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ON SOME WEST INDIAN ECHINOIDS

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The present work forms No. 74 of the *Bulletin* series.

RICHARD RATHBUN,
Assistant Secretary, Smithsonian Institution,
In charge of the United States National Museum.

WASHINGTON, D. C., September 7, 1910.

TABLE OF CONTENTS.

	Page.
Introduction	1
Description of species	2
Calocidaris micans (Mortensen)	2
Tretocidaris bartletti (A. Agassiz)	5
Stylocidaris lineata, new species	10
Cidaris abyssicola, var. teretispina, new variety	13
Cidaris rugosa (H. L. Clark)	16
Aræosoma belli Mortensen	17
Diadema antillarum Philippi	21
Revised list of the Echinoids known to occur in the American region of the North Atlantic, and in the West Indies	22
Explanation of plates	26
Index	29

ON SOME WEST INDIAN ECHINOIDS.

By Theodor Mortensen,
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INTRODUCTION.

In my work on the Echinoidea of the Danish *Ingolf* expedition preliminary diagnoses are given of several new species of echinoids. These diagnoses, though, I think, in general sufficient for the recognition of the species, are, of course, by no means detailed, and I hope in the future to be able to publish full descriptions of all the species which I have thus established. The difficulty is that most of these are not represented in the Copenhagen Museum, so that I must depend on what opportunities there may be for me to get material from other institutions. Such an opportunity was accorded me on a visit to the U. S. National Museum in the spring of 1906. I found there a good representation of two of my previously indicated species, namely, *Calocidaris micans* and *Araeosoma belli*. I was allowed to examine this material in detail, and as I had no time to do it during my short stay in Washington, I was permitted to borrow the specimens and to have them sent to Copenhagen, where I could study them exhaustively.

Together with this material I also received some other specimens of West Indian cidarids. The study of these specimens, together with some collections made by myself during a stay in the Danish West Indies in the winter 1905–6, made it clear to me that still another species of cidarid, besides those previously known, occurs in the West Indian seas, probably hitherto confounded with *Cidaris cidaris* (*Dorocidaris papillata*), as has been the case with so many other species. A description of this new form is included here. A full description is also given of the much discussed, but hitherto not thoroughly described, *Tretocidaris bartletti*, of which species I have likewise had material sent for study. Finally a few remarks are added on the species *Cidaris abyssicola* and *C. rugosa*.

The revised list of North American Atlantic and West Indian Echinoids may, I hope, prove not without value.

DESCRIPTION OF SPECIES.

CALOCIDARIS MICANS (Mortensen).

Plate 1; plate 14, figs. 5–6; plate 15, figs. 1–2, 7; plate 16, figs. 3–5, 7–8, 10, 13–14; plate 17, figs. 7, 12–13.

Dorocidaris (?) *micans* Th. Mortensen, *Ingolf* Echinoidea, pt. 1, 1903, p. 23, pl. 9, fig. 26; pl. 11, fig. 24.

Calocidaris micans H. L. Clark, The Cidaridæ, Bull. Mus. Comp. Zoöl., vol. 51, 1907, p. 211, pl. 3.

Two specimens of this very beautiful cidarid were received for examination from the U. S. National Museum, and form the basis of the following description. They were dredged at *Albatross* stations 2348 and 2354. The very beautiful specimen figured on plate 1 I have not examined in detail. It is the specimen mentioned by Clark as "the most beautiful echinoid" he has ever seen. The photograph was made at the U. S. National Museum.

Measurements.

Diameter.	Height.	Apical system.	Anal system.	Peristome.	Width of—		Number of plates.		Radioles.
					Ambulacra.	Interambulacra.	Ambulacra.	Interambulacra.	
mm.	*mm.*[a]	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*			
48	37 (44)	21	11.5	20	5	24	94–95	8–9	Broken.
28	20 (25)	13.5	7.5	13	3	13	53–54	6–7	Do.

[a] The figures within the parentheses indicate the height from the mouth opening to the anal opening; the other figures indicate the height of the corona.

The test is high, the height of the corona being from 72 to 75 per cent of the horizontal diameter; the sides are regularly curved, not flattened above or below; the edge of the peristome is not incurved; the peristome and apical system are not flattened, but rise in continuation of the curvature of the corona, which makes the whole test appear almost spherical.

The ambulacra are in the two specimens 20.9 per cent and 23.1 per cent of the interambulacra in width (Clark gives 25 per cent); each ambulacral plate carries inside the primary tubercle a secondary tubercle of almost equal size in the middle of the plate (Plate 14, fig. 6); a very small tubercle is found at the lower edge of the plate between the two larger tubercles; there are thus four longitudinal series of tubercles in the interporiferous zone, except quite near the peristome and a somewhat larger part at the abactinal end, where the inner tubercle is found only on one side, irregularly alternating; at the upper end it has not appeared as yet. There is scarcely a distinct, naked median line, and Clark's "nearly bare median ambulacral areas" is not an adequate expression for the specimens at hand; the specimen figured by Clark also appears to have distinct inner series of tubercles. The above description is based upon the larger specimen; in the smaller specimen the inner tubercle has not yet appeared on both sides, even at the ambitus, but stands irregularly alternating, now on several plates in succession on one side, then on some plates on the other side, and so on, quite irregularly. In this specimen

the ambulacra are thus more in accordance with Clark's description (which is, however, made from a specimen 61 mm. in diameter); here the interporiferous zone is also a little more than half the width of the whole ambulacrum, whereas in the larger specimen it does not exceed half that width. The pores are not yoked; the partition wall is rather broad, somewhat elevated; the part of the plate above the pore pair is slightly elevated (Plate 16, fig. 14). The poriferous zone is distinctly sunken in the larger specimen, less so in the smaller one; Clark's statement, "poriferous zone scarcely at all sunken," thus does not hold for the species. The number of ambulacral plates is unusually large (see above); 17–19 ambulacral plates correspond to one interambulacral plate toward the abactinal side in the larger specimen, 15–16 in the smaller specimen.

The interambulacra are described by Clark as having the "median interambulacral area not at all sunken, covered with numerous miliaries and with more or less horizontal grooves or narrow furrows, such as occur in *Temnocidaris*." The specimens before me do not agree with this. The median part of the area is distinctly sunken, especially in the larger specimen; the horizontal furrows across the inner part of the plates are very distinct, especially in the larger specimen; they are quite similar to those found in *Cidaris cidaris* (*Dorocidaris papillata*), only somewhat more regular (Plate 14, fig. 5, to compare with Plate 14, fig. 1, of Prouho's Recherches sur le Dorocidaris papillata). The expression, "such as occur in *Temnocidaris*," is less fortunate, as there is no trace of the peculiar pits so characteristic of *Temnocidaris*, and it is much more natural to compare this feature in *C. micans* with the quite similar structure found in the more nearly related *Cidaris cidaris*. The areoles are not very deep; only the two lowermost are confluent, all the others being distinctly separated by a wall with tubercles, narrow below, gradually becoming broader toward the abactinal side. The tubercles surrounding the areoles are somewhat larger than those outside; the rest of the plates is covered by smaller, not very closely set, secondary tubercles. There is no distinct bare median space.

The apical system is essentially as in *Cidaris*. In the specimen figured by Clark all the ocular plates are in contact with the anal area; in the larger specimen before me only two ocular plates are in contact with the anal area, in the smaller specimen all are widely excluded. The anal area is covered mainly by two circlets of plates, an outer, larger, and an inner, smaller, within which some quite small ones are found around the anal opening. In the smaller specimen the whole apical system, in the larger only the anal area, is considerably elevated. The genital openings are rather distant from the edge, small—perhaps both specimens are males. The whole apical system is rather closely tuberculated.

The peristome has 16–17 ambulacral plates in each series; those of each two neighboring series do not join within, so that the interambulacral plates continue almost to the very edge of the mouth. The latter bear comparatively few tubercles, the peristome being somewhat sparsely covered with spines. In the smaller specimen there are only 13–14 peristomial ambulacral plates in each series, and the interambulacral plates do not reach the edge of the mouth.

The radioles are, as described in the *Ingolf* Echinoidea and by Clark, very characteristic; smooth, as if polished.[a] They are rather fragile, almost all of them

[a] For section, compare *Ingolf* Echinoidea, pt. 1, pl. 11, fig. 24.

on the specimens at hand being broken; one shows distinct traces of having been regenerated. They reach a very considerable length, more than three times the horizontal diameter of the test (Clark); they are cylindrical, scarcely tapering at all toward the point (Plate 1). Sometimes they show faint longitudinal ridges, which are, however, always quite smooth. The actinal radioles are somewhat flattened and widened (more so in the large specimen), more or less fluted toward the point, but not serrate on the edges; they are slightly curved (Plate 15, figs. 1–2 and 7).

The secondary spines are flat and pointed, appressed to the test. Those around the radioles are the largest, about 6 mm. long, the following about half that length, the remainder on the inner part of the interambulacral plates only about 1 mm. long. The primary ambulacral spines are scarcely 3 mm. long, flattened and pointed like the others; the inner ambulacral spines are only about 0.5 mm. long. The spines on the apical system are likewise very small, the inner circlet of spines around the anal opening being somewhat larger. "Ampullæ" are not found. The spines of the peristome, as usual, are somewhat curved.

The spicules are of the usual type. The actinal tubefeet are provided with a well-developed sucking disk. In the abactinal tubefeet no sucking disk is developed. In the tubefeet on the peristome the disk and the spicules below it are more complicated, irregular, spinous plates.

The pedicellariæ, as stated in the *Ingolf* Echinoidea,[a] are in general similar to those of the genus *Cidaris*. The large globiferous pedicellariæ (Plate 17, figs. 12, 13) have the valves terminating in a powerful end tooth above the large round opening; the stalk has no limb of freely projecting rods. The small globiferous pedicellariæ have only a very inconspicuous end tooth; the opening is very large, reaching nearly to the basal part (Plate 16, figs. 4, 10). They occur of different sizes, and the larger cannot always be distinguished with certainty from the tridentate pedicellariæ (Plate 16, fig. 5). These latter (Plate 16, figs. 3, 7, 8, 13; Plate 17, fig. 7) are long and slender (up to 1.5 mm. length of head), the valves joining along their edges in their whole length; the larger ones are rather strongly spinous at the upper end of the apophysis, and the blade is filled with irregular meshwork. The edges are thick, irregularly spinous.

The color is as described by Clark; it ought only be remarked that in the larger specimen also the abactinal system is almost white.

According to Clark, the species is as yet known only from off the northwestern coast of Cuba and from off Barbados, in depths of 125–205 fathoms (*Blake; Albatross*). I cannot give any additional information on this point.

That the species has been confounded with *Histocidaris* (*Porocidaris*) *sharreri* is certain, since the type-specimen was found thus labeled in the British Museum, as stated in the *Ingolf* Echinoidea.[a] Whether Agassiz has confounded it with *Histocidaris sharreri*, I do not know; but until it has been definitely proved to which species the specimen of "*Porocidaris sharreri*," which was mentioned in the *Blake* Echini on page 13, as being "of a light greenish-pink color when alive, the spines white with a delicate brownish-pink base," really belongs, I would rather

[a] Pt. 1, p. 22.

suggest that it is *C. micans*. In any case that species was dredged by the *Blake* as is now stated by Clark.

The genus *Calocidaris*, which was established by Clark for this species, is evidently very nearly related to *Cidaris* in the restricted sense (formerly *Dorocidaris*). The characters pointed out by Clark are "the very broad and nearly bare median ambulacral areas, the remarkable color, and the smooth, polished primaries." As shown here the ambulacra do not really differ from those of *Cidaris*. There thus remain only the color and the character of the radioles. This is certainly not of much importance for a generic distinction—especially since Doctor Clark does not otherwise consider the characters afforded by the radioles as being at all of generic value, as is so conspicuously shown by his conception of the genus *Phyllacanthus*. Nevertheless, I think we can accept the genus, the radioles—in my opinion—affording characters of sufficiently high value for generic distinction. Compare my remarks on this matter in Die Echinoiden der deutschen Südpolar Expedition (p. 49). (In *C. abyssicola* the radioles also appear very smooth; a close examination, however, shows them to be finely striate and serrate—they are not "polished" as in *Calocidaris*.) Also the whole appearance of this cidarid is very characteristic. It thus seems to me that the genus *Calocidaris* may be valid; but it seems likewise beyond question that it is closely related to the genus *Cidaris* (*Dorocidaris*).

TRETOCIDARIS BARTLETTI (A. Agassiz).

Plates 2-3; plate 7, fig. 6; plate 14, figs. 8-9; plate 15, figs. 8, 12-14; plate 16, figs. 2, 12; plate 17 figs. 1, 6.

Dorocidaris bartletti A. Agassiz, Bull. Mus. Comp. Zoöl., vol. 8, 1880, p. 69; Mem. Mus. Comp. Zoöl., vol. 10, 1883, p. 9, pl. 2, figs. 17-27, (not fig. 16).—R. Rathbun, Proc. U. S. Nat. Mus., vol. 8, 1885, p. 610; vol. 9, 1886, p. 261.—A. Agassiz and H. L. Clark, Mem. Mus. Comp. Zoöl., vol. 34, 1907, no. 1, p. 8, pl. 12 *a*, figs. 6-13.

Tretocidaris bartletti Th. Mortensen, *Ingolf* Echinoidea, pt. 1, 1903, p. 16, pl. x, figs. 23, 30; pt. 2, 1907, p. 169.—H. L. Clark, Bull. Mus. Comp. Zoöl., vol. 51, 1907, p. 203, pls. 8-9.—Th. Mortensen, Echinoiden der deutschen Südpolar Expedition, 1909, Ergbn. d. deutsch. Südpolar Exped., XI, Zoologie, vol. 3, p. 47.

Tretocidaris annulata Th. Mortensen, *Ingolf* Echinoidea, pt. 1, 1903, p. 16, pl. 9, fig. 4; pl. 10, figs. 22, 31; pt. 2, 1907, pp. 169-170.

This species, though it was not described before 1880, has had already a rather intricate history, and it has played a somewhat prominent part in the discussion of the classification of the cidarids in recent years. The history is as follows:

Having at first probably been confounded with *Cidaris abyssicola* as suggested by Mr. Agassiz in the Preliminary Report on the *Blake* Echini it was established as a separate species of the genus *Dorocidaris* by him in the same paper. In the final report on the *Blake* Echini it was again described and figures were given of the spines and of parts of the test; but unfortunately this description is insufficient and apparently the figures given are not all of this species. In the *Ingolf* Echinoidea (pt. 1), I established a new species, *annulata*, based upon an old specimen seen in the British Museum. This supposed new species differed from *bartletti* mainly in the structure of its test, the ambulacra having only a small secondary tubercle on each plate inside the primary tubercle, whereas figure 16, on the second plate of the *Blake* Echini shows the whole ambulacral area closely covered with secondary

tubercles, two distinct secondary tubercles on each plate inside of, and not much smaller than, the primary (in the description it is only said that "the median granulation [is] finer, than in the other West India species of the genus,") the interambulacra having a distinct naked median space, whereas the figure shows no naked median space (in the description it is only stated that the interambulacral plates "are covered by a comparatively coarse, irregularly arranged secondary granulation.") I had at that time no reason to doubt the correctness of the figure given; the specimen examined in the British Museum, however, could not possibly be identified with *bartletti* as there represented and thus had to be made a new species of the genus *Tretocidaris*, to which genus it was referred on account of its globiferous pedicellariæ, which were essentially like those found in *bartletti*.

