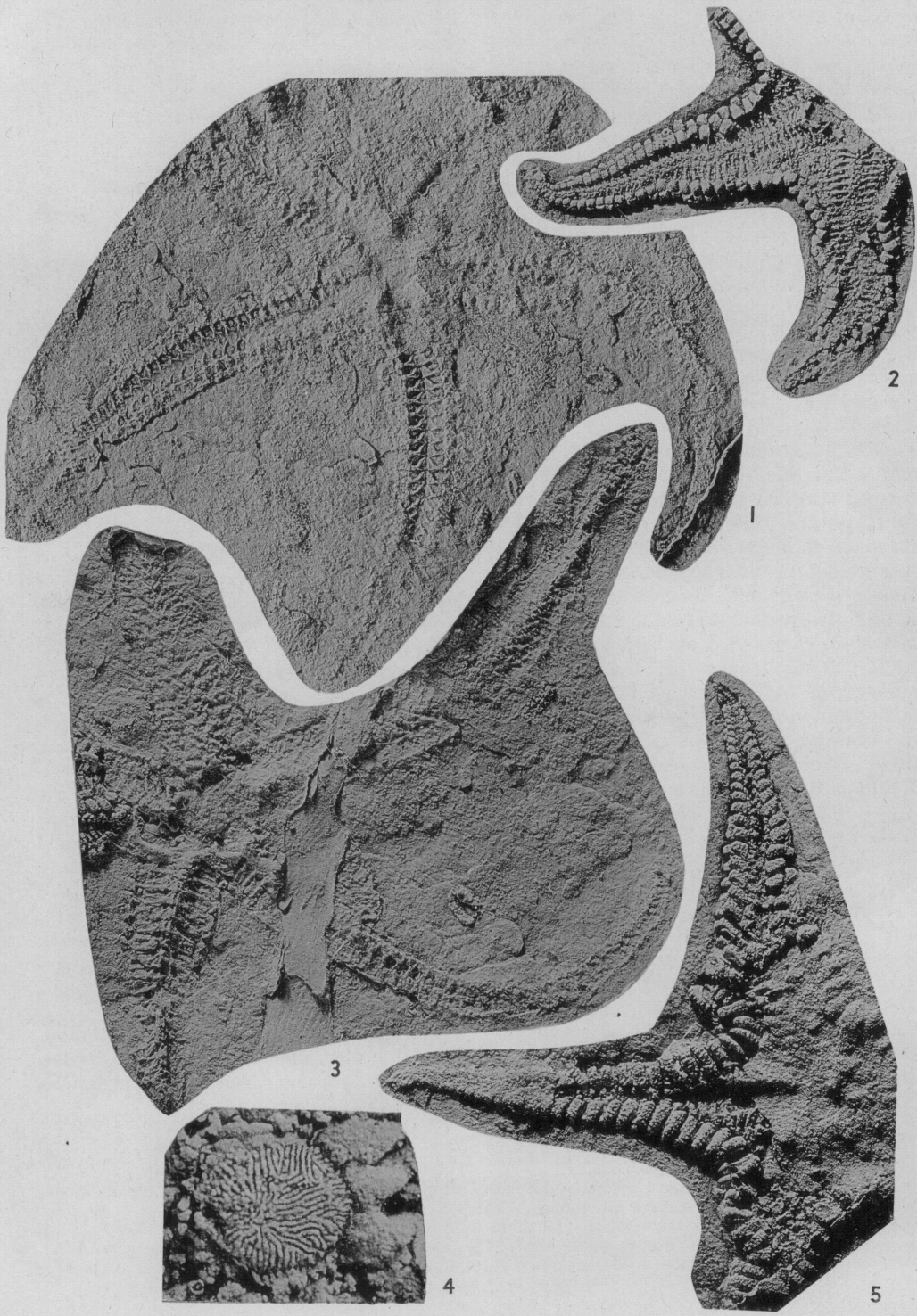

Durham and Roberts, Cretaceous Asteroids

In paratype no. 4860 most of the aboral integumental covering has been removed and the rays apparently were not flattened during fossilization. In this specimen (preserved so that the aboral surface is seen) the ambulacral plates are arched, presumably as in life, making an angle of about 150° with one another, except adjacent to the mouth where it is about 120°. Most specimens have been flattened during preservation and in those that show least evidence of further distortion (as in the holotype, and paratype no. 4859) it appears that the ambulacral, adambulacral, and marginal plates were all slightly inclined towards the tip of the ray, usually at an angle of about 70° with the axis of the ray.

