoly Kutasi photographed the ophiuroid and Mrs. Helen Mysyk typed the manuscript. Our sincere thanks to all for their excellent help.

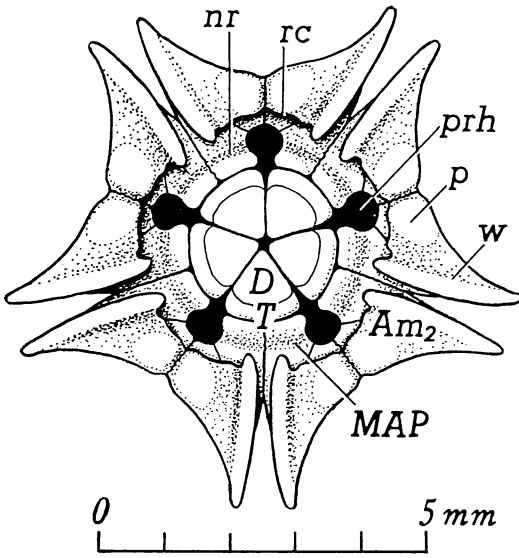
ONYCHASTER STRIMPLEI, n. sp.
Text-fig. 1; pl. 34, figs. 1-6

General form.—Small ophiuroid with small disk and five long, tapering, flexible arms. As preserved (pl. 34, figs. 1,2), arms drawn under disk and twined around one another, effectively obscuring the mouth. Ossicles of integument missing from parts of arms and disk, revealing

EXPLANATION OF PLATE 34

(All figures $\times 2$, except as noted)

FIGS. 1-6—*Onychaster strimplei*, n. sp. Holotype, SUI No. 32002. 1-3, Two lateral and one aboral stereograms, specimen coated with sublimate of ammonium chloride; 4,5, lateral and aboral stereograms of specimen submersed in xylol, one arm removed to expose its junction with second ambulacral; note raised rim and adradial peak of left second ambulacral (fig. 4); 6, aboral stereogram, $\times 10$, showing elements of mouth frame; note serrate suture between paired second ambulacrals and proximoradial hole through frame (upper left), narrow tori and well-developed denticles (center), and aboral median pit in ambulacral of arm (lower right).



TEXT-FIG. 1—*Onychaster strimplei*, n. sp. Mouth frame, based on camera lucida sketches of the holotype. The following abbreviations are used: Am_2 , second ambulacral; D , denticle; MAP , mouth angle plate (first ambulacral); nr , circular furrow to accommodate nerve ring; p , aboral peak of Am_2 ; prh , proximatorial hole through mouth frame; rc , depression to accommodate ring canal; T , torus; w , wing of Am_2 .

features of ambulacrual vertebrae and mouth frame (pl. 34, figs. 2,6).

Integument.—Arms covered with small embedded ossicles arranged more or less in hexagonal pattern (pl. 34, fig. 1). Disk apparently covered by flattened polygonal ossicles somewhat larger than those of the arms, to judge from dislocated plates still attached to aboral surface (pl. 34, fig. 6); pattern of these ossicles undeterminable. Size of ossicles in arms roughly proportional to diameter of arm; hence tip section of arm finely studded with minute ossicles.

Arms.—Proximal part of each arm rotund, attaining a diameter nearly equal to that of mouth frame (pl. 34, fig. 5); distal part of arm tapering to very small diameter (pl. 34, figs. 1,2). Total length of each arm difficult to determine because of broken-out sections, but estimated to be nearly 17 times the diameter of the mouth frame.

Vertebrae formed by pairs of ambulacrals, weakly fused together, with general shape of those in *Onychaster flexilis* Meek & Worthen, the type. Each vertebra relatively short, with a prominent aboral median pit (median central canal of Sollas, 1914). Insofar as can be seen on sides (pl. 34, fig. 2), vertebrae tapering toward oral (ventral) side of arm. Sides of vertebrae

with raised edges and central trough-like depression. Dorsoproximal surface of vertebra with median elongate pit bordered by two lateral protuberances; dorsodistal surface conversely constructed, with median node and lateral sulci.

Lateral shield plates rather small, not covered by ossicles, extending along ventrolateral edges of arms. Each lateral plate curved to lie alongside the vertebra, bearing on its outer edge small tapering spines.

Mouth frame.—Frame rather strongly constructed, despite five proximatorial holes extending through it (prh in text-fig. 1). Frame consisting of four sets of plates concentrically arranged, from the center outward: denticles (D), tori (T), mouth angle plates or first ambulacrals (MAP), and second ambulacrals (Am_2). D relatively large, the five together forming a central circle (text-fig. 1); each D subtriangular set in an interradial sector, close to the adjacent D plates and scarcely delineated from the associated T . Unlike *Onychaster flexilis* (with D plates in a central depression, well below level of T 's), this species with D plates forming slightly raised central dome. Tori narrow, the five together forming a thin band around D plates; each T short, curved, subrectangular, narrowly separated from adjacent T plates and firmly attached to associated D , the suture only slightly depressed (in pl. 34, fig. 6, taken in xylol, color differences between T and D plates make this junction seem more pronounced). Each T bordered distally by two MAP , one from each of the adjacent radial pairs.

Ten MAP , each separated from the other of the pair by a large subcircular proximatorial hole (prh in text-fig. 1); each plate set close against one of the adjacent pair of MAP , in some places separated only by a serrate suture. Adjacent MAP (one from each pair) with their inner edge set firmly against convex outer border of interradial T (text-fig. 1). Central parts of MAP depressed to form a circular furrow or trough to accommodate the nerve ring (nr in text-fig. 1; pl. 34, fig. 6). Distal edges of MAP meeting Am_2 adradially along a short oblique suture and abradially along a short arc-shaped suture. At the latter, Am_2 rising sharply, forming an angular depression to accommodate the ring canal (rc in text-fig. 1). Outermost margin of MAP extending downward and outward under interradial part of Am_2 .