During my visit to the U. S. National Museum I had occasion to examine the specimens of *Tretocidaris bartletti* preserved in the collections of that institution and I found that they had the same structure of the test as that described by me in *Tr. annulata*, not as shown in figure 16, of Plate 2 of the *Blake* Echini. Also a specimen examined in the collections of the Peabody Museum, Yale University, showed the same structure of the test. The result of these examinations was published in Part 2 of the *Ingolf* Echinoidea, pages 169–170, namely, that my *Tretocidaris annulata* was synonymous with *Tr. bartletti*, the quoted figure of the *Blake* Echini belonging to another species—or, in case this figure were correct, *Tr. annulata* must be maintained, and then all the specimens of *Tr. bartletti* seen by me in the U. S. National Museum and the Peabody Museum were not *Tr. bartletti* but *Tr. annulata*.

In Agassiz and Clark's memoir on the Cidaridæ (Hawaiian and other Pacific Echini) no mention is made of this question, but in H. L. Clark's important paper The Cidaridæ,[a] page 203, it is pointed out that my *Tr. annulata* can not be distinguished from *Tr. bartletti*. Although no full description is given of the species, it appears from his remarks thereon that he regards the specimens in the U. S. National Museum as true *bartletti*, and as he has had access to the type-specimen in the Museum of Comparative Zoology at Cambridge, this question has been solved. Of figure 16, on Plate 2, of the *Blake* Echini, which has caused the trouble, no word is said. Possibly it was made from a specimen of *Cidaris blakei* (A. Agassiz). Plate 14, fig. 7, represents part of an ambulacrum of this species. It will readily be conceded that the similarity to the quoted figure from the *Blake* Echini is considerable; only the latter figure represents the inner tuberculation a little more regular than it is in *C. blakei*. One more argument speaks for the correctness of the suggestion that the figure represents really *C. blakei*, namely, that no other West Indian cidarid has the ambulacra thus tuberculated; also the part of the interambulacral area represented in the figure agrees fairly well with *C. blakei*, only the tubercles around the areoles are scarcely so prominent as in nature (see fig. 1, on Plate 2 of the *Blake* Echini, which gives a good representation of this structure in *C. blakei*).

In the Hawaiian and other Pacific Echini, the Cidaridæ, it is pointed out that the globiferous pedicellariæ of *Tr. bartletti* may show a very considerable variation,

[a] Published in December, 1907; the second part of the *Ingolf* Echinoidea was published in November, 1907.

examples both with an end tooth and without occurring even in the same specimen, and this fact was especially urged as an argument against the value of the pedicellariæ in the classification of cidarids as set forth by me in the *Ingolf* Echinoidea. In The Cidaridæ Doctor Clark figured a specimen of *Tr. bartletti*, which, as he later informed me, was the specimen in which the various forms of pedicellariæ figured in the above quoted memoir (Plate 12*a*, figs. 6–13) were found. Now this specimen differs through its spines so much from the typical form of *Tr. bartletti* that I have suggested (Echinoiden der deutschen Südpolar Expedition, p. 47) that it may be a hybrid between *Tr. bartletti* and *Stylocidaris affinis;* the argument deduced from it against the classificatory value of the pedicellariæ would therefore be invalid. The correctness of this suggestion is discussed on page 10.

Thus runs the intricate history of this species. Though it has been so much discussed, as yet no adequate description or sufficient figures have been given of it. I thus naturally wished to take the opportunity here to give the description and figures wanted and, accordingly, two specimens were sent to me together with photographs of the largest specimen in the U. S. National Museum (Plates 2–3). The Museum of Copenhagen had previously received a small specimen of the species, which has also been made the object of study on this occasion. The following description is thus based mainly on these three specimens; but, of course, my notes on the specimens examined during my visit to Washington and New Haven are also taken into account.

Measurements.

Diameter.	Height.	Apical system.	Peristome.	Width of—		Number of plates.		Longest spines.
				Ambulacra.	Interambulacra.	Ambulacra.	Interambulacra.	
mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*			*mm.*
29	16	14	13	3.5	14	55–56	6–7	60
27	16	13	11.5	3.5	13.5	56–57	7	49
17	9	9	9.5	2.2	7.5	39–40	5–6	18.5

The test is rather low, the height 54–59 per cent of the horizontal diameter; the abactinal side is rather flat, the apical system only slightly elevated; the sides are beautifully arched; the edge of the peristome not incurved.

The ambulacra (Plate 14, fig. 9) are of the usual width, distinctly sinuate; close inside the primary tubercle each plate carries a small secondary tubercle at the lower edge, and between these two a very small miliary tubercle (carrying pedicellariæ) is generally found; the rest of the plate is naked, and there is thus a comparatively broad, wholly naked median space. In the largest specimen in the U. S. National Museum (68 mm. horizontal diameter) a small third tubercle has appeared inside the second on some of the ambulacral plates at the ambitus, but the naked median space remains as conspicuous as in the younger specimens.[a] On about 12–15 of the upper ambulacral plates as yet only the primary tubercle has

[a] The figures (Plates 2–3) do not show this, of course; a figure of the specimen in side view alone could show this feature.

appeared, and likewise some few of the plates at the actinal end of the area carry only the primary tubercle. This holds good for the larger and the smaller of the three specimens in hand; in the specimen of 27 mm. horizontal diameter the small inner tubercle has appeared on some of the plates near the apex and the peristome, but quite irregularly. The pores are separated by a rather broad wall, which is not at all elevated (Plate 16, fig. 12); the whole pore area is unusually flat and even, not distinctly sunken.

The interambulacra have a comparatively broad naked median line, which is slightly sunken; this is also the case with the upper horizontal sutures. The areoles are unusually low; only the two lowermost may be confluent (in larger specimens probably more may be so). The upper tubercles are very distinctly crenulated, but only on the abactinal side. (Plate 14, fig. 8.) The tubercles around the areoles are distinctly larger than those outside; these latter are few in number and only indistinctly arranged in horizontal series on the median part of the plate.

The apical system is 48–54 per cent of the horizontal diameter of the test; the genital plates are almost rectangular, only slightly broader within than without; the outer edge is very little prominent; the ocular plates are rather large, heart-shaped, more or less broadly in contact with the anal plate. (Plate 15, fig. 12.) In the smallest of the three specimens at hand they are all excluded from the anal area. (Plate 7, fig. 6.) The periproct is covered with rather numerous small plates. The whole apical system is somewhat sparsely covered with tubercles; those on the ocular plates are generally rather characteristically arranged, forming an arched series along the outer edge, just inside the ocular pore; those over the pore are considerably smaller than those laterally placed.

The peristome is from 42.5 to 45.5 per cent of the horizontal diameter, in the youngest specimen even 57 per cent; the interambulacral peristomial plates are quite regular; they do not reach quite to the mouth edge, but the adjoining ambulacral series do not, however, fully join at the inner edge. There are 11 ambulacral plates in each series in the specimen of 27 mm. The pores of each pair are placed nearly vertically (namely, one outside the other); the first pair is distinctly larger than the following.

The radioles are well shown in Plates 2–3; and the figures 18–27, Plate 2 of the *Blake* Echini likewise represent them very well. They are very characteristic, distinctly striate, coarsely spinous in the proximal part, the spinelets diminishing and disappearing toward the point. It is a very peculiar feature that these spines are developed exclusively on the upper side of the radioles, the lower side remaining almost entirely smooth, the longitudinal striæ being here only finely serrate (compare Plates 2–3). They are somewhat tapering, and the point may be somewhat widened. This form of radiole is evidently the typical form, but another form may occur in which the spines are not thus developed; the upper side of the radiole is then not more spinous than the lower side, the whole radiole being finely serrate along the longitudinal striæ. Such radioles are figured in Plate 2, figs. 20 and 23 of the *Blake* Echini, and according to Agassiz both forms may occur in one and the same specimen. I have not seen that myself. In the largest and the smallest of the specimens at hand the radioles are all of the typical spinous form, except some of the uppermost; but these are young radioles, not yet fully formed, without

ostracum. I might venture to suggest that the smooth radioles found by Agassiz in specimens with spinous radioles were really such young radioles. The third specimen at hand, on the contrary, has all the radioles of the smooth form; the same is the case in the specimen figured by Clark. (The Cidaridæ, Plates 8–9.) There are, however, reasons for suggesting that this form of radiole does not really belong to the species *bartletti*, the specimens bearing them being probably hybrids (see p. 10). The radioles are banded with brown, the ground color being whitish; the coarse spinelets are white, including those on the brown bands, which makes them especially prominent. In sections the radioles are seen to have the ostracum covered with fine, unbranched "hairs." (Plate 16, fig. 2.) In the smooth radioles these hairs appear to be somewhat less numerous. The actinal radioles (Plate 15, figs. 8, 13–14) are very little specialized, faintly serrate along the striæ of the aboral side; the striæ are very little developed on the adoral side and only toward the point. The secondary spines are flat and somewhat pointed; those around the radioles are distinctly longer and broader than the primary ambulacral spines (not nearly of the same size as mentioned in the description in the *Blake* Echini). The inner ambulacral spines are very small, not quite 1 mm. long; they scarcely reach the base of the primary ambulacral spines. These latter are about 3 mm., those surrounding the radioles about 4–5 mm. in length. The spines on the anal plates are rather large and are so bent as to cover the anal opening. Those on the genital and ocular plates are smaller, especially the latter; the spines forming the outer series on the ocular plates, mentioned under the description of the tuberculation, are bent outward so as to cover the ocular pore. "Ampullæ" are well developed on the abactinal spines, and also on those around the radioles.

The spicules do not afford any specific features; they are of the form typical of cidarids, and are arranged in the usual way so as to leave a naked space for the nerve.

The pedicellariæ of this species have received considerable attention. The large globiferous pedicellariæ are of the peculiar form described and figured in the *Ingolf* Echinoidea[a] with a well-developed end tooth and the opening reduced to a small pore. The stalk generally is provided with a limb of projecting rods, but this is not always distinct (see Plate 12*a*, figs. 12–13 of A. Agassiz and Clark; Hawaiian Echini, Cidaridæ).

The small globiferous pedicellariæ have, like the large form, a well-developed end tooth, but the opening is larger and triangular (Plate 17, fig. 6). As is often the case in Cidarids in which both large and small globiferous pedicellariæ have (or lack) an end tooth, intermediates occur of which it cannot be said with certainty whether they belong to the one or the other form, both forms varying considerably in size and also in the size of the opening. The tridentate pedicellariæ (Plate 17, fig. 1) are simple, narrow, the valves joining in the outer half of their length; there are numerous cross beams in nearly the whole length of the blade. They reach a size of 2 mm. in length of head.

In the Hawaiian Echini, Cidaridæ, Agassiz and Clark have figured a series of large globiferous pedicellariæ from a single specimen of *Tr. bartletti* (Plate 12*a*, figs. 6–11), showing a much larger degree of variation than described above, the

[a] Pt. 1, p. 16, pl. 10, figs. 22–23, 30–31.

variation ranging from the typical form to that with a large terminal opening and without an end tooth, resembling those of *Stylocidaris affinis*. Concerning this extraordinary variation I may first point out that the figure 6 in my opinion represents a young, not yet fully developed pedicellaria[a] and that figure 9 has very much the appearance of having the end tooth broken. But the figures 7 and 8 can not thus be disposed of; Doctor Clark has informed me that he is absoutely certain that they really belonged to the same specimen, and it is also said in the explanation of the plate that the form represented by figure 7 was quite common. The specimen in which these different forms of pedicellariæ were found is that figured by Clark in The Cidaridæ Plates 8–9, as Doctor Clark has informed me, namely, a specimen with the radioles of the unusual smooth form, so different from the typical spinous form. Agassiz and Clark do not indicate that they have found the different forms of pedicellariæ in any other specimen, and I, for my part, have found only the form with the small pore in all the specimens examined with spinous radioles; in the specimen with smooth radioles I have found a single globiferous pedicellaria of the *Stylocidaris* form among very numerous pedicellariæ of the typical form. On account of the uncommon form of the radioles in the specimen figured by Clark and the fact that two different forms of large globiferous pedicellariæ occur in this specimen I ventured to suggest, in my work Die Echinoiden der deutschen Südpolar Expedition (p. 47), that it is a hybrid between *Tr. bartletti* and *Stylocidaris affinis*. Having now had occasion to examine such a specimen myself, I feel strengthened in this opinion. On comparing this specimen with the typical form, one would at first refuse to regard the two as belonging to the same species, so different are they in appearance. But a close examination does not reveal any other features than the radioles by which to distinguish them, except the peculiar occurrence of the two forms of globiferous pedicellariæ. I do not, of course, maintain upon such scanty material that it is proved that the form with the smooth radioles is really a hybrid, but it seems to me a natural explanation of this peculiarity.

STYLOCIDARIS[b] LINEATA, new species.

Plates 4–6; plate 7, figs. 3–5; plate 14, fig. 10; plate 16, figs. 6, 9; plate 17, figs. 4, 8.

The shape of the test is very like that of *Stylocidaris affinis*, so that in this feature or in the relative proportions of the parts of the test scarcely any difference between the two species can be found. The ambulacra alone afford a difference, which appears to be constant and thus of value as a specific character. In all the four specimens at hand each ambulacral plate carries only one small tubercle within and a little below the primary tubercle; there is thus a rather broad bare median space left between the two quite regular series of tubercles (Plate 14, fig. 10). In *St. affinis* this also holds good in the younger specimens, but in the larger ones each ambulacral plate (at the ambitus) carries another smaller tubercle at the upper edge of the plate, the inner series thus becoming irregular and the median naked space less conspicuous (Plate 14, fig. 1). This third tubercle makes its appearance at a

[a] Agassiz and Clark (Hawaiian Echini, p. 8) have mentioned this as being possible but not probable.

[b] Concerning the name *Stylocidaris*, reference should be made to my work Die Echinoiden der deutschen Südpolar Expedition, p. 52.

size of about 25 mm. horizontal diameter. It must, however, be admitted that this tubercle (and its spine) is sometimes very small and inconspicuous, even in the larger specimens. The number of coronal plates is virtually the same in both species.

The apical system and peristome do not seem to afford any constant differences from *St. affinis* in structure or size. The radioles, on the other hand, afford a conspicuous difference through their greater length, more than twice the horizontal diameter of the test in grown specimens. This, it is true, may also be the case in *St. affinis*, as pointed out by Clark (The Cidaridæ, p. 203), but, so far as I have been able to find, only in the young specimens; in those fully grown specimens which I have seen they do not exceed one and one-half times the horizontal diameter. The structure of the radioles also differs somewhat in the two species. In *St. lineata* the hairs covering the ostracum are more slender than in *St. affinis* and they are not anastomosing (Plate 16, fig. 9), while in *St. affinis* they are generally somewhat branched and may form anastomoses (see *Ingolf* Echinoidea, pt. 1, pl. 11, fig. 1; the statement made there, p. 36, that they do not form anastomoses, does not always hold good). The radioles are beset with numerous small, longitudinally arranged spinelets as in *St. affinis*. The secondary spines do not differ in length or shape from those of *St. affinis*, only the "ampullæ" are, perhaps, somewhat larger than in that species.

The globiferous pedicellariæ do not present any distinct differences from those of *St. affinis;* the tridentate pedicellariæ, on the other hand, are characteristically different, as is best seen on comparing the two figures 4 and 14, Plate 17, representing a tridentate pedicellaria of each of the two species. The space between the valves is distinctly narrower in *lineata* than in *affinis;* and the basal part of the valves is also different in outline. They are considerably larger in *St. lineata* up to about 1.5 mm. length of head, whereas in *St. affinis* they scarcely exceed 0.8 mm. The spicules are alike in both species.

The color is white; against this ground color the brown median ambulacral and interambulacral line (to some extent also the horizontal interambulacral sutures), and a brown band over the middle of the genital plates, making a conspicuous ring on the apical system, stand out very beautifully. The secondary spines are wholly white; the radioles are also mostly white, but they may sometimes show a faint reddish tint, especially near the tip; there may even be traces of bands of this color.

