

# Upper Cenozoic Echinoids from the Lee Creek Mine

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## ABSTRACT

One Miocene, three Pliocene, and two Pliocene-Pleistocene echinoid species have been collected from the Lee Creek Mine, Aurora, North Carolina: *Abertella aberta* (Conrad) from the middle Miocene Pungo River Formation; *Echinocardium kelloggi*, new species, *Psammechinus philanthropus* (Conrad), and *Arbacia improcera* (Conrad) from the lower part of the Yorktown Formation (lower Pliocene), and *Mellita* cf. *M. acclinensis* Kier and *A. improcera* (Conrad) from the Croatan Formation (Pliocene-Pleistocene).

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## Introduction

Only a few specimens representing five species of echinoids have been collected at the Lee Creek Mine and most of them were found by Mr. Jack H. McLellan, who most generously presented them to the National Museum of Natural History, Smithsonian Institution. The mine is located on the south side of the Pamlico River, near Aurora, Beaufort County, North Carolina, and is operated by Texasgulf Inc. The stratigraphy, age determinations of the beds, and geographic setting of the mine are described in detail by Gibson (pp. 57–77, herein) and Hazel (pp. 90–98, herein).

*Abertella aberta* (Conrad) is found in the upper limey beds of the middle Miocene Pungo River Formation. This species is previously known from the Choptank Formation in Maryland, which is

considered to be middle Miocene. According to Gibson (1967:636–637) the Pungo River Formation correlates with the Calvert Formation of Maryland, which underlies the Choptank. *Echinocardium kelloggi*, new species, *Psammechinus philanthropus* (Conrad), and *Arbacia improcera* (Conrad) occur in spoil from the Yorktown Formation in beds which Gibson (1967) assigned to his unit 2, which he then considered late Miocene but now (p. 363, herein) places in the Pliocene. *Psammechinus philanthropus* and *A. improcera* have been found in Virginia in the Yorktown Formation (*Orionina vaughani* zone), which is now considered by Hazel (p. 94, herein) to be Pliocene. The beds where these specimens were found in the Lee Creek Mine are composed predominantly of spines that appear to be of *Echinocardium kelloggi*, suggesting that this species occurred in great numbers. *Mellita* cf. *M. acclinensis* Kier and fragments of *A. improcera* occur higher in the Croatan Formation, which Hazel (p. 94, herein) considers Pliocene-Pleistocene. *Mellita acclinensis* is known elsewhere from the Yorktown Formation (*Orionina vaughani* zone) of Virginia, the Tamiami Formation (also considered Pliocene by Hazel, p. 94 herein) of Florida, and the Yorktown Formation (*Puriana mesacostalis* zone) of North Carolina, which Hazel considers equivalent in age to the Croatan Formation.

ACKNOWLEDGMENTS.—I thank Jack H. McLellan, Peter J. Harmatuk, and the many other collectors who searched so assiduously for echinoids at the Lee Creek Mine and who then so generously presented them to the National Museum of Natural History. I am particularly in-

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debted to Clayton E. Ray who not only found some of the specimens but who has so ardently worked to bring about this comprehensive study of the fauna of the Lee Creek Mine. Thomas G. Gibson and Joseph E. Hazel advised on the stratigraphy and age determinations of the beds. The photography was done by Thomas F. Phelan and Mary H. Lawson.

### *Echinocardium kelloggi*, new species

FIGURE 1; PLATE 1: FIGURES 1-5.

**Diagnosis.**—Species characterized by high test, with wide area circumscribed by internal fasciole, oblique posterior truncation with entire periproct exposed adapically, and presence of large pore-pairs within internal fasciole in anterior poriferous zone of anterior petals.

**MATERIAL.**—One complete and uncrushed specimen, and many fragments.

**SHAPE AND SIZE.**—Specimen 36 mm long, 31.2 mm wide, 22.2 mm high; width 87 percent length, height 61 percent length. Greatest width anterior of center, greatest height midway between apical system and anterior margin; posterior pointed; truncation tilted exposing periproct adapically.