Am_2 large, disposed in five radial pairs. The two plates of each pair set close together, the suture between them in part deeply serrate (pl. 34, fig. 6). Am_2 differing from succeeding ambulacrals in not being fused together to form a vertebra, in having a lateral expansion or wing

TABLE 1—Comparison of species of *Onychaster*

Character	<i>O. barrisi</i> (Hall)	<i>O. flexilis</i> Meek & Worthen	<i>O. strimplei</i> , n. sp.
Age	Burlington	Keokuk	Chester (Golconda)
Size	Small	Large	Small
Integument	Thin plates irregularly arranged	Rather closeset rounded ossicles in tessellated pattern	Small rounded ossicles, arranged in hexagonal pattern
Mouth frame			
Denticles	Small, slightly below tori	Small, deeply depressed	Large, elevated as dome
Torus	Rounded, subrectangular, stout, distinctly set off from denticles	Pentagonal, inner face concave and sloping downward and inward	Rounded, subrectangular, short, suture with denticles only slightly depressed
Mouth angle plates	Very large, all plates in contact to form circle	Small, those of each pair widely separated	Large, those of each pair narrowly separated
Nerve ring furrow	Shallow	Deep	Intermediate
Proximoradial holes	Very small passages	Wide, kite-shaped	Intermediate, subcircular
Second ambulacrals	Relatively narrow	Wide	Wide
Wings	Narrow, distally directed	Wide, laterally directed	Wide, distally directed
Aboral pit (between pairs)	Shallow	Distinct	None
Aboral peak near radius	Gentle elevation	Intermediate	Very prominent
Perforation leading to second tube foot	None discernible	Large, distinct	None discernible
Distal articulating surface	Strongly indented	Nearly flat	Gently concave

(*w* in text-fig. 1) directed back near the interradial plane, and in lacking any kind of aboral median pit. Each Am_2 with short extension beside radius, set obliquely against corresponding *MAP* and bordering subcircular proximoradial hole (text-fig. 1); the two extensions of each pair of Am_2 meeting at radial suture, set at level of *MAP*, and bearing part of angular depression to accommodate the ring canal along their outer border (at junction with main part of Am_2). Aboral surface of each Am_2 with distinctive configuration: rather sharp peak (*p* in text-fig. 1) close to radial suture sloping down laterally, edge of plate next to interradius elevated as a rim (see left side of exposed Am_2 in pl. 34, fig. 4), and well-defined groove along inner border of the rim. Rim extending proximally to form short, rounded spur and distally to form tip of wing. Outer surface of Am_2 subtriangular (pl. 34, fig. 4), articulated with Am_3 .

Remarks.—To establish *Onychaster strimplei* as a new species, we examined the following specimens of the two species already in the genus as recognized by Spencer (1925):

Onychaster flexilis Meek & Worthen. All from Crawfordsville, Indiana. UMMP 6197—undoubtedly the specimen illustrated by Meek & Worthen (1868, p. 526; 1873, pl. 16, fig. 3a). UMMP 6196—two specimens; one free of matrix showing the mouth frame exceptionally well, the other partly embedded in siltstone showing the arms with integumental ossicles on one side and the mouth frame on the other. UMMP 56561—nearly complete, showing mouth frame exceptionally well; a dark substance adhering to surface of arms.

Onychaster barrisi (Hall). All from Burlington, Iowa. MCZ 398 (originally 412)—three specimens, one attached to tegmen of large crinoid and the other two partly in matrix; one shows mouth frame fairly well.

Label bears reference to Schuchert, 1915, p. 273. MCZ 398 (originally 1185 ?)—one specimen, rather large, nearly complete but poorly preserved. Label states collected by Wachsmuth; box bears number 12. MCZ 399 (originally 412)—one small specimen, nearly complete but poorly preserved. Collected by Wachsmuth and figured by Meek & Worthen (1873, pl. 10, figs. 1a, 1b). Box bears number 11 and labeled "Cotype." MCZ 398 (originally 1184)—one specimen, incomplete, poorly preserved and partly embedded, apparently consisting of parts of oral surface of mouth and proximal fragments of arms. Collected by Wachsmuth. Box bears number 10.

From our study of these ophiuroids we conclude that the mouth frame not only has strong diagnostic value but is one of the structures likely to be preserved in *Onychaster*. As shown in table 1, each of the species can be readily distinguished by the nature of its mouth frame. We are currently investigating this feature in more detail.

Through the courtesy of Mr. Strimple we were also permitted to study part of an ophiuroid arm from the Bangor Limestone in "shale break about 20 feet above old quarry floor on south side of quarry, SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 20, T.7S., R.2W., Somerville Quadrangle, Alabama, about 10 miles east of Hartselle, Alabama." The size of the arm, the configuration of the exposed surface of the ambulacrals, and the nature of the ossicles of the integument match very well with those of the holotype of *Onychaster strimplei*. Nevertheless, we decline to classify this fragment, awaiting discovery of a specimen retaining the mouth frame before applying a specific name.

Type.—SUI 32002, holotype and only specimen.

Occurrence.—Haney Shale, Golconda Forma-

tion, Upper Mississippian Chester Series. Road cut east of Anna, Union County, southern Illinois, on north side of Illinois 146 one-half mile east of its junction with Interstate 57, in NE $\frac{1}{4}$ sec. 30, T.12S., R.1W., Dongala Quadrangle. Collected by Harrell L. Strimple.

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