I dredged this species (2 specimens) in about 250 fathoms off Frederiksted, Santa Cruz (Danish West Indies), in January, 1906. In the U. S. National Museum I have seen additional specimens of it from off Havana, taken by the U. S. fisheries steamer *Albatross* in 1886, besides several more specimens from stations 2135 (Cat. no. 10753), 2152 (Cat. no. 7485), 2154 (Cat. no. 7476), 2157 (Cat. no. 7478), 2162 (Cat. no. 7482), 2319–24, 2327, 2336–37, 2342, 2345–49 (Cat. nos. 10709–10). These specimens are mentioned in Doctor Rathbun's Catalogue of the Collection of Recent Echini in the U. S. National Museum, page 260, as *Dorocidaris papillata;* on the labels of most of them, however, is found a question mark indicating that Doctor Rathbun was doubtful whether they were correctly referred to that species. The species evidently must be rather common in the West

Indian seas and it is thus probable that it has also been dredged by the *Blake* and, likewise, included under *Dorocidaris papillata*. Whether Clark has included this species under "*Tretocidaris*" *affinis*, I can not say; but in any case he must certainly have seen some of the specimens mentioned above, since he has examined the collection of cidarids in the U. S. National Museum.

I have been in some doubt whether I should mention this form as a new species or only as a new variety of *affinis*. The distinguishing characters are certainly not very important, and the material at hand is small (I have not examined very closely all the specimens mentioned above as seen in the U. S. National Museum). Judging from the material at my disposal it would appear to be quite evident that we have here a distinct species; but Clark's statement that *affinis* is so very variable in color makes me hesitate in creating a new specific name for this form. However, I have taken this course in view of the fact that the differences in the ambulacra and in the tridentate pedicellariæ seem to afford very good specific characters; in addition to which the length of the spines, the brown bands on the test, and the total lack of red on the secondary spines contribute to make this form appear very characteristic. Should it ever prove untenable as a separate species no great harm will have been done, for, in any case, it will certainly be necessary to keep it as a distinct variety.

The reference of *affinis* to the genus *Tretocidaris* in Clark's important work The Cidaridæ, I have criticised in my report on the Echinoidea of the German Southpolar Expedition, pages 51–52, to which work I may refer. I venture to hope that I have there made it sufficiently evident that this disposition of it was erroneous. The genus *Stylocidaris* was established there for the group of species related to *affinis*, which was made the genotype.

In the *Challenger* Echinoidea Mr. Agassiz ascribes to *Cidaris cidaris* (*Dorocidaris papillata*) an almost cosmopolitan distribution; the North Atlantic, from Norway to the Canaries, the West Indian seas, La Plata, the Philippines. The same distribution is still given for this species in his magnificent work The Panamic Deep Sea Echini (p. 228). In my work on the *Ingolf* Echinoidea I was able to restrict this enormous range considerably, finding the specimens from off La Plata and the Philippines to belong to widely different forms, none of them really being of the same genus as the "*Dorocidaris papillata*," to which they were referred.[a] As for those from the West Indies, I thought they might really prove to be identical with the form from the Norwegian Sea and the Northern Atlantic (excepting, of course, *Stylocidaris affinis*, which was also previously regarded only as a synonym of *Cidaris cidaris*). Having, however, no specimens of the West Indian form except two of *C. abyssicola*, I could form no definite opinion on the question. It is true that I had examined some specimens in the British Museum, but mainly for the pedicellariæ, and in their structure no reason was found for regarding the West Indian form as specifically different from *C. cidaris*. As for *C. abyssicola* I was inclined to regard it as a distinct species.[b]

After having examined a considerable number of specimens from the West Indies, Doctor Clark (The Cidaridæ) comes to the conclusion that not only *abyssicola*

[a] *Ingolf* Echinoidea, pt. 1, pp. 35, 170–172. [b] Idem, p. 34.

is a distinct species, but also another distinct new species (*C. rugosa*) is found here, which has hitherto been confounded with *C. cidaris*, whereas the true *C. cidaris* (*D. papillata*) does not seem to occur in the West Indian seas at all. This results in a much more restricted distribution of *C. cidaris*, which accordingly occurs only in the Eastern Atlantic and the Mediterranean. The *Challenger* specimens from St. Paul's Rocks which I have maintained to be true *C. cidaris* (*Ingolf* Echinoidea, pt. 1, p. 170), Clark supposes also to belong to *C. rugosa*. After the separation of *C. rugosa* from *C. cidaris* I do not venture to maintain that the St. Paul's Rocks specimens belong to the latter species, as I have not examined the structure of the test in detail; the pedicellariæ are not sufficiently characteristic in the different species to permit a definite answer to this question. *C. cidaris* would thus form one more species peculiar to the eastern Atlantic deep sea (besides *Poriocidaris purpurata* and *Sperosoma grimaldii*) a fact tending considerably to strengthen my view that this part of the Atlantic deep sea area forms a separate region. (See *Ingolf* Echinoidea, pt. 2, p. 187.)

Having recently obtained some additional material of *C. abyssicola* and also a specimen of *C. rugosa*, I have taken the occasion to compare these forms carefully with *C. cidaris* and to form an opinion of the question of their specific value. The result of my investigation is that I think *rugosa* is a distinct species, though I cannot agree with Clark regarding all the characters which he gives as distinguishing it from *C. cidaris*. That *C. abyssicola* is a distinct species also seems to me beyond doubt; but I think it necessary further to distinguish as at least a distinct variety a form with slender radioles hitherto confounded with *C. abyssicola*. Whether it will perhaps ultimately prove to be a species distinct from *abyssicola* I am unable to ascertain from the material at my disposal. A more detailed comparison of the two forms of *C. abyssicola* will thus be necessary. Also a few remarks on *C. rugosa* may not be out of place.

CIDARIS ABYSSICOLA, var. TERETISPINA, new variety.

Plate 7, figs. 1–2; plates 8–10; plate 14, figs. 2–4; plate 15, figs. 3–6, 9–11; plate 16, fig. 11; plate 17, figs. 2–3, 5, 9–11.

Measurements of the Typical Form.

Diameter.	Height.	Apical system.	Peristome.	Width of—		Number of plates.		Longest radioles.
				Ambulacra.	Interambulacra.	Ambulacra.	Interambulacra.	
mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*			*mm.*
32	20	16.5	13.5	3.5	15	44–45	6	58
32	19	15	13.2	3.5	15	44	6	67

Measurements of var. teretispina.

47	27	22	19.5	5.2	22	51–53	6–7	68
36.5	21	17	15	4	17.5	53–54	6–7	34
36	20.5	16	14	4	17	53–54	6–7	43
32	18	16	13.2	4	16	44–45	6	40

In the relative proportions of the parts of the test there seem to be no constant differences, as is apparent from the measurements. In the general shape of the test there may perhaps prove to be a difference. The large specimen of the variety is distinctly pentagonal in outline, the interambulacra being rather convex at the ambitus, forming the (rounded) angles of the pentagon (Plate 10, fig. 2). In the specimen of 36.5 mm. horizontal diameter this feature is also indicated, though much less distinct than in the large specimen. Whether this feature is observable also in the two other specimens I can not state definitely, not having denuded them.

The ambulacra are somewhat different, at least in the specimens before me. In the original description of *abyssicola* Agassiz says that "each plate carries a larger exterior tubercle with a smaller one nearer the abactinal edge, and sometimes a third and fourth miliary between the two." This description agrees entirely with the two specimens of the typical form before me—excepting that the small inner tubercle lies at the actinal edge (Plate 14, fig. 2). Considering, however, that, so far as I know, this inner tubercle (when only one is found) is elsewhere in cidarids never placed at the abactinal edge, but either in the middle of the plate or nearer the actinal edge, I think it not unreasonable to suggest that "abactinal" here is a *lapsus calami* for "actinal." In the variety I find the inner tubercle placed more in the middle of the plate, and the miliary tubercles (carrying pedicellariæ) along the lower edge more numerous, forming, especially in the larger specimen, a complete series along the lower edge. (Plate 14, figs. 3–4.)

In the interambulacra I find the median space distinctly broader in the variety than in the typical form. The deepening of the median line is distinct almost to the peristome, that is to plates 1 and 2 in the typical form, scarcely visible below the ambitus in the variety, that is to plates 3 and 4.

The apical system does not seem to afford any constant differences. In the two specimens of 36 mm. horizontal diameter of the variety the anal plates send out a prolongation reaching the ocular plates, which are thus in contact with the periproct; in the two other specimens this is not the case. Also the shape of the ocular plates is somewhat variable; they seem upon the whole to be slightly larger and less prominent than in the typical form. (Plate 15, figs. 3, 6, 9.)

The peristome shows no distinguishing features.

The radioles afford the most conspicuous differences. In the typical form (Plate 7, figs 1–2; Plate 8) they are somewhat fusiform, and attain their greatest diameter "at about one-fifth the length of the spine from the base," as described by Agassiz (p. 254). In the variety (Plates 9–10) they are quite cylindrical and generally more slender. (In the large specimen they are, however, as stout as those of the typical form.) The actinal radioles (Plate 15, figs. 4–5, 10–11) are a little more widened in the variety than in the typical form, but this difference is not quite constant; also in the typical form they may be just as much widened (Plate 15, fig. 10). They are slightly curved and flattened on the proximal side. The edges are generally distinctly serrate, though scarcely so much as in the one figured in Plate 15, fig. 10. In transverse sections (Plate 16, fig. 11) the radioles are seen to be finely spinous; though they appear very smooth, they thus really differ conspicuously from those of *Calocidaris micans*, in which the ostracum is quite smooth.[a]

[a] See *Ingolf* Echinoidea, pt. 1, pl. 11, fig. 24.

The secondary spines do not present any differences. "Ampullæ" are found in both the typical form and the variety, at least on some of the spines of the abactinal system; whether on all of them cannot be decided from the material at hand.

Certain of the pedicellariæ afford a rather good distinguishing character, namely, the small globiferous. In the variety they have the valves distinctly constricted toward the large opening, which is generally not the case in the typical form (Plate 17, figs. 2, 10); however, similar shapes may be met with occasionally in the typical form. In the variety, moreover, the small globiferous pedicellariæ vary considerably in size, the larger ones being very like tridentate pedicellariæ (Plate 17, fig. 3), as is also the case in *Calocidaris micans*. A very curious instance of a small globiferous pedicellaria with two heads was found in the typical form of this species (Plate 17, fig. 9). The large globiferous and the tridentate pedicellariæ (Plate 17, figs. 5, 11) are alike in both forms. The same holds good for the spicules.

In the Hawaiian and other Pacific Echini, the Cidaridæ,[a] Agassiz and Clark give in Plate 12*a*, figures 1–5, a series of illustrations showing "the great diversity in the large globiferous pedicellariæ in *Cidaris abyssicola*," on account of which it is deemed to be "unwise to lay any stress on their form as a systematic character" (p. 7). I may reply to this: First, that the figures probably all represent "small" globiferous pedicellariæ, not those of the large form. Perhaps figure 1 represents a large one, though the small gland cavity decidedly points toward its being a "small" globiferous pedicellaria. Next I think that even though the small globiferous pedicellariæ are very variable—I quite agree with Agassiz and Clark that they really are—the peculiar form with the constricted valves may be very useful as a specific character; judging from the figures 3–5 in the plate cited of Agassiz and Clark's work I would even suggest that the specimen from which these pedicellariæ were taken was one belonging to the variety *teretispina*.

Regarding the color it can only be stated that the two specimens at hand of the typical form are quite white, the specimens of the variety more or less brownish. Whether they are differently colored in life must remain undecided for the present.

It seems very probable that it is this variety upon which Clark has based his description of *C. abyssicola*.[b] The expression "median ambulacral area * * * almost wholly covered with small tubercles" certainly agrees best with the variety. Also the fact pointed out by Clark that "the uppermost coronal plates do not carry primaries, and even the second ones may lack a well-developed spine," decidedly agrees better with the variety than with the typical form, in which latter some of the upper plates have well-developed radioles in both the specimens at hand. Finally, the figures in the Revision of the Echini (Plate 1, figs. 1–4) to which Clark refers,[b] seem to represent the variety; figure 1 alone with its thick radioles seems to represent the typical form, though the radioles are not so distinctly fusiform. But in any case the original description gives some of the distinguishing characters—the radioles and the ambulacra—so excellently that it seems beyond question that it is the form figured here in Plate 7, figures 1–2, and Plate 8, which must be regarded as the typical *Cidaris abyssicola*. Regarding the variety described above, I am inclined to think that it will ultimately prove to be a distinct species,

[a] Mem. Mus. Comp. Zool., vol. 24, 1907.

[b] The Cidaridæ, p. 208.

but the material at my disposal is far from sufficient to decide that, especially in view of the fact that some specimens of the variety have the radioles as stout as those of the typical form. A close examination of a large series of these forms will be necessary to decide the question; for the present, however, it seems to me necessary to keep the variety distinct from the typical form.

CIDARIS RUGOSA (H. L. Clark).

Plate 14, fig. 11; plate 16, fig. 1.

Dorocidaris rugosa H. L. Clark, The Cidaridæ, p. 210, pls. 4–5, pl. 7, figs. 5–8.

The most conspicuous difference from *C. cidaris* (*papillata*) is evidently the more closely tuberculated median ambulacral area. Whereas in *C. cidaris* there is, even in very large specimens, only one secondary tubercle within the primary one, placed almost in the middle of the plate,[a] there are in *C. rugosa* generally two secondary tubercles on each plate, the result being that the median space is wholly covered with tubercles, whereas in *C. cidaris* it is comparatively open (Plate 14, fig. 11 to compare with fig. 12). The median space is also conspicuously narrower in *C. rugosa* than in *C. cidaris*, as shown in the two figures cited, which have been drawn from equal sized specimens of the two species.

That the median interambulacral space is broader in *C. rugosa* than in *C. cidaris*, as stated by Clark, seems to me to be scarcely a constant feature; but there is another distinguishing character in the interambulacra not mentioned by Clark, namely, that the tubercles around the areoles are more prominent than in *C. cidaris* (compare Clark's figs. 7 and 8, Plate 7). That the abactinal system is more uniformly tuberculated in *C. rugosa* than in *C. cidaris* does, at least, not hold good in the single specimen at my disposal.

The radioles are stated by Clark to be twice to two and one-half times the horizontal diameter. In the specimen before me, 32 mm. horizontal diameter, the longest radioles are 40 mm. Also in the specimens figured by Clark the longest radioles appear to be scarcely twice the horizontal diameter. In transverse sections the radioles do not differ from those of *C. cidaris*.

The pedicellariæ are mainly like those of *C. cidaris*. The lower edge of the terminal opening in the large globiferous pedicellariæ is not slit up, as is often (always?) the case in *C. cidaris*. The tridentate pedicellariæ (Plate 16, fig. 1) are slightly broader than in that species. In this species also one may find transitional forms between the tridentate and the small globiferous pedicellariæ.

In the place cited in The Cidaridæ, Clark mentions that I have identified seven specimens of this species in the U. S. National Museum as "*Dorocidaris papillata*" and another one as "*Stereocidaris ingolfiana*"; on page 190 it is stated that I have identified a series of remarkably short-spined specimens of "*Phyllacanthus baculosa*" from Aden as "*Cidaris metularia*." "As M. did not clean an ambulacrum, it is not strange that he failed to see the very characteristic poriferous zones. But it is hard to understand how he overlooked the conspicuous purple spots on the collar of the spines." I am not going to defend my identifications of

[a] In younger specimens of *C. cidaris*, up to about 30 mm. horizontal diameter, the inner tubercle is developed only on one side, irregularly alternating.

these specimens—though I should like to examine the specimen labeled *Stereocidaris ingolfiana*. During my short stay at the U. S. National Museum I had to use the time for investigations relating to my own special work. When I found in the collections of the museum specimens which were unnamed, or which I thought evidently wrongly named, I put a label in the jars with the name I thought the right one. But I had no time to spend for a more exact and entirely reliable identification. What has here happened is a warning that one should never trust oneself to name a specimen without having examined it fully in regard to all its characters. I venture to think that among the specimens really examined in detail by me, and not seen only in a cursory way in foreign museums, such erroneous identifications will not be found.