**APICAL SYSTEM.**—Four genital pores, ethmolytic with genital 2 extending far posteriorly, apical system located at distance from anterior margin to center of genital pores equal to 44 percent length of test.

**AMBULACRA.**—Anterior ambulacrum not petaloid, in groove from apical system to peristome, at anterior margin depth of groove equal to 4.4 percent length of test; pore-pairs within internal fasciole oblique with adapical pore of pair larger than adoral, small node between pores of each pair; pores in plates between internal fasciole and phyllode very small, single or slit-like; 8 pores in single poriferous zone from internal fasciole to peristome.

Anterior paired petals very wide with large pore-pairs outside of internal fasciole and 6 large pore-pairs within internal fasciole in posterior poriferous zones, 2 in anterior poriferous zones; petals slightly depressed, narrowing distally; 10

large pore-pairs outside of internal fasciole in petal IIa, 6 large pore-pairs outside of internal fasciole in petal IIb.

Posterior paired petals with no large pore-pairs within internal fasciole, 8 large pore-pairs in petal Va and petal Vb outside of internal fasciole; outer poriferous zones of anterior and posterior petals forming almost continuous arc; ambulacral plates beyond petals with single pores except within anal fasciole, where 2 pore-pairs in each single poriferous zone.

**INTERAMBULACRA.**—23 plates in interambulacrum 5, 14 in interambulacrum 1, 11 in 2 from internal fasciole to peristome.

**PERISTOME.**—Located at distance from anterior margin to anterior edge of peristome equal to 31 percent length of test; opening wider than high with width 20 percent length of test.

**PERIPROCT.**—Located high on posterior truncation, opening slightly higher than wide with height 14 percent length of test; located between plates 6-11.

**ORAL PLATE ARRANGEMENT.**—Labrum wide (Figure 1), extending across almost entire width of peristome, extending posteriorly and including part of second ambulacral plate; length of labrum, 11 percent length of test; plastron extending to posterior margin, length 50 percent length of test, greatest width 26 percent length of test; first plate of interambulacra 1, 4 very narrow. Ambulacra widening near peristome, phyllodes with 5 pores in ambulacrum III, 9 in II, 7 in I.

**FASCIOLAS.**—Internal fasciole prominent, but tract not clear enough for measurement of width, fasciole crossing ambulacral plates 7a and 7b in ambulacrum III, 18a and 14b in ambulacrum II,

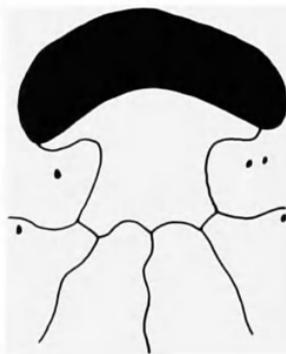


FIGURE 1.—*Echinocardium kelloggi*, new species, labrum of holotype, USNM 186521,  $\times 4$ .

20a and 21b in ambulacrum I, 13a and 13b in interambulacrum 5, 10a and 10b in interambulacrum 1, 7a and 7b in interambulacrum 2; greatest width of area circumscribed by internal fasciole anterior of apical system, width 46 percent length of test. Tract of subanal fasciole not clear.

COMPARISON WITH OTHER SPECIES.—*Echinocardium kelloggi* is easily distinguished from the other two fossil species (Table 1) of this genus known from North America: *E. marylandiense* Kier and *E. orthonotum* (Conrad). It differs from *E. marylandiense* in having a narrower test with its width only 87 percent of its length whereas in *E. marylandiense* the width is 98 percent of the length. Its peristome is narrower, 19 percent its length versus 23 percent, its plastron is narrower 26 percent its length versus 35 percent, and the area circumscribed by the internal fasciole is wider in *E. kelloggi*, 46 percent the length of the test versus 39 percent in *E. marylandiense*. Furthermore, in *E. kelloggi* the test has its greatest height anterior to the apical system, whereas it is posterior in *E. marylandiense*, the posterior is very pointed in *E. kelloggi* and truncated in *E. marylandiense*, the internal fasciole extends further anteriorly, and the labrum extends back to the second ambulacral plate whereas in *E. marylandiense* it does not extend beyond the first plate, and in *E. kelloggi* there are two large pore-pairs in the anterior poriferous zone inside the internal fasciole, whereas there are no large pore-pairs in these zones in *E. marylandiense*.

