

Geology of Saipan Mariana Islands

Part 3. Paleontology

GEOLOGICAL SURVEY PROFESSIONAL PAPER 280-E-J

Chapter E. Calcareous Algae

By J. Harlan Johnson

Chapter F. *Discoaster* and Some Related Microfossils

By M. N. Bramlette

Chapter G. Eocene Radiolaria

By William R. Reidel

Chapter H. Smaller Foraminifera

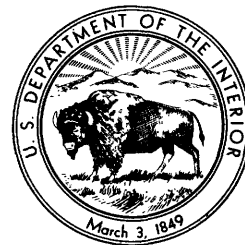
By Ruth Todd

Chapter I. Larger Foraminifera

By W. Storrs Cole

Chapter J. Echinoids

By C. Wythe Cooke



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GEOLOGICAL SURVEY PROFESSIONAL PAPER 280

Geology of Saipan, Mariana Islands

Part 1. General Geology

A. General Geology

By PRESTON E. CLOUD, Jr., ROBERT GEORGE SCHMIDT, *and* HAROLD W. BURKE

Part 2. Petrology and Soils

B. Petrology of the Volcanic Rocks

By ROBERT GEORGE SCHMIDT

C. Petrography of the Limestones

By J. HARLAN JOHNSON

D. Soils

By RALPH J. McCRACKEN

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By C. WYTHE COOKE

Part 4. Submarine Topography and Shoal-Water Ecology

K. Submarine Topography and Shoal-Water Ecology

By PRESTON E. CLOUD, Jr.

Professional Paper 280 is being published in the foregoing sequence of parts and chapters

Echinoids

By C. WYTHE COOKE

GEOLOGICAL SURVEY PROFESSIONAL PAPER 280-J

*Introducing four new species of
echinoids of Miocene age*



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GEOLOGY OF SAIPAN, MARIANA ISLANDS

ECHINOIDS

By C. WYTHE COOKE

ABSTRACT

Among echinoids obtained from Saipan, Mariana Islands, are the following species from the Miocene Tagpochau limestone: *Parasalenia marianae* Cooke, n. sp.; *Echinostrephus saipanicum* Cooke, n. sp.; *Heterocentrotus* sp.; *Acanthocidaris* sp.; *Echinoneus* sp.; *Clypeaster saipanicus* Cooke, n. sp.; *Sismondia polymorpha* Duncan and Sladen?; *Paraster saipanicus* Cooke, n. sp.; and *Echinolampas* sp. *Sismondia polymorpha*, though originally attributed to the Eocene Khirtar series of India, is probably restricted to the Miocene. It is the most abundant echinoid found in Saipan.

A few fragments of echinoids were also obtained from the Pleistocene(?) Mariana limestone, but the only recognizable Pleistocene(?) species is *Clypeaster reticulatus* (Linnaeus).

INTRODUCTION

Most of the few fossil echinoids reported on herein were obtained in 1949 by Preston E. Cloud, Jr., and Robert G. Schmidt from the Tagpochau limestone on Saipan, Mariana Islands. The age of this formation, as determined from other classes of organisms in the same limestone, is early Miocene. This correlation appears to be supported by the occurrence at several places in great abundance of a species of *Sismondia* tentatively identified as *S. polymorpha* Duncan and Sladen. This *Sismondia* has been reported under several different names in Miocene formations throughout the Indo-Pacific region. Other species of echinoids in the collection yield little evidence as to the age, for all are described as new.

Besides the Miocene species a few fragments of echinoids were obtained from the Pleistocene(?) Mariana limestone. The only species that has been identified is *Clypeaster reticulatus* (Linnaeus), which was found in fallen blocks at the foot of a bluff along the southeastern coast of Saipan (C46). The Recent species is widely distributed in Indo-Pacific waters. The Pleistocene(?) specimen measures 61 millimeters in length, larger than the usual size of the Recent forms, which range from 28 to 58 millimeters according to Mortensen's (1948, p. 73) table of measurements.

In lieu of detailed descriptions, localities referred to in the text are recorded on a gridded locality map (pl. 4)

and there listed in numbered sequence. This map also includes stratigraphic assignment for each locality.