Quite recently this matter has become somewhat more serious. Lambert and Thiery, in their Notes échinologiques I, Sur le genre Cidaris,[a] find in this case an argument against the use of pedicellariæ in classification: "En négligeant les caractères du test, on s'expose à des erreurs de détermination comme celles commises, d'après H. L. Clark, par Mortensen, l'auteur de cette classification." I may state here expressly that this case can in no way be taken as a proof against the value of the pedicellariæ; it is not the pedicellariæ which have led me to the false determinations (as far as I can remember I did not even examine the pedicellaria of the specimens of *Phyllacanthus baculosa*), but the fact that I did not examine the specimens more closely.

ARÆOSOMA BELLI Mortensen.

Plate 11; plate 12, fig. 1.

Aræosoma belli Th. Mortensen, *Ingolf* Echinoidea, pt. 1, p. 54–55, pl. 12, fig. 29; pl. 13, figs. 10, 11, 22.

This species, of which a short preliminary description was given in the *Ingolf* Echinoidea,[b] I found represented by several specimens in the collection of the U. S. National Museum (labeled *Asthenosoma hystrix*). Having had some specimens sent to Copenhagen, I am at length able to give a full description of the species and to point out more clearly the affinities with the real *Aræosoma hystrix* and with *A. fenestratum*, as also with *A. violaceum*, which has also hitherto not been fully described or figured. *A. belli* is, moreover, perfectly recognizable from the preliminary description, the pedicellariæ being really very characteristic for this species.

The specimens examined are from the *Albatross* stations 2350 (off Havana, 213 fathoms; 2 young specimens) and 2655 (north of the Bahamas, 338 fathoms; 2 large specimens). In addition there is one specimen from Mayaguez Harbor, Porto Rico, 220–225 fathoms (the *Fish Hawk* Porto Rican expedition). The species is as yet known only from the West Indian seas (137–338 fathoms), not from the European side of the Atlantic, in contrast to *A. fenestratum*, which occurs on both sides of the Atlantic Ocean—at least I have been unable to distinguish the West Indian from the east Atlantic form from the material at hand.

[a] Bull. Soc. Sci. Nat. Haute-Marne, vol. 6, 1909, p. 24.

[b] Pt. 1, pp. 54–55.

Table of measurements.

[NOTE.—ac=the plates of the actinal side; ab=those of the abactinal side.

Araeosoma belli.

Diameter.	Apical system.	Peristome.	Width at ambitus of— Ambulacra.	Interambulacra.	Number of plates. Ambulacra.	Interambulacra.	Peristome.
mm.	*mm.*	*mm.*	*mm.*	*mm.*			
140	22	32	32 (35 ab)[a]	52 (45 ab)[a]	ca 24 (ac) ca 38 (ab)	17–18 (ac) ca 26 (ab)	ca 12
ca 110	15	24	28	36	18–19 (ac) ca 35 (ab)	13–14 (ac) 25 (ab)	9–10
100	14–16	21	25	35	17–18 (ac) ca 30 (ab)	14–15 (ac) 19 (ab)	9
[b] 25	6.5	8	5	10	8–9 (ac) 11–12 (ab)	8–9 (ac) 9–10 (ab)	4–5
[b] 20	5.5	7	4	7.5	8–9 (ac) 9–10 (ab)	8 (ac) 8–9 (ab)	5

Araeosoma fenestratum.

ca 140	ca 22	35	35	48	25–26 (ac) ca 37 (ab)	19–20 (ac) 21–23 (ab)	ca 14
ca 115	ca 22	27	28	40	ca 21 (ac) ca 30 (ab)	14–15 (ac) 18–20 (ab)	ca 12
ca 110	ca 18	27	28	40	20–21 (ac) ca 28 (ab)	ca 15 (ac) ca 22 (ab)	ca 12

Araeosoma violaceum.

[c] ca 150	(?)	ca 30	ca 30	ca 58	ca 34 (ac)	ca 23 (ac)	ca 12

Calveria hystrix.

ca 165	22	ca 33	39	57	ca 35 (ac) ca 38 (ab)	26 (ac) 30 (ab)	ca 13
ca 125	15	25	29	43	ca 25 (ac) ca 38 (ab)	17–18 (ac) 26–28 (ab)	ca 12
ca 105	ca 17	25	23	37	23–24 (ac) ca 35 (ab)	ca 20 (ac) ca 27 (ab)	ca 14
[b] 23	5.5	7	5	8	8–9 (ac) 15–16 (ab)	9 (ac) 12–13 (ab)	4

[a] Above the ambitus.
[b] Without genital openings.
[c] Too badly preserved for counting the abactinal plates. The present specimen is not the one figured on Plate 13, fig. 1. See explanation of this plate.

The measurements and enumerations given here show clearly that, as regards the relative dimensions of the different parts of the test, there are no very reliable differences to be found between *A. belli* and the other three species from the Atlantic with which it must be compared, namely, *A. fenestratum*, *A. violaceum*, and *Calveria hystrix*. The last upon the whole appears to have a somewhat larger number of ambulacral and interambulacral plates, and *A. violaceum* likewise seems to have a proportionately larger number of coronal plates than *A. belli*.

Regarding the shape of the plates there are evidently some rather important differences. Professor Bell, it is true, maintains[a] that these differences are quite unreliable, all transitional forms occurring. Since, however, he does not hold *A. fenestratum* as specifically different from *C. hystrix* (of which there is not the slight-

[a] On the Echinoderms collected by the S. S. *Fingal* in 1890 and by the S. S. *Harlequin* in 1891 off the west coast of Ireland. Proc. Roy. Dublin Soc. (n. s.), vol. 7, 1892, p. 528, pl. 25.

est doubt), one can not feel sure that the specimens examined by him are really the same species—on the contrary, it is beyond doubt that both *hystrix* and *fenestratum* are among them, perhaps also *violaceum*—and thus his statement loses its weight. In fact, I find, after having examined a rather considerable number of these forms (especially *hystrix*), that the shape of the plates and the extent of the membranous interstices between the plates is not so very variable. Thus in *C. hystrix* I never find the wide membranous spaces between the plates so characteristic of *A. fenestratum; A. belli* in this respect comes near to *A. fenestratum*, though the membranous spaces are not quite so conspicuous; the same holds good of *A. violaceum*. Instead of giving long descriptions I think it is sufficient to refer to the figures, Plates 11–13.

The most conspicuous difference is found in the arrangement and size of the primary tubercles of the actinal interambulacra. (Plate 11, fig. 2 and Plates 12–13.) In *A. belli* there are near the middle line two arched series of large tubercles, one tubercle to each plate.[a] In the other species there is certainly something corresponding to this, but the series are less curved, and there is generally a tubercle only on every second plate. Further, in *A. belli* these tubercles are larger than in the other species; in *A. fenestratum* they are not much smaller, but in *A. violaceum* and in *C. hystrix* they are considerably smaller. In the larger specimens some large tubercles appear between the marginal and the inner series, and here again the same fact holds good: Larger and on each plate in *A. belli*, smaller and not on each plate in the other species.

In the abactinal side of the test, as well as in the apical and oral systems, I do not find any reliable differences, in size or structure, between the four species. In the two young specimens of *A. belli* the apical plates are still in contact, and the genital openings have not yet appeared.

The spines do not seem to afford any reliable differences either. In the specimens of *A. belli* before me all the primary actinal spines are broken; in the specimen of 25 mm. horizontal diameter only a single spine has kept the hoof; judging from this the hoof is not especially large in this species, as is also the case in the other species.[b] The miliary spines, those on the actinal as well as those on the abactinal side, have a small (poison) gland at the point. The tubefeet are as in the other species.

The pedicellariæ afford the most conspicuous differences as shown in the original description.[c] Tetradactylous pedicellariæ I have been unable to find in any of the specimens of *A. belli* at hand; that they will prove to occur also in this species I can scarcely doubt. The tridentate pedicellariæ, so very characteristic that the species may be at once distinguished thereby (especially the small form), have been sufficiently described and figured in the *Ingolf* Echinoidea. (Pt. 1, p. 55, pl. 13, figs. 10, 11, 22.) The large form (fig. 10) I have not found in any of the specimens at hand. I have nothing to add concerning the triphyllous pedicellariæ. The

[a] There may, however, be some inconsistency in this character; some of the plates may want the large tubercle, but still in such cases this series of tubercles is generally more prominent and regular than in *A. fenestratum*.

[b] I may note that in none of the European specimens of *A. fenestratum* at my disposal has the hoof been preserved, all the primary actinal spines being broken.

[c] *Ingolf* Echinoidea, pt. 1, p. 55.

sphæridia are more globular than in *A. fenestratum;* they continue far up the abactinal side.

The color is violet, more or less intense; in the two small specimens the color has almost totally disappeared.

This species is evidently most nearly related to *A. fenestratum*, from which it is, however, easily distinguished by means of the pedicellariæ[a] (especially the small tridentate), and the arrangement of the tubercles of the actinal interambulacra. The color of *A. fenestratum*—though generally more brownish—may be as violet as that of *A. belli* (alcoholic specimens of *A. fenestratum*, however, have mostly lost all color). From *A. violaceum* the species is still more easily distinguished by the same characters and also by the color, which is much more intense in this species. Finally from *C. hystrix* it is at once distinguished by the color (*C. hystrix* is always beautifully red, retaining the color in alcoholic specimens), the pedicellariæ, and the structure of the test.

On examining the entire series of "*Asthenosoma hystrix*" from the Caribbean Sea preserved in the U. S. National Museum, I have found the specimens to be either *Araeosoma fenestratum* or *A. belli*, while the true *Calveria hystrix* was not found among them. It is thus very probable that this latter species does not occur at all on the American side of the Atlantic.

In my work on the *Ingolf* Echinoidea[b] I made the species *hystrix* the type of a separate genus, to which also the *Asthenosoma gracile* A. Agassiz was referred. The name *Calveria* of Wyville Thomson was restored to this genus following Wyville Thomson in his work on the *Porcupine* Echinoidea. In his Panamic Deep Sea Echini (p. 84) Mr. Agassiz pointed out that the name *Calveria hystrix* was originally given to a starfish (the one known as *Korethraster hispidus* Wyville Thomson), a fact which I had overlooked. Dr. F. A. Bather in his paper The Echinoderm Name *Calveria hystrix*[c] gave the complete history of the name, which proves that *Calveria* can not, on a strict application of the priority rule, be used for the genus to which it was applied by me; that the species name *hystrix* likewise can not be used for the echinoid in question, as maintained by Doctor Bather, I am not inclined to admit. Accordingly, the genus *Calveria* as circumscribed by me ought to have another name, if the genus can be maintained. Mr. Agassiz, in the work quoted, does not recognize this as a valid genus and still maintains the two genera *Phormosoma* and *Asthenosoma* in the wide sense, as they are used in the *Challenger* Echinoidea.[d] Considerably more weight must be ascribed to the fact that Professor Döderlein, who otherwise agrees with me in the subdivision of the two "genera" *Phormosoma* and *Asthenosoma*, thinks it doubtful whether the genus "*Calveria*" can be maintained. "Auf das Fehlen einer bestimmten Pedicellarienform einen generischen Unterschied zwischen sonst sehr nahe verwandten Arten

[a] For description and figures of pedicellariæ in *A. fenestratum*, *A. violaceum*, and *C. hystrix* reference must be made to the *Ingolf* Echinoidea.

[b] Pt. I, pp. 51, 63.

[c] Ann. Mag. Nat. Hist., ser. 7, vol. 17, 1906, p. 249.

[d] In the latest work of A. Agassiz and H. L. Clark, Hawaiian and other Pacific Echini, the Echinothuridæ (Mem. Mus. Comp. Zoöl., vol. 34, 1909), published since the above was written, the limitation of the old genera *Phormosoma* and *Asthenosoma* given in my *Ingolf* Echinoidea, I, is adopted. Also my genus *Araeosoma* is adopted while *Calveria* is not regarded as generically distinct from *Araeosoma*.

zu begründen, möchte ich nicht emphfehlen."[a] It must be agreed that the only difference from the genus *Arœosoma* pointed out in the *Ingolf* Echinoidea is that of the pedicellariæ; though conspicuous enough, this difference is certainly not very fundamental, and in case no other structural differences could be found, it would perhaps not really be worth while to maintain the group of species *hystrix* and *gracilis*, as a separate genus. But there is a difference in the test-structure, which, together with the characters derived from the pedicellariæ, seems to me to make it fully justifiable to maintain *hystrix* as the type of a separate genus, namely, that the membranous spaces between the plates are much less developed than in all the species referred to *Arœosoma* (compare Plate 13). That this fact also holds good for the species *gracilis* is shown by figure 4 on Plate 17*a* of the *Challenger* Echinoidea, and it is also especially pointed out in the description (p. 90). Accordingly I think the genus valid.

Regarding the name of this genus, *Calveria*, I am not going to change it at present. In a recently published paper: On some Points in the Nomenclature of Echinoids (Ann. Mag. Nat. Hist., ser. 8, vol. 5, 1910, p. 117) I have made the proposal that some of the more important echinoid and other names should be internationally protected, as exceptions from the priority rule. I think this is another case where an exception should be made. It is evident that the first application of the name *Calveria hystrix* (to the starfish *Korethraster hispidus*) was due to a mistake and it is not even accompanied by any description, so that it can only indirectly be seen that it is the starfish named above which is meant. It is then only just that the name *Calveria hystrix* be kept for the species described so excellently under that name by Sir Wyville Thomson.

On seeking for possible characters for generic differentiation between *hystrix* and *fenestratum*, I examined their internal anatomy, without finding any differences of importance. Especially is it to be noticed that the Stewart's organs are large in both, and of the same shape as in *Sperosoma grimaldii*, so admirably illustrated by Professor Kœhler.[b] On examining these organs in a specimen of *fenestratum* I was very puzzled to find them only in two radii; a closer examination, however, revealed the remarkable fact that those of the three other radii were lying in the dental pyramid, within the alveoli. How they had acquired this remarkable position seems difficult to understand; but the fact that they were turned inside out seems to indicate that it must be due to an inversion which has taken place in an early stage of their development. The alternative that it might possibly be due to hard pressure on the test of the animal during its passage from the sea bottom to the ship's deck among the other material contained in the dredge seems excluded by the facts of the inversion of the long organs, and that the delicate walls of the dental pyramid are intact.

DIADEMA ANTILLARUM Philippi.

In his Revision of the Echini, Mr. Agassiz distinguished only two species of the genus *Diadema*: *D. mexicanum* and *D. setosum*. In the latter were included as

[a] Echinoiden der Deutschen Tiefsee-Expedition, p. 120.

[b] Resultats des Campagnes scientifiqnes de S. A. S. le Prince de Monaco. Fasc. XII. Échinides et Ophiures * * * de *l'Hirondelle*, 1898, pl. 4, fig. 8.

synonyms all the other species which had been established, partly by Mr. Agassiz himself. In my Siam Echinoidea I undertook a revision of the genus and came to the conclusion that several species ought to be distinguished, which had hitherto been wrongly made synonyms of *D. setosum*, and in their recently published great work Hawaiian and other Pacific Echini; the Salenidæ * * * and Diadematidæ, Agassiz and Clark fully agree with me in regard to both the West Indian form, *D. antillarum*, and the other species.

In the work mentioned[a] I made the suggestion that it may perhaps be possible to distinguish the species of *Diadema* also when alive by their coloration, without taking the minor differences in the pedicellariæ, etc., into consideration. Accordingly I took occasion during a stay in the West Indies in the winter of 1905–6 to examine the living *Diadema antillarum*. I may then here give a description of its coloration in life.