*Echinocardium kelloggi* differs from *E. orthonotum* in its higher test with its height 61 percent the length versus 53 percent in *E. orthonotum*, shorter plastron, 52 percent the length as opposed to 57 percent, longer labrum, 11 percent the length versus 7 percent, and far wider area circumscribed by the internal fasciole, 46 percent the length versus 31 percent in *E. orthonotum*. *E. kelloggi* has two large pore-pairs within the internal fasciole in the anterior poriferous zone of the anterior petals, whereas there are none in *E. orthonotum*, its greatest height is anterior of the apical system, whereas it is posterior in *E. orthonotum*, and the posterior truncation is very oblique in *E. kelloggi*

TABLE 1.—Comparison of mean percent of test length among *Echinocardium kelloggi*, *E. orthonotum*, and *E. marylandiense*

Characters measured	<i>E. kelloggi</i>	<i>E. orthonotum</i>	<i>E. marylandiense</i>
Width of test	87	86	98
Height of test	61	53	59
Distance from anterior edge of peristome to anterior margin	31	27	32
Width of peristome	19	20	23
Width of periproct	14	16	13
Length of plastron	52	57	52
Width of plastron	26	29	35
Length of labrum	11	7	9
Width of area circumscribed by internal fasciole	46	31	39

exposing all the periproct adapically, whereas it is more vertical in *E. orthonotum*.

OCCURRENCE.—Unit 2 (Gibson, 1967) of the Yorktown Formation (lower Pliocene). This echinoid, and many fragments of the same species, occurs in a lightly cemented greenish sand containing numerous hollow spines that appear to be from this species, and the mollusks *Echphora quadricostata*, varieties of *Pecten jeffersonius*, and *Ostrea disparilis* (McLellan, 1972 in litt.). The echinoids appear to have been reworked; the tests are fragmentary, and the spines are jumbled.

TYPE SPECIMEN.—Holotype, USNM 186521. Collected by Jack H. McLellan. Fragments of other specimens collected by Clayton E. Ray.

### *Arabacia improcera* (Conrad)

PLATE 1: FIGURE 6

*Echinus improcerus* Conrad, 1843a:310.

*Psammechinus improcerus*.—Stefanini, 1912:705.

*Coelopleurus improcerus*.—Clark and Twitchell, 1915:180, pl. 84, fig. 4a-c.

*Arabacia improcera*.—Cooke, 1941:11, pl. 1, figs. 7-9.—Cooke, 1959:20, pl. 4, figs. 1-3.—Kier, 1963, pl. 1, fig. 6; 1972:8-9, pl. 1.

Five specimens belong to this species previously known from the lower Pliocene, Yorktown Formation (*Orionina vaughani* zone) in Virginia. These

specimens were collected in float but the matrix inside one of them contains hollow spines similar to those found in Gibson's (1967) unit 2 low in the Yorktown Formation, and presumably these specimens came from this unit. The spines are probably from *Echinocardium kelloggi*, new species.

Some isolated plates and spines that appear to belong to *A. improcera* were collected from higher in the Croatan Formation. Three interambulacral plates are preserved intact, and they have the same ornamentation of crenulations and a single row of tubercles typical of *A. improcera*. The spines are indistinguishable from those found in a living *Arbacia* (they have not been found previously with *A. improcera*) and some of the spines even retain their color, which is similar to the color of the spines of the Recent *Arbacia punctulata* (Lamarck), a species very similar to *A. improcera*, living off the coast of North Carolina.