Some specimens, for example paratype no. 4864, have the rays much more rounded. This may have been the outline of the animal during life, or it may be that the flattened impressions like the holotype and paratype no. 4859 represent more nearly the true shape in life. If this latter is the case, then specimens like paratype no. 4865 must represent individuals which had died some time previous to burial and had their rays somewhat rolled up before interment. At first it was thought that these individuals represented another species, but upon careful examination it was seen that they had the same number of marginal plates, and these plates are the same shape as in individuals like the holotype, so it was concluded that they are distorted individuals of the present species.

Types.—In the California Institute of Technology Paleontological Collections, holotype no. 4858; paratypes nos. 4859–4865, 4867, 4868. In addition there are the fragments and poorly preserved impressions representing the remaining 25 specimens which have not been assigned type numbers. Plaster casts of all the numbered specimens have been deposited with the U. S. National Museum and in the Museum of Paleontology of the University of California at Berkeley, Calif. Unfortunately part of the mold of the ambulacral area of the holotype was destroyed during the making of the casts. Fortunately the photographs used in illustrating it, and an excellent latex impression of it were taken before it was damaged.

Astropecten pêwêi Miller and Unklesbay (1943) from the Jurassic Sundance formation of Wyoming does not appear to be closely related to the present species; it has fewer and differently shaped marginal plates.

Order SPINULOSA
Family ECHINASTERIDAE
Genus HENRICIA Gray

Henricia GRAY (1840), Ann. Mag. Nat. Hist., vol. 6, p. 184; CLARK (1946), Carnegie Inst. Washington, Pub. 566, p. 148.

Genotype: *Henricia oculata* Gray = *Asterias sanguinolenta* Müller

HENRICIA (?) VENTURANA Durham and Roberts n. sp.
Plate 66, figures 1, 3

This species is represented by both oral and aboral impressions of a single individual. Unfortunately the details are not consistently well preserved, but it is believed that sufficient characters are preserved to warrant giving it a specific name. The disc is very small in comparison to the length of the arms. The arms are more or less gracefully curved, both the oral and aboral surfaces are represented. The margins of the arms are not distinct but it is believed that this is due to a lack of conspicuous marginal plates. However on one ray of the aboral mold, the integument has been removed and the aboral surface of the ambulacral plates is exposed and in this particular area the ambulacral plates appear to terminate laterally against vertical plates which might represent marginal plates.

Rays 5, radius of rays about 40 mm., radius of disk about 5 mm. Rays slender, width at base about 6.8 mm., tapering grace-

EXPLANATION OF PLATE 66

FIGS. *1, 3*—*Henricia venturana* Durham and Roberts, n. sp. Holotype no. 4866. *1*, oral surface no. 4866a, ×1.7. *3*, aboral surface no. 4866b, ×1.8. (p. 437)

2, 4, 5—*Astropecten matilijaensis* Durham and Roberts, n. sp. *2*, Paratype no. 4868, ×1.8, aboral surface. *4*, Paratype no. 4867, ×11, madreporite (retouched), *5*, Paratype no. 4864, ×2.45, oral surface, note contracted state of arms. (p. 435)

fully to tip. Interbrachial arcs acute. Margin of rays uncertain, probably rounded, marginal plates not conspicuous. The ambulacral plates occupy over one-half the width of oral surface of rays. It is suspected that this is due to flattening during fossilization. Aboral surface covered by a coarse granular network, possibly a few traces of short spines near the margins of the rays. Apparently about 35 ambulacral plates to a ray. Tube feet pores large, about 0.8 mm. in longitudinal diameter, adambulacral plates apparently corresponding to ambulacrals, not spinose, apparently about as long as wide. Madreporite dorsal, on margin of disk, about 1.5 mm. in diameter, surface marked by numerous vermiform radiating ridges.