From the well-known white spot in the middle line of the interambulacra, in the naked abactinal part of the area, a continuous thin blue line runs down toward the ambitus along either side of the interambulacrum; both lines also continue parallel upward to the anal area, without forming a ring on the apical system. Round the base of all the larger spines there is a fine blue ring; a few small blue spots may occur irregularly on the skin of the test, on the abactinal side, which is otherwise quite black; the blue lines may be very slightly developed; also the white interambulacral spot may be very small. Some specimens may be almost black. The anal tube is black, not reddish toward the end (as is the case in *D. saxatile*). The actinal side and the peristome are purple.

Unfortunately the blue color is not kept in the preserved specimens, either in alcohol or formalin, so the coloration cannot be of use for distinguishing the species in a preserved state. Whether all the different species have their own peculiar coloration, can, of course, only be affirmed after observations on the living individuals. In any case, *D. antillarum* differs considerably in coloration from *D. saxatile*, in which there is no continuous blue line along the primary series of interambulacral spines, but a series of blue spots, as is shown by the Sarasins in their magnificent paper Die Augen und das Integument der Diadematiden,[b] and as I have myself had occasion to observe during my stay in Siam.

This point seems to be well worthy of more detailed investigation, so I have thought it not inappropriate to call the attention of those who are fortunate enough to have easy access to the living animals to the matter. It is quite probable that we may here find valuable facts for the determination of the interrelations of the different species of *Diadema*.

REVISED LIST OF THE ECHINOIDS KNOWN TO OCCUR IN THE AMERICAN REGION OF THE NORTH ATLANTIC, AND IN THE WEST INDIES.

It may prove useful to give here a list of the Echinoids occurring on the American side of the North Atlantic and in the West Indian seas. Though there has been very little new material collected since the *Blake* and the *Albatross* expeditions, this list differs very considerably from that given by Mr. Agassiz in the report on the *Blake* Echini, the recent researches (by A. Agassiz,

[a] Siam Echinoidea, p. 17.

[b] Ergebnisse naturw. Forschungen auf Ceylon, vol. 1, 1887, pl. 3, figs. 14–15.

H. L. Clark, Döderlein, and myself) having to a considerable extent altered the specific conception of several Echinoids, besides pointing out several cases of incorrect identification. For the sake of comparison the list given in the *Blake* Echini is reproduced beside the revised list, and references are given to the work in which the corrections and additions are first pointed out. In the cases where only the generic name has been changed such reference has not been thought necessary.

Several of the species have not of late years been reexamined; it is not improbable that some further changes and additions will have to be made to the list. The Clypeastrids especially might repay a careful revision.

List of North American and West Indian Echinoids.

List from the *Blake* Echini.	Revised list.	References to literature.
Dorocidaris papillata A. Agassiz	*Cidaris abyssicola* (A. Agassiz) *Cidaris rugosa* (Clark)	H. L. Clark, The Cidaridæ, pp. 208, 210.
	Stylocidaris affinis (Philippi) *Stylocidaris lineata* Mortensen	Th. Mortensen, *Ingolf* Echinoidea, pt. 1, p. 35, also the present work.
Dorocidaris blakei A. Agassiz	*Cidaris blakei* (A. Agassiz)	
Dorocidaris bartletti A. Agassiz	*Tretocidaris bartletti* (A. Agassiz)	
Cidaris tribuloides Blainville	*Eucidaris tribuloides* (Lamarck)	
Porocidaris sharreri A. Agassiz	*Histocidaris sharreri* (A. Agassiz) *Calocidaris micans* (Mortensen)	Th. Mortensen, *Ingolf* Echinoidea, pt. 1. pp. 23, 38.
	Stereocidaris ingolfiana Mortensen	
Salenia goesiana Lovén *Salenia varispina* A. Agassiz	*Salenocidaris varispina* (A. Agassiz)	A. Agassiz and H. L. Clark, Hawaiian and other Pacific Echini. The Salenidæ, Arbaciadæ, etc., p. 58.
Salenia pattersoni A. Agassiz	*Salenia pattersoni* A. Agassiz	
Arbacia punctulata Gray	*Arbacia punctulata* (Lamarck)	
Podocidaris sculpta A. Agassiz	*Podocidaris sculpta* A. Agassiz	
Podocidaris scutata A. Agassiz	*Habrocidaris scutata* (A. Agassiz)	
Cœlopleurus floridanus A. Agassiz	*Coelopleurus floridanus* A. Agassiz	
Aspidodiadema jacobyi A. Agassiz	*Aspidodiadema jacobyi* A. Agassiz	
Aspidodiadema antillarum A. Agassiz	*Dermatodiadema antillarum* (A. Agassiz)	
Diadema setosum Gray	*Diadema antillarum* Philippi	Th. Mortensen, Siam Echinoidea, vol. 1, p. 14.
Hemipedina cubensis A. Agassiz	*Hemipedina cubensis* A. Agassiz	
Phormosoma placenta Wyv. Thomson	*Phormosoma sigsbei* A. Agassiz	L. Döderlein, Echinoiden d. deutschen Tiefsee Exp., p. 126.
Phormosoma uranus Wyv. Thomson	*Hygrosoma petersi* (A. Agassiz)	Th. Mortensen, *Ingolf* Echinoidea, pt. 1, p. 58.
	Calveria hystrix (Wyv. Thomson)	(?) The present work.
Asthenosoma hystrix A. Agassiz	*Araeosoma fenestratum* (Wyv. Thomson) *Araeosoma belli* Mortensen	Th. Mortensen, *Ingolf* Echinoidea, pt. 1, pp. 55, 72.
	Tromikosoma kœhleri Mortensen	
Temnechinus maculatus A. Agassiz	*Genocidaris maculata* A. Agassiz	
Trigonocidaris albida A. Agassiz	*Trigonocidaris albida* A. Agassiz	
Echinus acutus Lamarck *Echinus elegans* Düben and Koren *Echinus norvegicus* Düben and Koren	*Echinus alexandri* Danielssen and Koren *Echinus affinis* Mortensen	Th. Mortensen, *Ingolf* Echinoidea, pt. 1, pp. 145, 149, 152, 159.
Echinus wallisi A. Agassiz	*Echinus elegans* Düben and Koren	
Echinus gracilis A. Agassiz	*Echinus gracilis* A. Agassiz	
Toxopneustes variegatus A. Agassiz	*Psammechinus blainvillei* Desmarest	Lambert. Description des Échinides fossiles de la Province de Barcelone. 2-3. Mém. Soc. Géol. d. France, vol. 14, 1906, p. 66.
	Psammechinus atlanticus (A. Agassiz)	According to researches by Prof. R. T. Jackson, not yet published.

List of North American and West Indian Echinoids—Continued.

List from the *Blake* Echini.	Revised list.	References to literature.
Hipponoë esculenta A. Agassiz	*Tripneustes esculentus* (Leske)	
Strongylocentrotus dröbachiensis A. Agassiz	*Strongylocentrotus dröbachiensis* (O. F. Müller).	
Echinometra subangularis Desmoulins	*Echinometra lucunter* (Linnæus)	Lovén, Echinoidea descr. by Linnæus, p. 157.
Echinometra viridis, A. Agassiz	*Echinometra viridis*, A. Agassiz	
Echinocyamus pusillus Gray	*Echinocyamus grandiporus* Mortensen	Th. Mortensen, *Ingolf* Echinoidea, pt. 2, p. 36.
Clypeaster latissimus A. Agassiz	*Clypeaster latissimus* (Lamarck)	
Clypeaster ravenellii A. Agassiz	*Clypeaster ravenellii* (A. Agassiz)	
Clypeaster subdepressus Agassiz	*Clypeaster subdepressus* (Gray)	
Echinanthus rosaceus Gray	*Echinanthus rosaceus* (Linnæus)	
Echinarachnius parma Gray	*Echinarachnius parma* (Lamarck)	
Mellita sexforis A. Agassiz	*Mellita sexforis* (Lamarck)	
Mellita testudinata Klein	*Mellita testudinata* Klein	
Encope emarginata Agassiz	*Encope emarginata* (Leske)	
Encope michelini Agassiz	*Encope michelini* Agassiz	
Echinoneus semilunaris Lamarck	*Echinoneus semilunaris* (Gmelin)	
Neolampas rostellata A. Agassiz	*Neolampas rostellata* A. Agassiz	
Echinolampas depressa Gray	*Echinolampas depressa* Gray	
Rhynchopygus caribbæarum Lütken	*Rhynchopygus caribbæarum* (Lamarck)	
Conolampas sigsbei A. Agassiz	*Conolampas sigsbei* A. Agassiz	A. Agassiz, *Blake* Echini p. 51.
Pygastrides relictus Lovén		
Pourtalesia miranda A. Agassiz	*Pourtalesia miranda* A. Agassiz	
Pourtalesia jeffreysi Wyv. Thomson	*Pourtalesia wandeli* Mortensen	Th. Mortensen, *Ingolf* Echinoidea, pt. 2, p. 62.
Urechinus naresianus A. Agassiz	*Urechinus naresianus* A. Agassiz	
Palæobrissus hilgardi A. Agassiz	*Palæobrissus hilgardi* A. Agassiz	
Palæotropus josephinæ Lovén	*Palæotropus josephinæ* Lovén	
Palæotropus thomsoni A. Agassiz	*Palæotropus thomsoni* A. Agassiz	
Homolampas fragilis A. Agassiz	*Homolampas fragilis* A. Agassiz	
Palæopneustes cristatus A. Agassiz	*Palæopneustes cristatus* A. Agassiz	
Palæopneustes hystrix A. Agassiz	*Palæopneustes hystrix* A. Agassiz	
Linopneustes longispinus A. Agassiz	*Linopneustes longispinus* (A. Agassiz)	
Rhinobrissus micrasterioides A. Agassiz	*Rhinobrissus micrasterioides* A. Agassiz	
Agassizia excentrica A. Agassiz	*Agassizia excentrica* A. Agassiz	
Aërope rostrata Wyv. Thomson	*Aëropsis rostrata* (Wyv. Thomson)	
Aceste bellidifera Wyv. Thomson	*Aceste bellidifera* Wyv. Thomson	
Schizaster fragilis Agassiz	*Brisaster fragilis* (Düben and Koren)	
Schizaster orbignyanus A. Agassiz	*Schizaster orbignyanus* A. Agassiz	
Periaster limicola A. Agassiz	*Periaster limicola* A. Agassiz	
Moira atropos A. Agassiz	*Moira atropos* (Lamarck)	
Hemiaster expergitus Lovén	*Hemiaster expergitus* Lovén	Th. Mortensen, *Ingolf* Echinoidea, pt. 2, p. 105.
Hemiaster mentzi A. Agassiz		
Brissus unicolor Klein	*Brissus unicolor* Klein	
Meoma ventricosa Lütken	*Meoma ventricosa* (Lamarck)	
Metalia pectoralis A. Agassiz	*Metalia pectoralis* (Lamarck)	
Spatangus purpureus Leske	*Macropneustes spatangoides* A. Agassiz	
Macropneustes spatangoides A. Agassiz		
Echinocardium cordatum Gray	*Echinocardium cordatum* (Pennant)	
Echinocardium flavescens A. Agassiz	*Echinocardium flavescens* (O. F. Müller?)	
Echinocardium pennatifidum Norman	*Echinocardium lævigaster* (A. Agassiz) (?)	Th. Mortensen, *Ingolf* Echinoidea pt. 2, pp. 127, 136, 144, 159, 160, 163.
Brissopsis lyrifera Agassiz	*Brissopsis alta* Mortensen	
	Brissopsis atlantica Mortensen	
	Brissopsis elongata Mortensen	

In the list quoted from the *Blake* Echini on pages 23 and 24 it will be observed that the authors of several of the species differ from those used in this work. This is due to the different nomenclatorial principles adopted by Mr. Agassiz and the present writer. Mr. Agassiz holds the not uncommon view that the author who removes a previously known species to another genus than that to which it was referred by its original describer should put his own name after the species, while the present author, in accordance with the international rules, holds that the name of the first describer of the species should always be kept, but put in a parenthesis, when the species is removed to another genus. Thus, for instance, *Spatangus atropos* Lamarck for Mr. Agassiz becomes *Moira atropos* A. Agassiz, while according to the international rules it must be *Moira atropos* (Lamarck); *Spatangus pectoralis* Lamarck becomes *Metalia pectoralis* A. Agassiz, instead of *Metalia pectoralis* (Lamarck); etc. Quite apart from the fact that it is contrary to the rules, this practice of omitting the name of the original author tends to involve the history of the species in more or less obscurity. In case it seems desirable also to add the name of the author of the new combination, it may well be added after the name of the author of the species, as, for instance, *Metalia pectoralis* (Lamarck) A. Agassiz. By this latter course one is doing justice to both parties.

While the list in the *Blake* Echini (excluding the species not found in North America or in the West Indies, as it is done here) numbers 76 species, the revised list numbers 82 species, and probably the number will be somewhat further augmented when all the species have been carefully reexamined. The more important differences between the two lists depend on the removing of such familiar species as *Cidaris cidaris* (*Dorocidaris papillata*), *Phormosoma placenta*, "*Asthenosoma*" *hystrix* (?), *Echinus acutus*, *Ech. norvegicus*, *Echinocyamus pusillus*, *Pourtalesia jeffreysi*, *Spatangus purpureus* and *Brissopsis lyrifera*. The elimination of these European species from the American fauna makes the difference between the European and the North American Echinoid faunæ very pronounced. On the other hand, the presence in both regions of the arctic circumpolar *Strongylocentrotus dröbachiensis*, the almost cosmopolitan *Echinocardium cordatum*, of such widely distributed deep-sea species as *Echinus elegans*, *E. alexandri*, *E. affinis*, *Araeosoma fenestratum*, and others, can not prove any near relationship of the two faunas. A different matter is the occurrence of several West Indian littoral Echinoids in the North African region (for instance, *Diadema antillarum*, *Echinometra lucunter*, etc.). These may perhaps be taken to indicate a former land connection (the Archhelenis-Theory); but there is always a possibility of their having been transferred as larvæ from the one region to the other. Here, however, a considerable work remains yet to be done. The question whether these species supposed to occur on both sides of the Atlantic are really identical must be carefully reinvestigated. In the Report on the Echinoidea of the German South-Polar Expedition, it was proved that the *Eucidaris tribuloides* from the Cape Verde Islands differs considerably from that from the West Indies, forming at least a separate variety. This may well be the case with other of these species. Further, it remains to be proved whether those species really have pelagic larvæ. Of this we know almost nothing, as, in general, we know nothing of the larval development of the tropical echinoderms. What ample fields of most promising research here remain to be opened up!

EXPLANATION OF PLATES.

Plate 1.

Calocidaris micans (Mortensen). Actinal side. × ¾.

Plate 2.

Tretocidaris bartletti (A. Agassiz). Abactinal side. × ¾. (Same specimen as Plate 3.)

Plate 3.

Tretocidaris bartletti (A. Agassiz). Actinal side. × ¾. (Same specimen as Plate 2.)

Plate 4.

Stylocidaris lineata, new species. Actinal side. Natural size. (Same specimen as Plates 5 and 6.)

Plate 5.

Stylocidaris lineata, new species. Abactinal side. Natural size. (Same specimen as Plates 4 and 6.)

Plate 6.

Stylocidaris lineata, new species. Side view. Natural size. (Same specimen as Plates 4 and 5.)

Plate 7.

(All figures natural size.)

Figs. 1–2. *Cidaris abyssicola* (A. Agassiz). 1. Abactinal side. 2. Side view; same specimen.
3–5. *Stylocidaris lineata*, new species. 3. Side view. 4. Actinal side. 5. Abactinal side; same specimen.
6. *Tretocidaris bartletti* (A. Agassiz). Young specimen. Abactinal side.

Plate 8.

(Both figures natural size.)

Fig. 1. *Cidaris abyssicola* (A. Agassiz). Actinal side.
2. *Cidaris abyssicola* (A. Agassiz). Side view.

Plate 9.

Natural size.