**OCCURRENCE.**—Complete specimens found in float of the Yorktown Formation (probably Gibson's unit 2). Fragments and spines found in the Croatan Formation.

**FIGURED SPECIMEN.**—USNM 186522, collected by Robert W. Purdy. Other specimens collected by Clayton E. Ray, Jack H. McLellan, Donald and Ralph Chamness, and Edgar A. Womble, Jr.

### *Psammechinus philanthropus* (Conrad)

PLATE 1: FIGURE 7; PLATE 2: FIGURES 4–7

*Echinus philanthropus* Conrad, 1843a:310; Conrad, 1846:220.  
*Psammechinus philanthropus*.—Meek, 1864:2.—Stefanini, 1912:705.—Clarke and Twitchell, 1915:181, pl. 84: fig. 6a–c.—Cooke, 1941:16; 1959:6, pl. 3: figs. 1, 2.—Kier, 1972:9–11, fig. 3, pl. 2: figs. 2–8, pl. 3, pl. 4: figs. 1, 3, pl. 5: figs. 1, 3.

*Echinus ruffini* Forbes in Lyell, 1845a:426, fig. 1a–d; 1845b: 560, 2 figs.).—Desor, 1858:121.—Emmons, 1858:306, fig. 239a–d.—Stefanini, 1912:705.

Fourteen specimens have been found that are indistinguishable from specimens of this species known previously from the Yorktown Formation (*Orionina vughani* zone) of Virginia.

**OCCURRENCE.**—Unit 2 (Gibson, 1967) of the lower Pliocene Yorktown Formation.

**FIGURED SPECIMEN.**—USNM 186523. Collected by Jack H. McLellan. Other specimens collected by Francis M. Hueber, Michael Cohen, Edgar A. Womble, Jr., James Kaltenbach, Clayton E. Ray, Ralph Eshelman, Ronald H. Pine, and Frank C. Whitmore, Jr.

### *Abertella aberti* (Conrad)

*Scutella aberti* Conrad, 1842:194 [for a complete synonymy, see Cooke, 1959:44].

Many fragments can be assigned to this species previously known from the Miocene Choptank Formation in Maryland and the Chipola Formation in Florida.

**OCCURRENCE.**—Upper limey layers of the middle Miocene Pungo River Formation, which Gibson (1967) correlates with the Calvert Formation of Maryland. Specimens collected by Jack H. McLellan.

### *Mellita* cf. *M. acclinensis* Kier

PLATE 2: FIGURES 1–3

*Mellita acclinensis* Kier, 1963:40–45, figs. 36–41; pl. 15:figs. 1–3; 1972:11–12, pl. 6, pl. 7: fig. 1.

There are five moderately well-preserved specimens that are very similar to this species previously described from the Pliocene Tamiami Formation in Florida, the Pliocene *Orionina vughani* zone of the Yorktown Formation of Virginia, and the Pliocene-Pleistocene *Puriana mesacostalis* zone of the Croatan Formation of North Carolina. These specimens are also quite similar to *Mellita caroliniana* (Ravenel) known from Pliocene-Pleistocene beds in South Carolina. They appear to be intermediate between these two species. *Mellita acclinensis* is distinguished from *M. caroliniana* in having a flatter test and narrower lunules. These Lee Creek specimens have the flat test of *M. acclinensis* but in some of the Lee Creek specimens the lunules are more rounded as in *M. caroliniana*. Furthermore, in *M. acclinensis* the posterior lunule extends anteriorly almost in contact with the

periproct; whereas, in the Lee Creek specimens and in *M. caroliniana* the periproct is separated by a considerable distance from this lunule. Perhaps these two species are synonymous, but more specimens are needed before this can be decided.

OCCURRENCE.—Croatan Formation.