SYSTEMATIC DESCRIPTIONS

Parasalenia marianae Cooke, n. sp.

Plate 119, figures 1-3

Horizontal outline elliptical, longitudinally elongated; upper surface gently arched; lower surface has a concave longitudinal profile. Apical arrangement unknown; apical scar subpentagonal, longer than wide. Ambulacra about half as wide as interambulacral areas; poriferous zones uniserial, nearly straight above the ambitus, breaking into inclined groups of 3 pairs below the ambitus; 3 pairs to each plate. Peristome large, elliptical, slightly wider than long; gill slits very shallow. Primary tubercles large, one on each plate, which it nearly covers; larger on the interambulacral areas than on the ambulacra, where they are much reduced near the apex. Secondary tubercles small, lying in zigzag rows along the median suture lines and in straighter rows along the outer suture lines. Intermediate spaces covered by a fine granulation.

Occurrence.—S144, northwest-central Saipan.

Geologic horizon.—Miocene, Tagpochau limestone, marly beds in inequigranular facies, *Sismonia* zone.

Type—USNM 561578.

Comparisons.—The apical system of *Parasalenia marianae* is subpentagonal, whereas those of the Recent *P. gratiosa* A. Agassiz and *P. pöhlii* Pfeffer as figured by Mortensen (1943, pls. 29-31) are plainly star shaped and proportionately larger. *Parasalenia marianae* is very similar to *P. prisca* (Cotteau) (Jackson, 1922, p. 25, pl. 1, figs. 21-24) from the Miocene of Anguilla, British West Indies, but its primary tubercles are larger and occupy a greater part of the plate, and its peristome is more weakly notched. I fail to find more than three pairs of pores on one ambulacral plate of any of the cotypes of *P. prisca*, and the longer diameter of the test seems to coincide with the longitudinal axis, as in *Parasalenia*. These features remove *P. prisca*

from *Echinometra*, as was pointed out by Pomel (1883, p. 78).

Parasalenia marianae is more elongated than *P. fontannesii* Cotteau (1888, p. 266, pl. 9, figs. 9-13; 1889, p. 332, pl. 15, figs. 11, 12), but its primary tubercles and the arrangement of its pores are similar. The type is larger than Cotteau's figured specimens and has more secondary tubercles. *P. fontannesii* is from the Aquitanian of France.

Echinostrephus saipanicum Cooke, n. sp.

Plate 119, figures 4-6

Horizontal outline subpentagonal; lower surface nearly flat; upper surface moderately inflated; margin rounded. Apical system rather small; arrangement of plates obscure. Periproct central, small. Amublacra about half as wide as interambulacral areas; zygopores arranged in diagonal groups of 3; 1 row of primary imperforate tubercles adjacent to the poriferous zones, 1 tubercle to each compound plate, and 1 row of smaller tubercles adjacent to the median sutures, these tubercles rapidly dwindling in size away from the ambitus; several other very small tubercles on each plate. Interambulacral areas having 1 complete row of primary tubercles along each outer edge and 3 additional equally large tubercles on each plate in the ambital and subambital regions; intermediate regions above the ambitus bare except for very small secondaries; secondary tubercles also surround the primaries in the ambital region. Peristome large, occupying about half of the diameter; rather deeply notched. Horizontal diameter 21.8 mm; height 10 mm; diameter of peristome 10.7 mm; diameter of periproct about 2 mm.

Occurrence.—S617, northeast-central Saipan.

Geologic horizon.—Miocene, Tagpochau limestone, tuffaceous facies.

Type.—USNM 561579.

Comparisons.—Apparently no fossil species of this rock-boring genus have been described, and only two Recent species are known—*Echinostrephus molare* (de Blainville) and *E. aciculatum* A. Agassiz, both Pacific species. *E. saipanicum* is more or less intermediate between these two and may be the ancestor of both. It resembles *E. molare* in having its zygopores in arcs of three, not four as in *E. aciculatum*, but seems to be closer to the latter in the arrangement of its tubercles.

Acanthocidaris sp.