Holotype, California Institute of Technology Paleontological Collections, nos. 4866A (oral surface), 4866B (aboral surface). Plaster casts have been deposited with the U. S. National Museum, and in the Museum of Paleontology of the University of California at Berkeley, Calif.

The reference of this species to the genus *Henricia* is very uncertain because of the apparent wide ambulacral grooves and lack of adambulacral spines, but it is possible that this is an apparent condition produced by flattening during fossilization. If, as suggested on the arm showing the aboral surface of the ambulacral plates, there are conspicuous marginals bounding the ray, the species might better be assigned to *Linckia* which may also have granular adambulacral plates.

BIBLIOGRAPHY

ADKINS, W. S., 1920, The Weno and Pawpaw formations of the Texas Comanchean: Univ. Texas Bull. no. 1856, pp. 1–174, pls. 1–11.

——, 1928, Handbook of Texas Cretaceous fossils: Univ. Texas Bull. no. 2838, pp. 1–385, pls. 1–37.

——, and WINTON, W. M., 1920, Paleontological Correlation of the Fredericksburg and Washita formations in North Texas, Univ. Texas Bull. no. 1945, pp. 1–128, pls. 1–21.

ALEXANDER, C. I., 1931, A new Lower Cretaceous ophiuroid: Jour. Paleontology, vol. 5, pp. 152–153, pl. 20, figs. 19–20.

ARNOLD, R., 1908, Description of a new brittle star from the upper Miocene of the Santa Cruz Mountains, Calif., U. S. Nat. Mus., Proc., vol. 34, pp. 403–406, pl. 40.

BERRY, C. T., 1934, Miocene and Recent *Ophiura* skeletons: Johns Hopkins Univ. Studies Geol., no. 11, pp. 9–136.

——, 1935, A Pliocene Ophiuran from Trinidad: Jour. Paleontology, vol. 9, pp. 430–433.

——, 1937, An Ophiuran from the Byram Marl (Oligocene) of Mississippi: Jour. Paleontology, vol. 11, pp. 235–240.

——, 1938, Ophiurans from the Upper Senonian of South Limburg, Holland: Jour. Paleontology, vol. 12, pp. 61–71, pls. 14–16.

——, 1939, More Complete Remains of *Ophiura marylandica*: Proc. Am. Phil. Soc., vol. 80, no. 1, pp. 87–94, 1 pl., 1 fig.

——, 1941a, Cretaceous Ophiurans from Texas: Jour. Paleontology, vol. 15, pp. 61–67, pls. 9–11.

——, 1941b, Tertiary Ophiurans from Venezuela: Jour. Paleontology, vol. 15, pp. 68–70, pl. 11.

——, 1942, A New Ophiuran from the Eocene of New Jersey: Jour. Paleontology, vol. 16, pp. 393–396, pl. 60.

CLARK, B. L., 1915, Fauna of the San Pablo Group of Middle California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 8, pp. 385–572, pls. 42–71.

——, 1918, The San Lorenza Series of Middle California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 11, pp. 45–234, pls. 3–24.

CLARK, H. L., 1913, Asterozoa in Eastman Zittel: pp. 244–257, figs. 347–364 (Macmillan and Co., Limited, London).

——, 1946, The Echinoderm Fauna of Australia: Carnegie Inst. Washington, publ. 566, pp. 1–567.

CLARK, W. B., 1893, The Mesozoic Echinodermata of the United States: U. S. Geol. Surv., Bull. 97, pp. 1–207, pls. 1–50.

——, 1904, Maryland Geological Survey, Miocene Report: pp. 430–433.

——, and TWITCHELL, M. W., 1915, The Mesozoic and Cenozoic Echinodermata of the United States, U. S. Geol. Surv. Mon. 54, pp. 1–134, pls. 1–108.

COOKE, C. W., GARDNER, J., and WOODRING, W. P., 1943, Correlation of the Cenozoic Formations of the Atlantic and Gulf Coastal Plain and the Caribbean Region: Bull. Geol. Soc. Am., vol. 54, pp. 1713–1733.

DOUGLAS, E., 1903, *Astropecten ? montanus*, a new starfish from the Fort Benton, and some geological notes, Carnegie Mus., Ann., vol. 2, pp. 5–8.

DURHAM, J. W., 1944, Megafaunal zones of the Oligocene of northwestern Washington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 27, pp. 101–212, pls. 13–18.