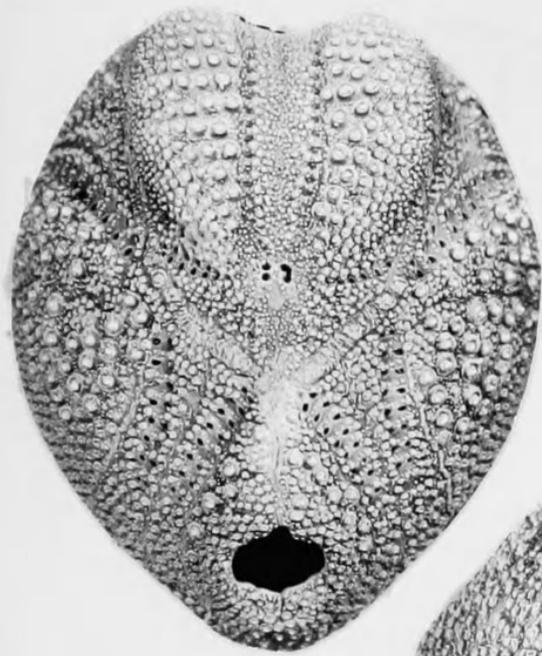
FIGURED SPECIMEN.—USNM 186524, collected by Jack H. McLellan; other specimens collected by Lauck W. Ward, William W. Bennett, and Clayton E. Ray.

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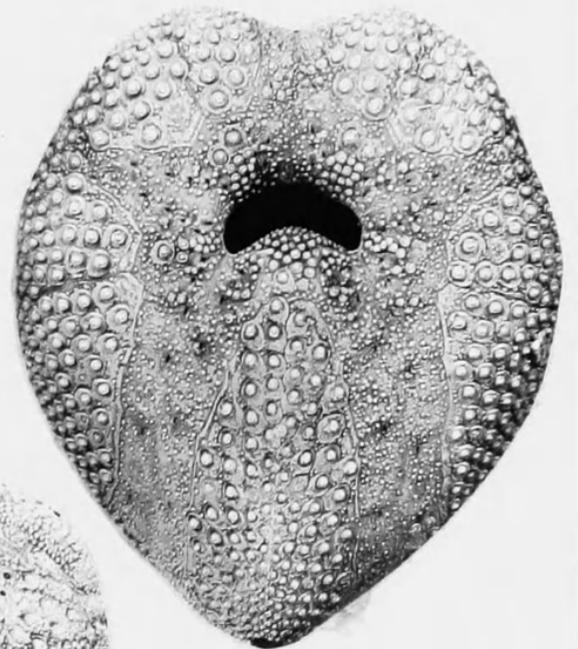
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## PLATE 1

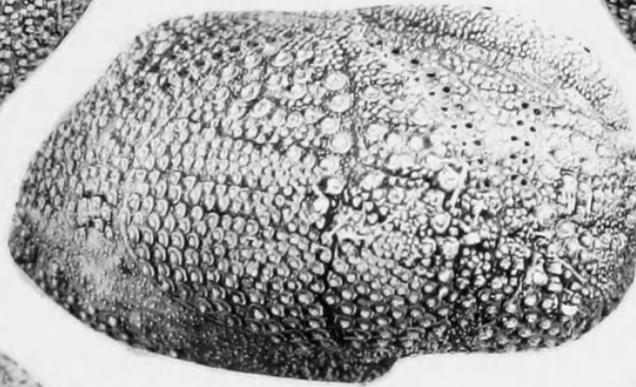
- 1-5. *Echinocardium kelloggi*, new species, USNM 186521, holotype: 1, adapical view; 2, adoral view; 3, right side; 4, posterior view; 5, anterior view;  $\times 2$ . Unit 2 (Gibson, 1967) of the Yorktown Formation (lower Pliocene). Collector: Jack H. McLellan.
6. *Arbacia improcera* (Conrad), USNM 186522, adapical view,  $\times 3$ . Presumably unit 2 (Gibson, 1967) of Yorktown Formation (lower Pliocene). Collector: Robert W. Purdy.
7. *Psammechinus philanthropus* (Conrad), USNM 186523, view of interambulacrum at ambitus,  $\times 5$ . Unit 2 (Gibson, 1967) of the Yorktown Formation (lower Pliocene). Collector: Jack H. McLellan.