Plate 119, figure 8

A fragment apparently represents an undescribed species of *Acanthocidaris* or a related genus.

Occurrence.—S673, east-central Saipan.

Geologic horizon.—Miocene, Tagpochau limestone, transitional facies.

Figured specimen.—USNM 561580.

Heterocentrotus sp.

Plate 119, figure 7

A fragment of a *Heterocentrotus* has not been specifically identified.

Occurrence.—S673, east-central Saipan.

Geologic horizon.—Miocene, Tagpochau limestone, transitional facies.

Figured specimen.—USNM 561581.

Echinoneus sp.

One small fragment apparently representing the genus *Echinoneus* but not specifically identifiable.

Occurrence.—S128, northeast-central Saipan.

Geologic horizon.—Miocene, from limestone block in Donni sandstone member of Tagpochau limestone.

Clypeaster saipanicus Cooke, n. sp.

Plate 119, figures 14-17

Horizontal outline oval, much longer than wide; petaloidal region moderately high; lower surface deeply concave; margin thick. Apical system having four genital pores rather close together. Petals short, anterior the longest; poriferous zones wide open at the outer ends; sides moderately curved. Peristome central, small. Ambulacral grooves not conspicuous. Periproct very near the margin. Tubercles deeply scrobiculate. Length 42.5 mm; width 30.9 mm; height 11 mm.

Occurrence.—S673, east-central Saipan.

Geologic horizon.—Miocene, Tagpochau limestone, transitional facies.

Types.—Type, USNM 561582; paratype, USNM 561583.

Remarks.—This species seems to be quite different from any other described from the Indo-Pacific region. In shape it resembles the internal mold from Luzon figured without description by Pratt and Smith (1913, pl. 2, fig. 3) under the name *Laganum multiforme tayabum* and by Israelsky (1933, p. 302, pl. 1, figs. 2-4) as *Clypeaster* cf. *C. scutiforme* Gmelin. It is represented by the holotype, one broken paratype, and several smaller fragments.

Sismondia polymorpha Duncan and Sladen?

Plate 119, figures 9-13

?*Sismondia polymorpha* Duncan and Sladen, 1884, Palaeontologia Indica, ser. 14, v. 1, pt. 3, fasc. 3, p. 137, pl. 25, figs. 1-13.

?*Sismondia murravica* Tate, 1893, Royal Soc. New South Wales Jour., v. 27, p. 193, pl. 13, fig. 5.

- Sismondia javana* Gerth, 1922, Geol. Reichs-Mus. Leiden Samml., n. F., Band 1, Abt. 2, Heft 4, p. 502, pl. 62, figs. 4, 4a.
Sismondia convexa Nisiyama, 1937, Tokyo Imp. Acad. Proc., v. 13, no. 2, p. 41, figs. 1-13.
Sismondia javana Gerth, Jeannet and Martin, 1937, Leidsche Geol. Meded., Deel 8, Afl. 2, p. 241, figs. 24, 25.
 ?*Sismondia murravica* Tate. Clark, 1946, Carnegie Inst. Washington Pub. 566, p. 351.

Horizontal outline ovate to subpentagonal; upper surface nearly flat; lower surface slightly concave; margin thick, rounded. Apical system central, tumid, with 4 widely spaced genital pores and 1 variably placed madreporic pore. Ambulacra slightly tumid, much expanded near the margin, where they are 4 times as wide as the interambulacral areas; poriferous zones open at the apex, expanding and then becoming nearly straight and slightly flaring at the outer ends, which are wide open; inner pores circular; outer pores oval, conjugate; zygopores diagonal, becoming strongly slanted at the outer ends of the petals, which extend more than halfway to the margin; interporiferous zones about 3 times as wide as the poriferous zones. Peristome small, central, pentagonal, sunken; surrounded externally by 5 short, inconspicuous ambulacral grooves, forming the apices of 5 internal U-shaped ridges that extend to the margin, where they form buttresses. Periproct circular or oval, nearly as large as the peristome; on lower surface about halfway to the margin; the distance to the margin varies according to the degree of truncation of the posterior end of the test. Surface covered with widely spaced small imperforate tubercles in deep circular scrobiculi. Sutures between the plates bordered by very fine pores. Length of largest individual 19.5 mm; width 18.3 mm; height 5.6 mm.