Figs. 1–2. *Cidaris abyssicola*, var. *teretispina* Mortensen. 1. Actinal side. 2. Abactinal side; same specimen.

Plate 10.

(Both figures natural size.)

Fig. 1. *Cidaris abyssicola*, var. *teretispina* Mortensen. Side view. (Same specimen as Plate 9.)
2. *Cidaris abyssicola*, var. *teretispina*. Actinal side; same specimen.

Plate 11.

Figs. 1–2. *Araeosoma belli* Mortensen. × ⅞. 1. Abactinal side. 2. Actinal side; same specimen.

Figure 1 is made up from two different photographs; the left side was made to show the undenuded part of the test, the right to show the denuded part as clearly as possible, the color of these two parts contrasting so much as to make it impossible to represent both parts clearly in the same photograph.

Plate 12.

Fig. 1. *Araeosoma belli* Mortensen. Actinal side. Natural size.
2. *Araeosoma fenestratum* (Wyville Thomson). Actinal side. × ¾.

PLATE 13.

(Both figures × ¾.)

FIG. 1. *Araeosoma violaceum* Mortensen. Actinal side.
The specimen was received in a very bad condition, denuded, flattened, and dried; it has thus been impossible to examine other features than those of test structure, and the identification is therefore given with a little reservation.

FIG. 2. *Calveria hystrix* (Wyville Thomson). Actinal side.

PLATE 14.

FIG. 1. *Stylocidaris affinis* (Philippi). Part of ambulacrum × 7.
2. *Cidaris abyssicola* (A. Agassiz). Part of ambulacrum × 6.8.
3. *Cidaris abyssicola*, var. *teretispina* Mortensen. Part of ambulacrum (from the specimen represented in Plate 10, fig. 2) × 5.8.
4. *Cidaris abyssicola*, var. *teretispina*. Part of ambulacrum × 5.
5. *Calocidaris micans* (Mortensen). Interambulacral plate × 4.
6. *Calocidaris micans* (Mortensen). Part of ambulacrum × 5.
7. *Cidaris blakei* (A. Agassiz). Part of ambulacrum × 6.
8. *Tretocidaris bartletti* (A. Agassiz). Interambulacral plate × 6.
9. *Tretocidaris bartletti* (A. Agassiz). Part of ambulacrum × 8.5.
10. *Stylocidaris lineata*, new species. Part of ambulacrum × 7.5.
11. *Cidaris rugosa* (Clark). Part of ambulacrum × 8.
12. *Cidaris cidaris* (Linnæus). Part of ambulacrum from a specimen of 33 mm. horizontal diameter of test, corresponding in size to the specimen of *C. rugosa*, from which fig. 11 was made × 8.5.

PLATE 15.

FIGS. 1–2. *Calocidaris micans* (Mortensen). Actinal spines × 7. (Compare fig. 7.)
3. *Cidaris abyssicola*, var. *teretispina* Mortensen. Apical system. From a specimen of 47 mm. h. d. × 3. (Compare fig. 6.)
4–5. *Cidaris abyssicola* (A. Agassiz). Actinal spines × 7. (Compare figs. 10–11.)
6. *Cidaris abyssicola*, var. *teretispina* Mortensen. Apical system. From a specimen of 36 mm. h. d. × 2.8/1. (Compare fig. 3.)
7. *Calocidaris micans* (Mortensen). Actinal spine × 7. (Compare figs. 1–2.)
8. *Tretocidaris bartletti* (A. Agassiz). Actinal spine × 8. (Compare figs. 13–14.)
9. *Cidaris abyssicola* (A. Agassiz). Apical system × 2.8.
10–11. *Cidaris abyssicola* (A. Agassiz). Actinal spines × 7. (Compare figs. 4–5.)
12. *Tretocidaris bartletti* (A. Agassiz). Apical system × 5.5.
13–14. *Tretocidaris bartletti* (A. Agassiz). Actinal spines × 8. (Compare fig. 8.)

PLATE 16.

FIG. 1. *Cidaris rugosa* (Clark). Valve of tridentate pedicellaria. Side view × 60.
2. *Tretocidaris bartletti* (A. Agassiz). Transverse section of spine × 55.
3–5. *Calocidaris micans* (Mortensen). Valves of pedicellariæ. 3. Tridentate pedicellaria from the inside. 4. Small globiferous pedicellaria; side view. 5. Small globiferous (?). Side view × 60. (Compare figs. 7–8, 10, 13.)
6. *Stylocidaris lineata*, new species. Part of ambulacral plates × 35.
7–8. *Calocidaris micans* (Mortensen). Valves of tridentate pedicellariæ. 7. Side view; 8, from the inside 60. (Compare figs. 3–5, 10, 13.)
9. *Stylocidaris lineata*, new species. Transverse section of radiole × 55.
10. *Calocidaris micans* (Mortensen). Valve of small globiferous pedicellaria. Side view 60. (Compare figs. 3–5, 7–8, 13.)
11. *Cidaris abyssicola* (A. Agassiz). Transverse section of radiole × 55.
12. *Tretocidaris bartletti* (A. Agassiz). Part of ambulacral plates × 30.
13. *Calocidaris micans* (Mortensen). Valve of small tridentate pedicellaria. Side view 60. (Compare figs. 3–5, 7–8, 10.)
14. *Calocidaris micans* (Mortensen). Part of ambulacral plates × 24.

PLATE 17.

FIG. 1. *Tretocidaris bartletti* (A. Agassiz). Valve of tridentate pedicellaria. Side view × 50. (Compare fig. 6.)

2. *Cidaris abyssicola*, var. *teretispina* Mortensen. Valve of small globiferous pedicellaria × 60.

3. *Cidaris abyssicola*, var. *teretispina* Mortensen. Valve of small globiferous pedicellaria × 60. (Compare fig. 5.)

4. *Stylocidaris lineata*, new species. Tridentate pedicellaria × 60.

5. *Cidaris abyssicola*, var. *teretispina* Mortensen. Valve of tridentate pedicellaria, side view × 40. (Compare fig. 3.)

6. *Tretocidaris bartletti* (A. Agassiz). Valve of small globiferous pedicellaria × 70. (Compare fig. 1.)

7. *Calocidaris micans* (Mortensen). Valve of tridentate pedicellaria. Side view × 45. (Compare pl. 16, figs. 3, 7–8, 13.)

8. *Stylocidaris lineata*, new species. Valve of tridentate pedicellaria. Side view × 60.

9. *Cidaris abyssicola* (A. Agassiz). Two-headed small globiferous pedicellaria × 60.

10. *Cidaris abyssicola* (A. Agassiz). Valve of small globiferous pedicellaria × 60.

11. *Cidaris abyssicola* (A. Agassiz). Tridentate pedicellaria × 35.

12. *Calocidaris micans* (Mortensen). Valve of large globiferous pedicellaria. Side view × 60.

13. *Calocidaris micans* (Mortensen). Large globiferous pedicellaria × 40.

14. *Stylocidaris affinis* (Philippi). Tridentate pedicellaria × 60.

INDEX.

Page.

abyssicola, Cidaris 1, 5, 12, **13**, 15, 23
var. teretispina, Cidaris **13**
Aceste bellidifera 24
acutus, Echinus 23, 25
Aërope rostrata 24
Aëropsis rostrata 24
affinis, Echinus 23, 25
Stylocidaris 7, 10, 11, 12, 23
Tretocidaris 12
Agassizia excentrica 24
albida, Trigonocidaris 23
alexandri, Echinus 23, 25
alta, Brissopsis 24
annulata, Tretocidaris 5, 6
antillarum, Aspidodiadema 23
Dermatodiadema 23
Diadema **21**, 23, 25
Araeosoma 20, 21
belli 1, **17**, 23
fenestratum 17, 18, 19, 20, 21, 23, 25
violaceum 17, 18, 19, 20
Arbacia punctulata 23
Aspidodiadema antillarum 23
jacobyi 23
Asthenosoma 20
gracile 20
hystrix 17, 20, 25
atlantica, Brissopsis 24
atlanticus, Psammechinus 23
atropos, Moira 24, 25
Spatangus 25
baculosa, Phyllacanthus 16
bartletti, Dorocidaris 5, 23
Tretocidaris 1, **5**, 23
belli, Araeosoma 1, **17**, 23
bellidifera, Aceste 24
blainvillei, Psammechinus 23
blakei, Cidaris 6, 23
Dorocidaris 23
Brisaster fragilis 24
Brissopsis alta 24
atlantica 24
elongata 24
lyrifera 24, 25

Page.

Brissus unicolor 24
Calocidaris 5
micans **12**, 14, 15, 23
Calveria 20, 21
gracilis 21
hystrix 18, 19, 20, 21, 23
caribbaearum, Rhynchopygus 24
Cidaris 3, 4, 5
abyssicola 1, 5, 12, **13**, 15, 23
abyssicola, var. teretispina **13**
blakei 6, 23
cidaris 1, 3, 12, 13, 16, 25
metularia 16
papillata 16
rugosa 1, 13, **16**, 23
tribuloides 23
Clypeaster latissimus 24
ravenellii 24
subdepressus 24
Coelopleurus floridanus 23
Conolampas sigsbei 24
cordatum, Echinocardium 24, 25
cristatus, Palaeopneustes 24
cubensis, Hemipedina 23
depressa, Echinolampas 24
Dermatodiadema antillarum 23
Diadema 21, 22
antillarum **21**, 23, 25
mexicanum 21
saxatile 22
setosum 21, 22
Dorocidaris 5
bartletti 5, 23
blakei 23
micans 2
papillata 1, 3, 11, 12, 13, 16, 23, 25
rugosa 16
dröbachiensis, Strongylocentrotus 24, 25
Echinanthus rosaceus 24
Echinarachnius parma 24
Echinocardium cordatum 24, 25
flavescens 24
lævigaster 24
pennatifidum 24

Page.
Echinocyamus grandiporus 24
pusillus 24, 25
Echinolampas depressa 24
Echinometra lucunter 24, 25
subangularis 24
viridis 24
Echinoneus semilunaris 24
Echinus acutus 23, 25
affinis 23, 25
alexandri 23, 25
elegans 23, 25
gracilis 23
norvegicus 23, 25
wallisi 23
elegans, Echinus 23, 25
elongata, Brissopsis 24
emarginata, Encope 24
Encope emarginata 24
michelini 24
esculenta, Hipponoë 24
esculentus, Tripneustes 24
Eucidaris tribuloides 23, 25
excentrica, Agassizia 24
expergitus, Hemiaster 24
fenestratum, Araeosoma 17, 18, 19, 20, 21, 23, 25
flavescens, Echinocardium 24
floridanus, Cœlopleurus 23
fragilis, Brisaster 24
Homolampas 24
Schizaster 24
Genocidaris maculata 23
goësiana, Salenia 23
gracile, Asthenosoma 20
gracilis, Calveria 21
Echinus 23
grandiporus, Echinocyamus 24
grimaldii, Sperosoma 13, 21
Habrocidaris scutata 23
Hemiaster expergitus 24
mentzi 24
Hemipedina cubensis 23
hilgardi, Palæobrissus 24
Hipponoë esculenta 24
hispidus, Korethraster 20, 21
Histocidaris sharreri 4, 23
Homolampas fragilis 24
Hygrosoma petersi 23
hystrix, Asthenosoma 17, 20, 25
Calveria 18, 19, 20, 21, 23
Palæopneustes 24
ingolfiana, Stereocidaris 16, 17, 23
jacobyi, Aspidodiadema 23
jeffreysi, Pourtalesia 24, 25

Page.
josephinæ, Palæotropus 24
kœhleri, Tromikosoma 23
Korethraster hispidus 20, 21
lævigaster, Echinocardium 24
latissimus, Clypeaster 24
limicola, Periaster 24
lineata, Stylocidaris **10**, 23
Linopneustes longispinus 24
longispinus, Linopneustes 24
lucunter, Echinometra 24, 25
lyrifera, Brissopsis 24, 25
Macropneustes spatangoides 24
maculata, Genocidaris 23
maculatus, Temnechinus 23
Mellita sexforis 24
testudinata 24
mentzi, Hemiaster 24
Meoma ventricosa 24
Metalia pectoralis 24, 25
metularia, Cidaris 16
mexicanum, Diadema 21
micans, Calocidaris **12**, 14, 15, 23
Dorocidaris 2
michelini, Encope 24
micrasterioides, Rhinobrissus 24
miranda, Pourtalesia 24
Moira atropos 24, 25
naresianus, Urechinus 24
Neolampas rostellata 24
norvegicus, Echinus 23, 25
orbignyanus, Schizaster 24
Palæobrissus hilgardi 24
Palæopneustes cristatus 24
hystrix 24
Palæotropus josephinæ 24
thomsoni 24
papillata, Cidaris 16
Dorocidaris 1, 3, 11, 12, 13, 16, 23, 25
parma, Echinarachnius 24
pattersoni, Salenia 23
pectoralis, Metalia 24, 25
Spatangus 25
pennatifidum, Echinocardium 24
Periaster limicola 24
petersi, Hygrosoma 23
Phormosoma 20
placenta 23, 25
sigsbei 23
uranus 23
Phyllacanthus 5
baculosa 16
placenta, Phormosoma 23, 25
Podocidaris sculpta 23
scutata 23

Page.
Poriocidaris purpurata 13
Porocidaris sharreri 4, 23
Pourtalesia jeffreysi 24, 25
miranda 24
wandeli 24
Psammechinus atlanticus 23
blainvillei 23
punctulata, Arbacia 23
purpurata, Poriocidaris 13
purpureus, Spatangus 24, 25
pusillus, Echinocyamus 24, 25
Pygastrides relictus 24
ravenellii, Clypeaster 24
relictus, Pygastrides 24
Rhinobrissus micrasterioides 24
Rhynchopygus caribbæarum 24
rosaceus, Echinanthus 24
rostellata, Neolampas 24
rostrata, Aërope 24
Aëropsis 24
rugosa, Cidaris 1, 13, **16**, 23
Dorocidaris 16
Salenia goësiana 23
pattersoni 23
varispina 23
Salenocidaris varispina 23
saxatile, Diadema 22
Schizaster fragilis 24
orbignyanus 24
sculpta, Podocidaris 23
scutata, Habrocidaris 23
Podocidaris 23
semilunaris, Echinoneus 24
setosum, Diadema 21, 22
sexforis, Mellita 24
sharreri, Histocidaris 4, 23
Porocidaris 4, 23
sigsbei, Conolampas 24
sigsbei, Phormosoma 23

Page.
spatangoides, Macropneustes 24
Spatangus atropos 25
pectoralis 25
purpureus 24, 25
Sperosoma grimaldii 13, 21
Stereocidaris ingolfiana 16, 17, 23
Strongylocentrotus dröbachiensis 24, 25
Stylocidaris 10, 12
affinis 7, 10, 11, 12, 23
lineata **10**, 23
subangularis, Echinometra 24
subdepressus, Clypeaster 24
Temnechinus maculatus 23
Temnocidaris 3
teretispina, Cidaris abyssicola, var **13**
testudinata, Mellita 24
thomsoni, Pakeotropus 24
Toxopneustes variegatus 23
Tretocidaris 6, 12
affinis 12
annulata 5, 6
bartletti 1, 5, 23
tribuloides, Cidaris 23
Eucidaris 23, 25
Trigonocidaris albida 23
Tripneustes esculentus 24
Tromikosoma kœhleri 23
unicolor, Brissus 24
uranus, Phormosoma 23
Urechinus naresianus 24
variegatus, Toxopneustes 23
varispina, Salenia 23
Salenocidaris 23
ventricosa, Meoma 24
violaceum, Araeosoma 17, 18, 19, 20
viridis, Echinometra 24
wallisi, Echinus 23
wandeli, Pourtalesia 24