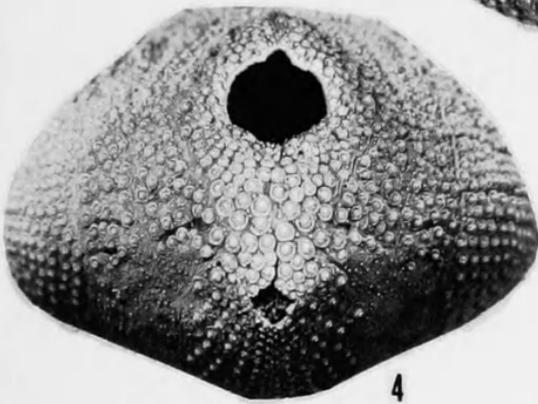
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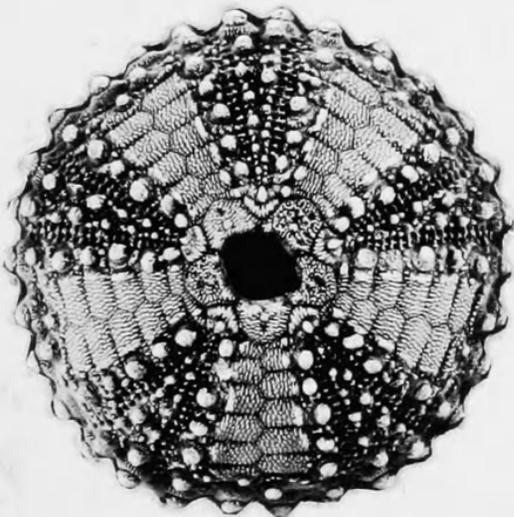
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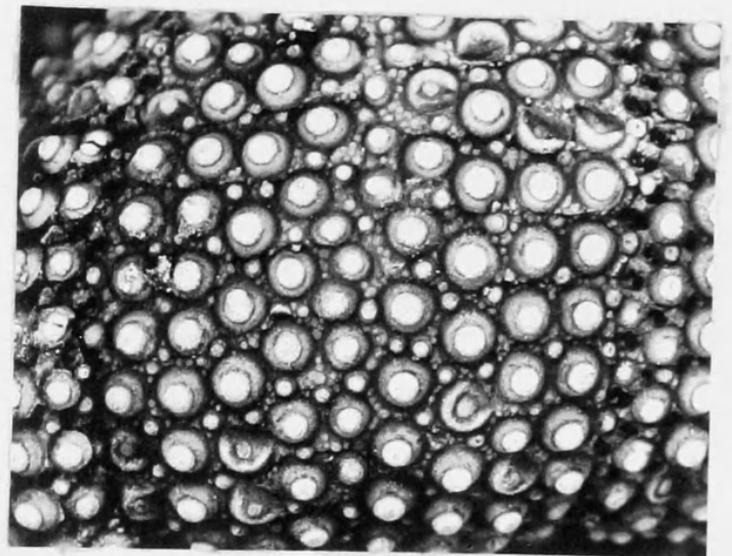
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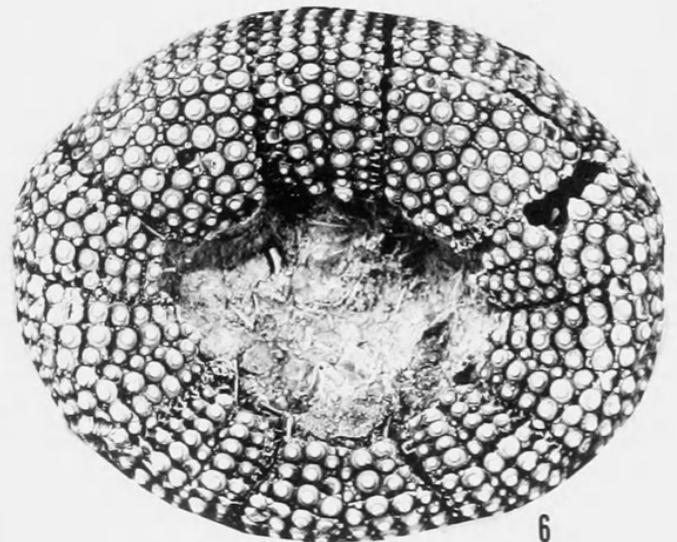
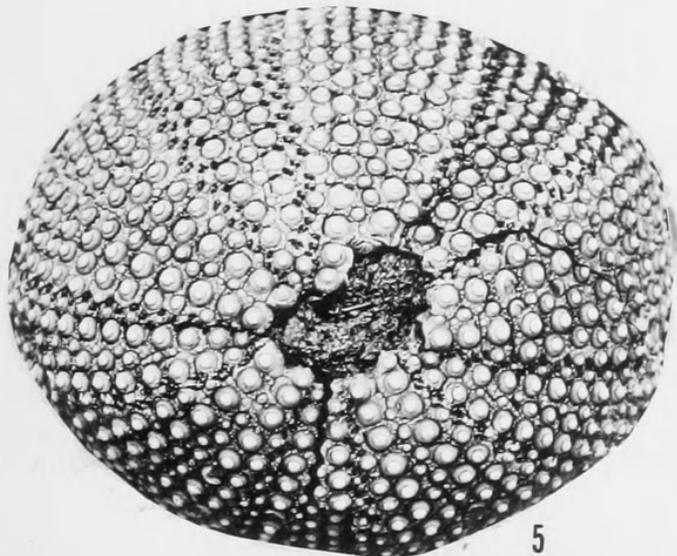