Occurrence.—Very abundant at S144, northwest-central Saipan in marly beds of inequigranular facies, Tagpochau limestone. Also found at localities S541, C109, C110, C122, C130, C134, C141, and C150.

Geologic horizon.—Miocene, Tagpochau limestone; inequigranular, marly, rubbly, and tuffaceous facies.

Figured specimens.—USNM 561584.

Remarks.—The specimens from Saipan agree in all details with Duncan and Sladen's illustrations of *Sismondia polymorpha*, no specimens of which have been available for direct comparison, however. Their identification is questioned because such a distinctive species is unlikely to have such a long geologic range as from the Eocene (Khirtar series of India, from which the type is reported) to the early Miocene, where it is abundant in Saipan. However, as Duncan and Sladen report no other species from the same locality, they may have been mistaken as to its age.

Sismondia murravica from Australia is placed in the synonymy tentatively because Tate's illustrations of

it are not detailed enough to prove its identity with *S. polymorpha*. Tate referred it to the Eocene, but according to Chapman (Clark, 1946, p. 351) it is Miocene.

There seems little doubt that the species from Saipan is the same as *Sismondia javana* Gerth from the Miocene of Java and *S. convexa* Nisiyama from the so-called Oligocene of Titi-zima, one of the Bonin Islands [Ogasawara-guntō]. The differences pointed out between these species and *S. polymorpha* appear to be individual variations.

The figures of *Laganum dickersoni* Israelsky (1933, pl. 2, figs. 1-9) bear some resemblance to this species, but they are about twice as large, and one (fig. 8) shows much more conspicuous ambulacral grooves, which may have been emphasized by retouching. The wide-open petals are unusual, to say the least, in the genus *Laganum*. *Laganum dickersoni* was described from the Pliocene Malumbang formation of the Philippines.

Paraster saipanicus Cooke, n. sp.

Plate 119, figures 18-21

Horizontal outline ovate-cordate, greatest width in front of the center; upper surface inflated, creased by a rounded anterior sulcus, which extends from the apex to the peristome; lower surface convex; posterior end truncated, overhanging. Apical system one-third the length from the posterior end; 4 genital pores arranged in a rectangle, the anterior pair smaller than the posterior and close to them. Petals deeply sunken; anterior pair curved forward to an angle of about 80° with each other, extending three-quarters of the way to the margin; posterior pair straight, more than half as long as the anterior pair, forming an angle of about 50° with each other; pores elongated, outer pores the longer, strongly conjugate; poriferous zones wider than the interporiferous. Anterior ambulacrum in a U-shaped, straight-sided sulcus; pores small, circular or oval; poriferous zones narrow; interporiferous zone very wide. Peristome semilunate, far forward, with a posterior lip. Periproct oval, higher than wide, high up on the posterior end. Peripetalous and lateral fascioles present. Length 30 mm; width 26 mm; height 18.5 mm.

Occurrence.—S144, northwest-central Saipan.

Geologic horizon.—Miocene, Tagpochau limestone, marly beds in inequigranular facies.

Type.—USNM 561585.

Comparison.—The posterior truncation of the type of this species is not so steep as that of *Schizaster jeanneti* R. Martin as figured by Jeannet and Martin (1937, p. 293, figs. 63a-c, 64) from the Pliocene(?) of the Dutch East Indies. There may be other differences

that are not apparent from the figures, for the differences between species of *Paraster* are generally so subtle and the individual variation or distortion so great that study of a large series is necessary to determine the specific peculiarities.

***Echinolampas* sp.**

Plate 119, figures 22, 23

A large, badly crushed *Echinolampas* measuring 87 mm in length by 80 mm in width may represent *Echinolampas concavus* Hayasaka (1948, p. 89; Hayasaka and Morishita, 1947, pl. 9, fig. 2), a species described from the Kokan tuff of Formosa and attributed to the early Miocene. Its petals are rather short, and the poriferous zones are of unequal length.

Occurrence.—C136, south-central Saipan.