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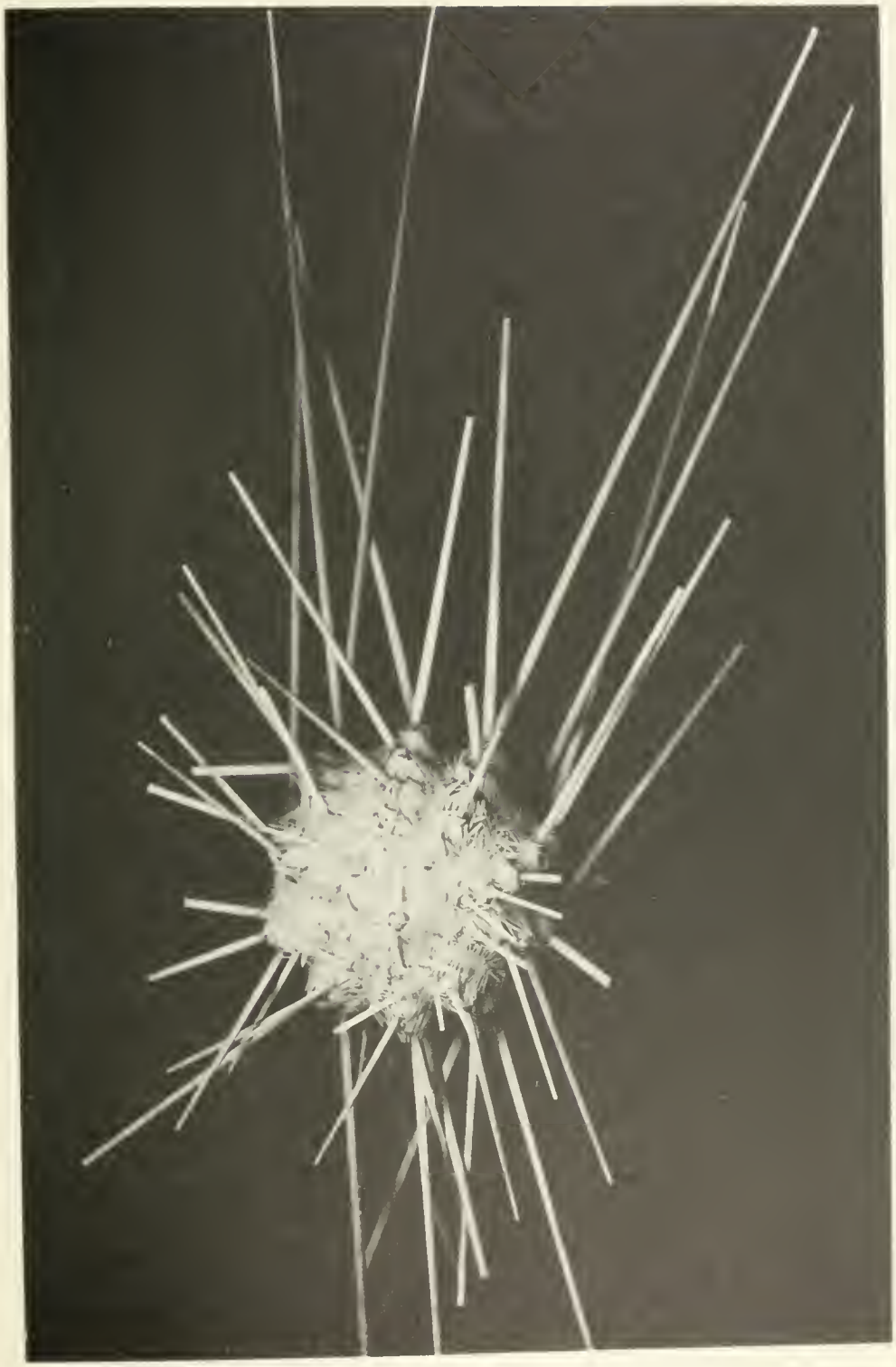

CALOCIDARIS MICANS (MORTENSEN).

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TRETOCIDARIS BARTLETTI (A. AGASSIZ).

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TRETOCIDARIS BARTLETTI (A. AGASSIZ).

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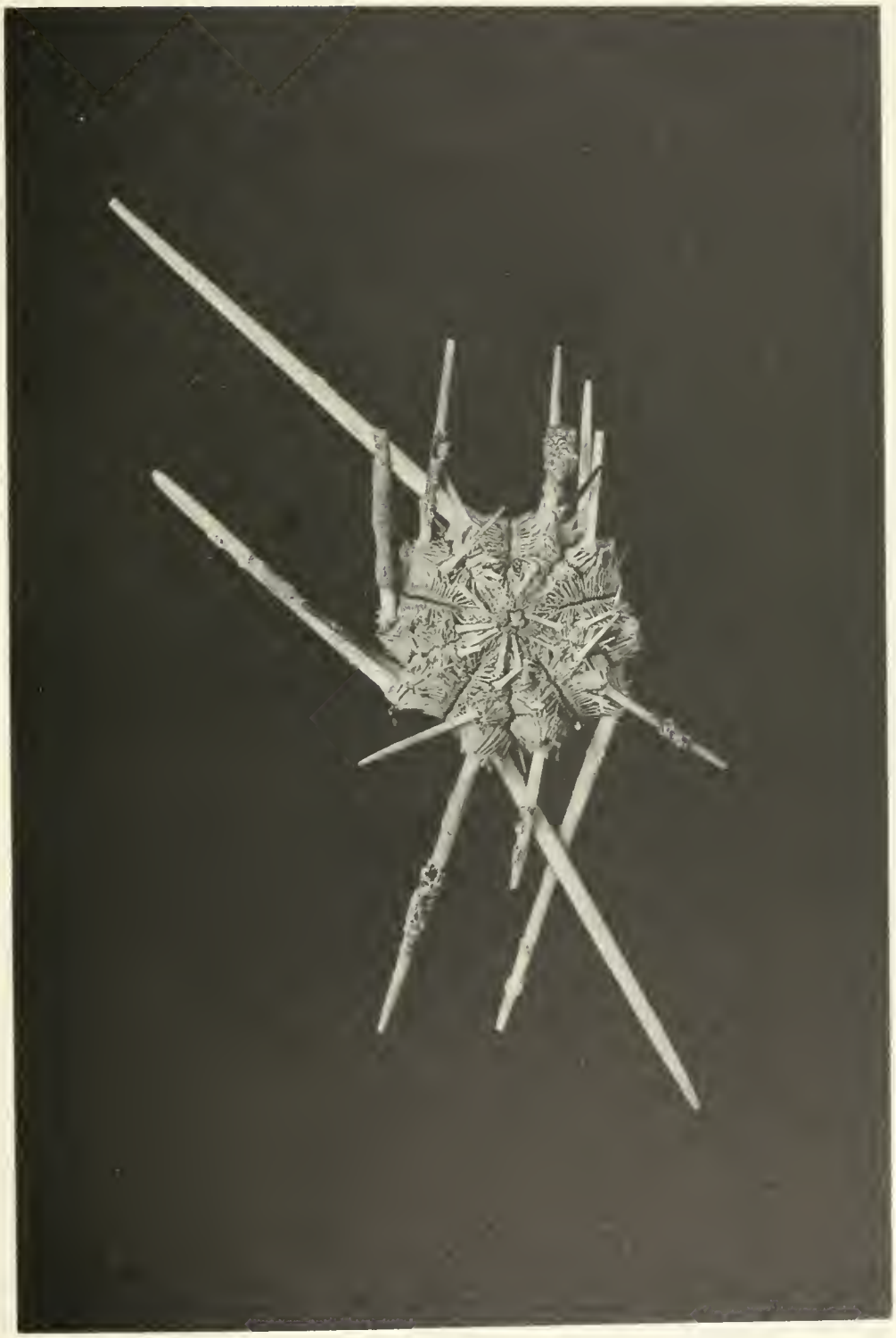

STYLOCIDARIS LINEATA, NEW SPECIES.

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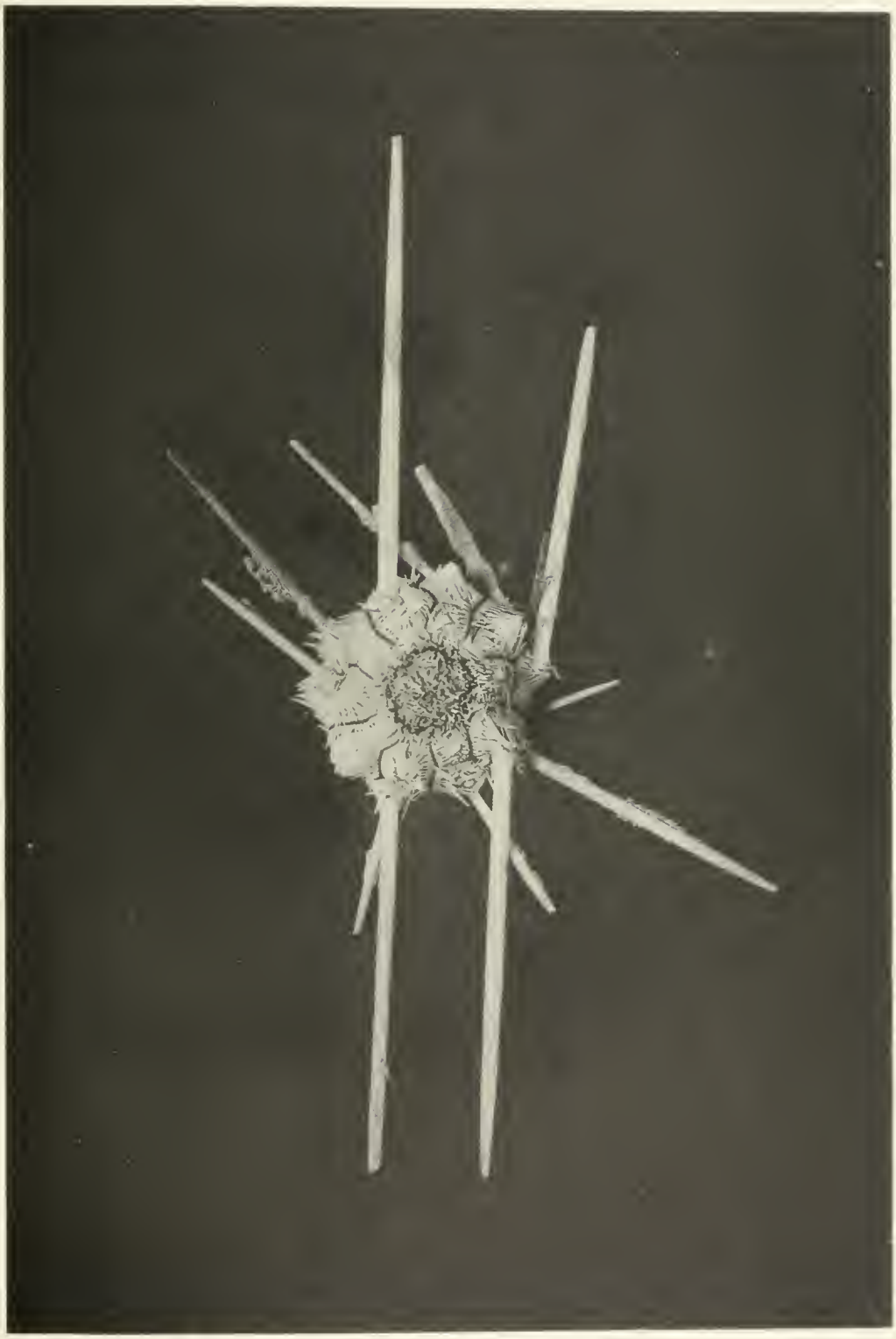

STYLOCIDARIS LINEATA, NEW SPECIES.

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STYLOCIDARIS LINEATA, NEW SPECIES.

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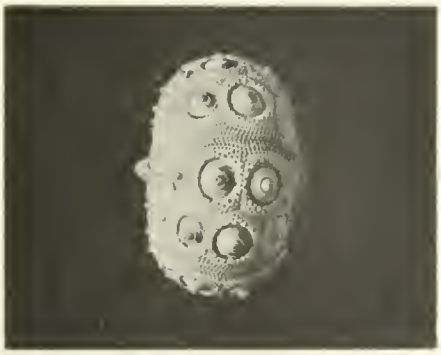

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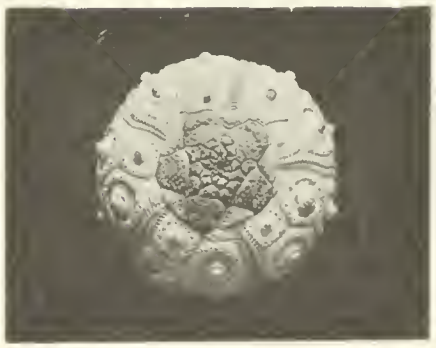

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1-2. CIDARIS ABYSSICOLA (A. AGASSIZ). 3-5. STYLOCIDARIS LINEATA, NEW SPECIES.
6. TRETOCIDARIS BARTLETTI (A. AGASSIZ).

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CIDARIS ABYSSICOLA (A. AGASSIZ).

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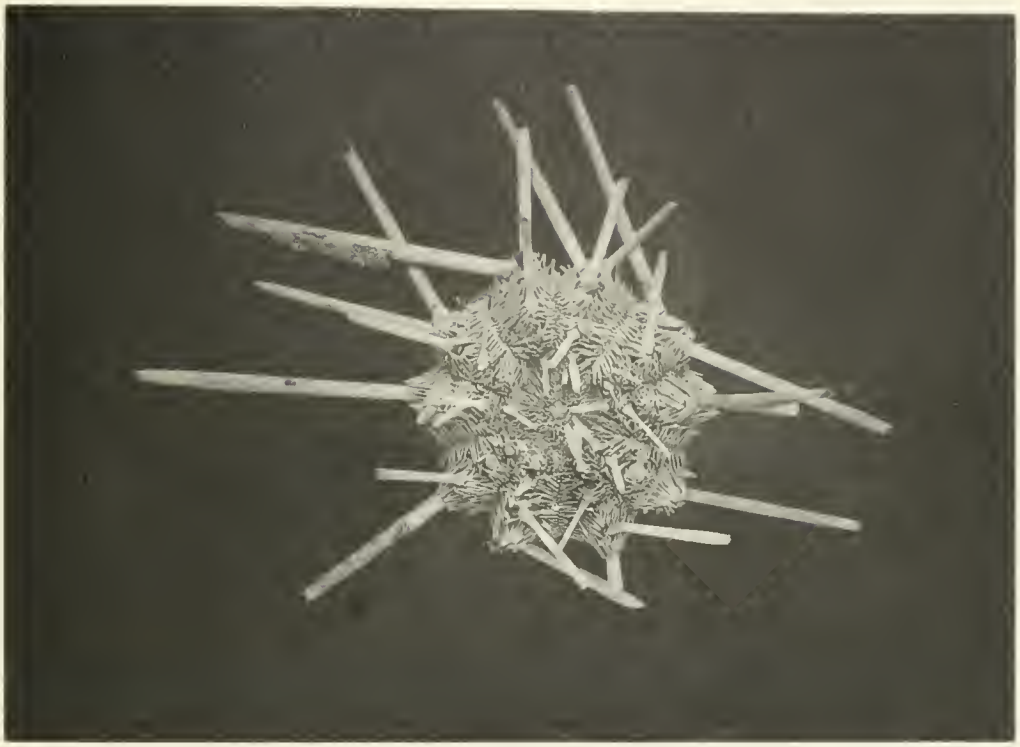