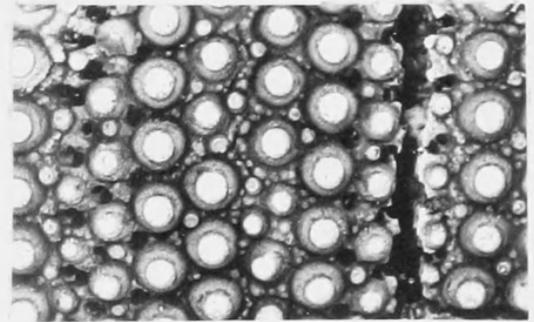
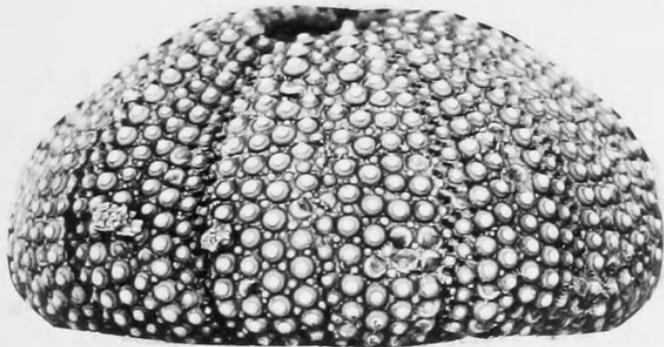
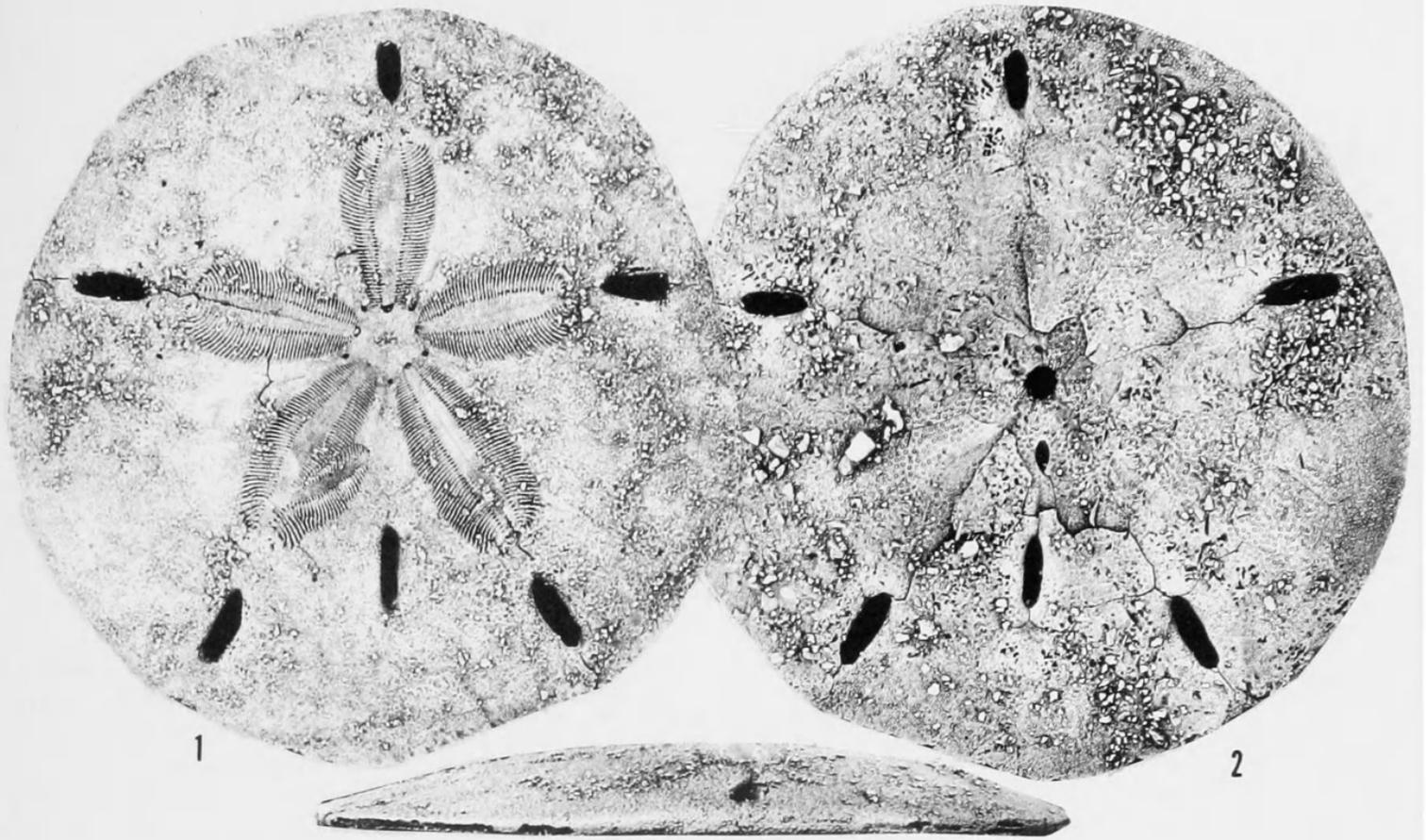
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**PLATE 2**

- 1-3. *Mellita* cf. *M. actinensis* Kier, USNM 186524: 1, adapical view; 2, adoral view; 3, right side;  $\times 2$ . Croatan Formation. Collector: Jack H. McLellan.
- 4-7. *Psammechinus philanthropus* (Conrad), USNM 186523: 4, side view;  $\times 2$ ; 5, adapical view,  $\times 2$ ; 6, adoral view,  $\times 2$ ; 7, view of ambulacrum at ambitus,  $\times 5$  (see Plate 1: figure 7 for view of interambulacrum). Unit 2 (Gibson, 1967) of the Yorktown Formation (lower Pliocene). Collector: Jack H. McLellan.







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