GABB, W. M., 1869, Paleontology of California, vol. 2, pp. 1–299, pls. 1–36.

——, 1876, Note on the discovery of representatives of three orders new to the Cretaceous formation of North America, Proc. Acad. Nat. Sci. Philadelphia, vol. 28, pp. 178–179.

HOWE, H. V., 1942, Neglected Gulf Coast Tertiary microfossils, Bull. Am. Assoc. Petr. Geol., vol. 26, pp. 1188–1199, figs. 1–25.

KERR, P. F., and SCHENCK, H. G., 1928, Significance of the Matilija Overturn, Bull. Geol. Soc. America, vol. 39, pp. 1087–1102.

LOGAN, W. N., 1900, The Stratigraphy and invertebrate faunas of the Jurassic formation in the Freeze-out Hills of Wyoming, Kansas Univ. Quart., ser. A, vol. 9, pp. 109–134, pls. 25–31.

MEEK, F. B., 1873, United States geological and geographical survey of territories, Pal. Rept. for 1872, pt. 2, pp. 429–518.

MERRIAM, C. W., 1931, Notes on a Brittle-star Limestone from the Miocene of California, Am. Jour. Sci., ser. 5, vol. 21, pp. 304–310, 2 figs.

MILLER, A. K., and UNKLESBAY, A. G., 1943, A New Asteroid from the Jurassic of central Wyoming, Jour. Paleontology, vol. 17, pp. 179–180, pl. 30, fig. 5.

PACKARD, E. L., 1916, Faunal studies in the Cretaceous of the Santa Ana Mountains of southern California, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, pp. 137–159.

SLADEN, W. P., 1889, Report on the Asteroidea, Sci. Res. Voy. H.M.S. Challenger, 1873–76, Zool., vol. 30, pp. 1–935, pls. 1–118.

——, 1891, A Monograph on the British fossil Echinodermata from the Cretaceous formations. Volume Second. The Asteroidea, part first, pp. 1–28, pls. 1–8 (Paleontographical Society, London).

——, 1893, A Monograph on the British fossil Echinodermata from the Cretaceous formations. Volume Second. The Asteroidea, Part Second, pp. 29–66, pls. 9–16 (Paleontographical Society, London).

SPENCER, W. K., 1905, A Monograph on the British fossil Echinodermata from the Cretaceous formations. Volume Second. The Asteroidea, Part Third, pp. 67–90, pls. 17–26 (Paleontographical Society, London).

——, 1907, A Monograph on the British fossil Echinodermata from the Cretaceous formations. Volume Second. The Asteroidea and Ophiuroidea, Part Fourth, pp. 91–132, pls. 27–29 (Paleontographical Society, London).

VANDERPOOL, H. C., 1933, Upper Trinity microfossils from southern Oklahoma, Jour. Paleontology, vol. 7, pp. 406–411, pl. 49.

WADE, BRUCE, 1926, The Fauna of the Ripley formation on Coon Creek, Tennessee, U. S. Geol. Surv. Prof. Pap. 137, pp. 1–272, pls. 1–72.

WARING, C. A., 1917, Stratigraphic and Faunal relations of the Martinez to the Chico and Tejon of southern California, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 41–124, pls. 7–16.

WELLER, S., 1905, A fossil starfish from the Cretaceous of Wyoming, Jour. Geol., vol. 13, pp. 257–258.

——, 1907, A Report on the Cretaceous paleontology of New Jersey, Geol. Surv. New Jersey, Pal. ser., vol. 4, pp. 1–871, pls. 1–111.

WHITEAVES, J. F., 1903, Mesozoic fossils (Geol. Surv. Canada), vol. 1, pt. 5, pp. 309–416, pls. 40–51.

WHITFIELD, R. P., 1880, Paleontology of the Black Hills of Dakota in Newton and Jenney's report on the geology and resources of the Black Hills of Dakota, U. S. Geog. and Geol. Survey Rocky Mountain Region, pp. 325–468, pls. 1–16.

WHITFIELD, R. P., 1877, Preliminary report on the paleontology of the Black Hills, U. S. Geog. and Geol. Survey Rocky Mtn. region, pp. 1–49.