Geologic horizon.—Miocene, Tagpochau limestone, marly facies.

Figured specimen.—USNM 561586.

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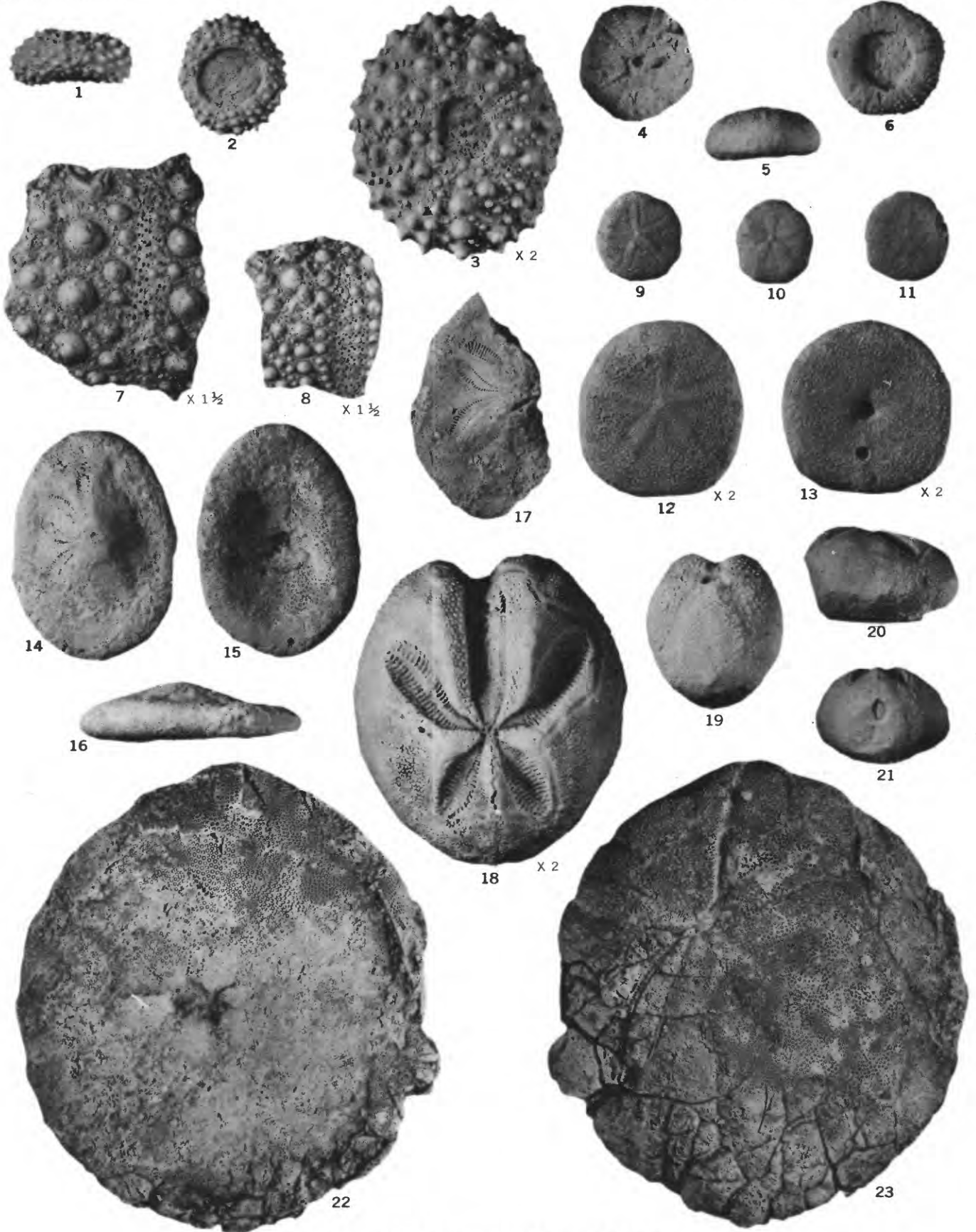
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PLATE 119

PLATE 119

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MIOCENE ECHINOIDS FROM SAIPAN