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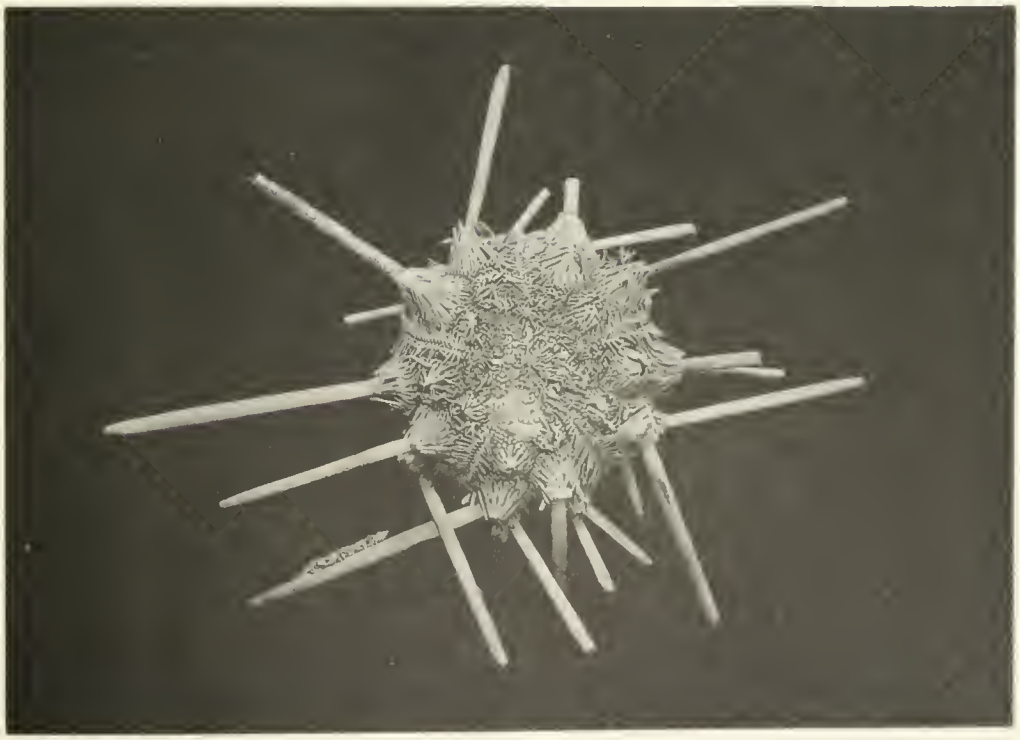

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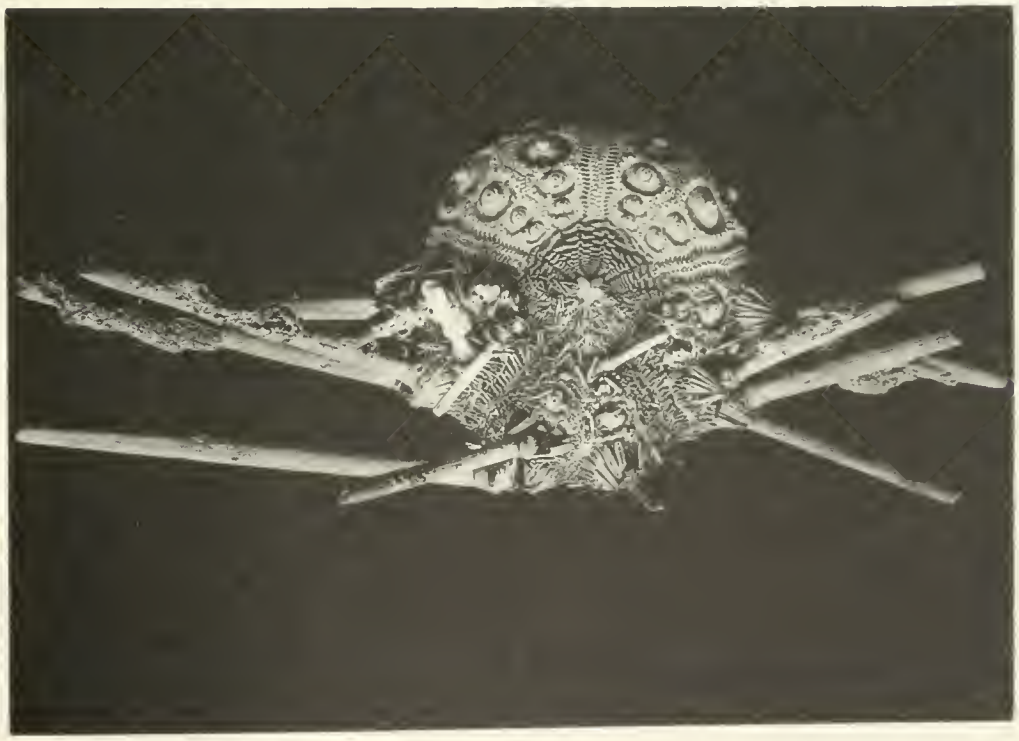

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CIDARIS ABYSSICOLA, VAR. TERETISPINA MORTENSEN.

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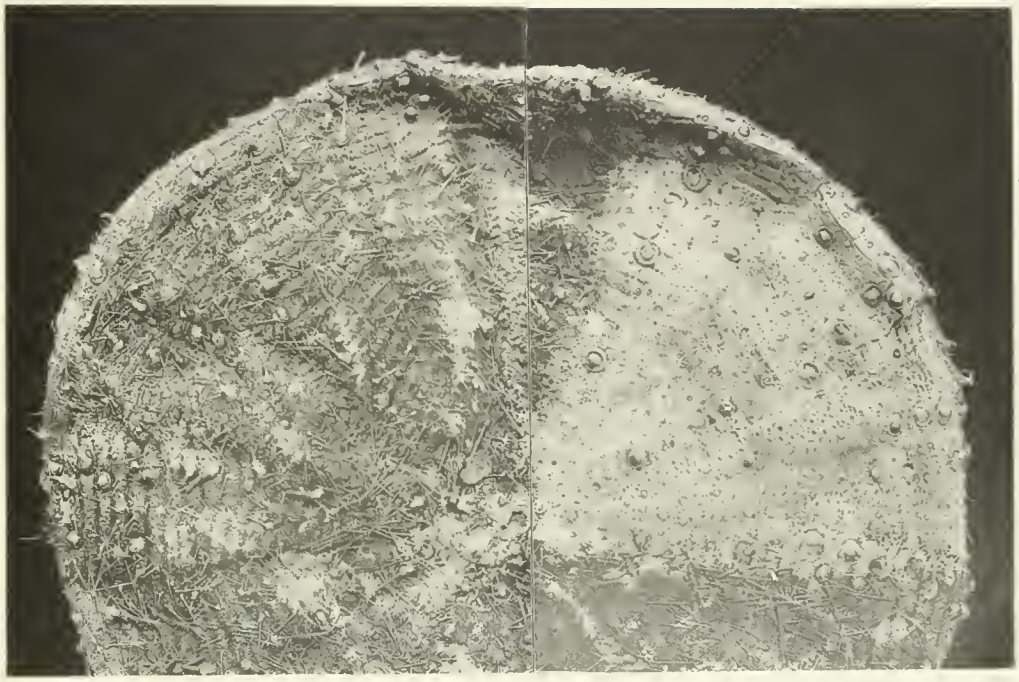

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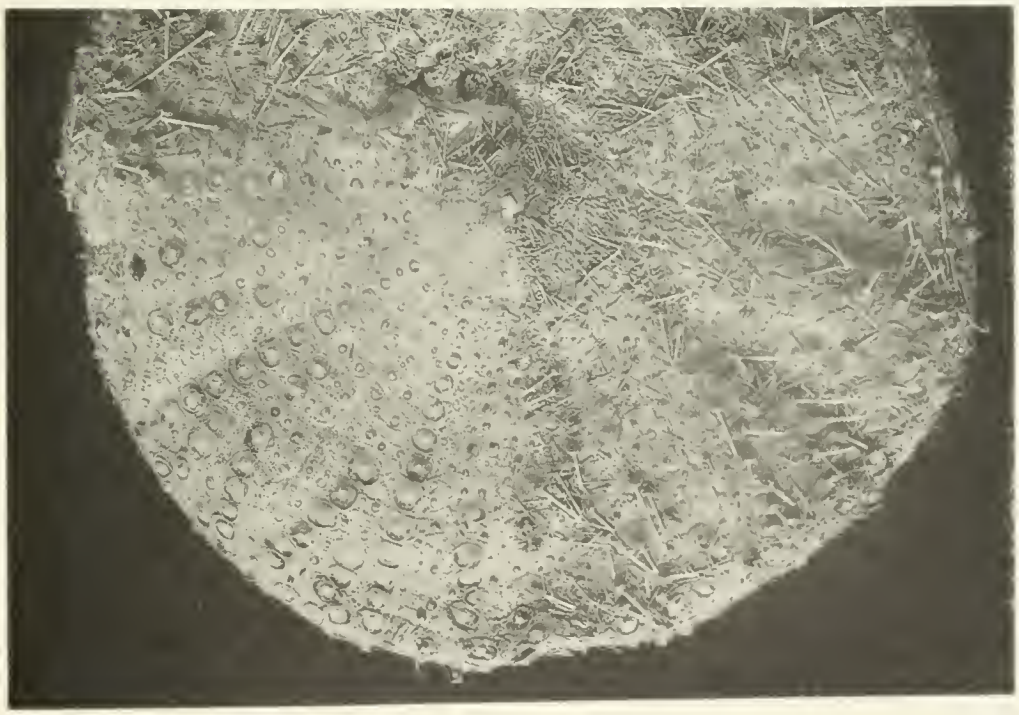

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ARÆOSOMA BELLI MORTENSEN.

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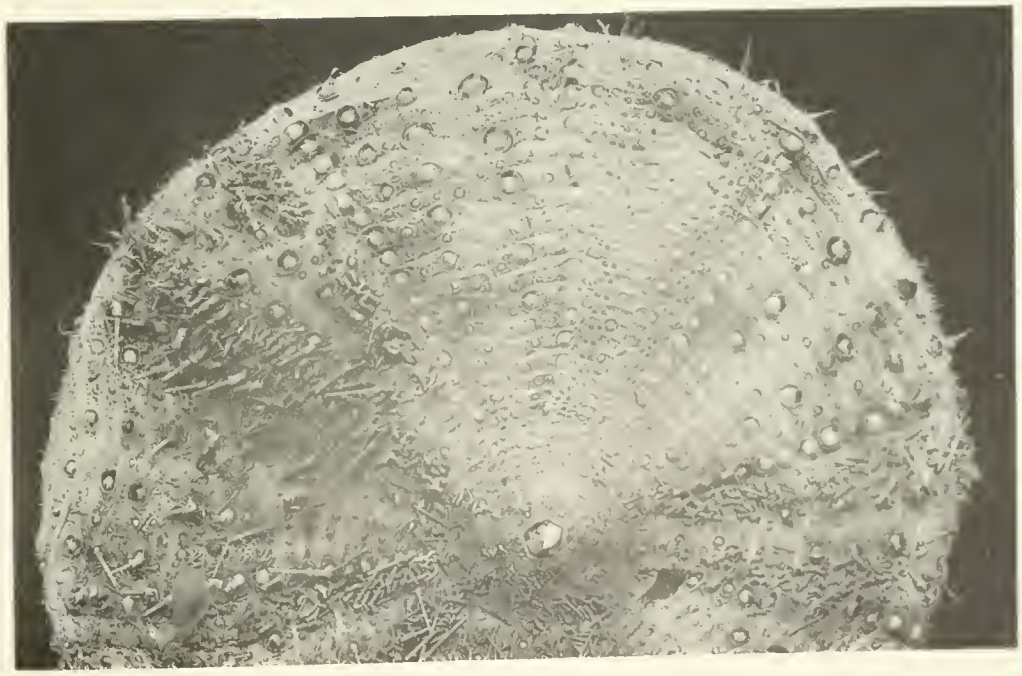

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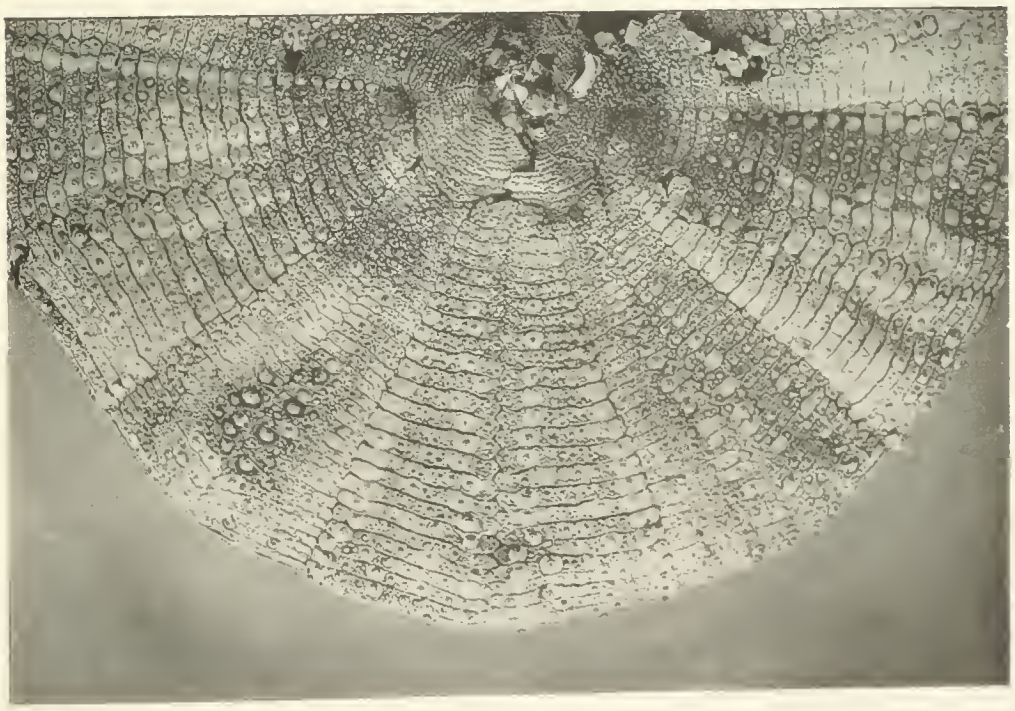

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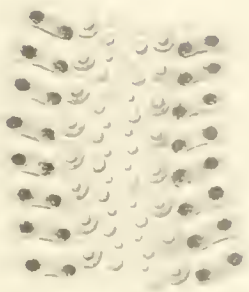
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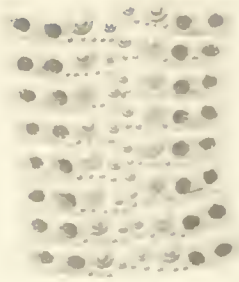
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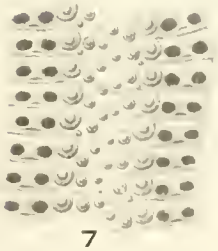
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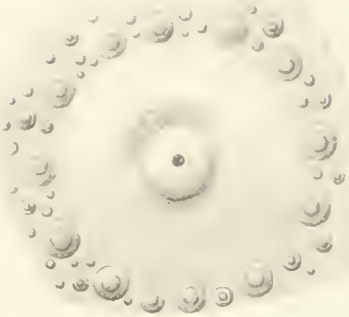
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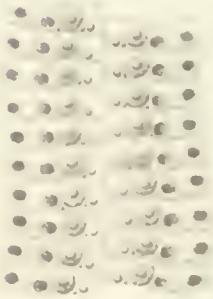
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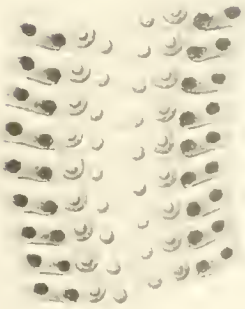
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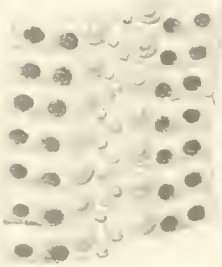
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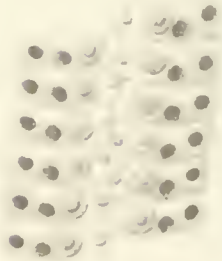
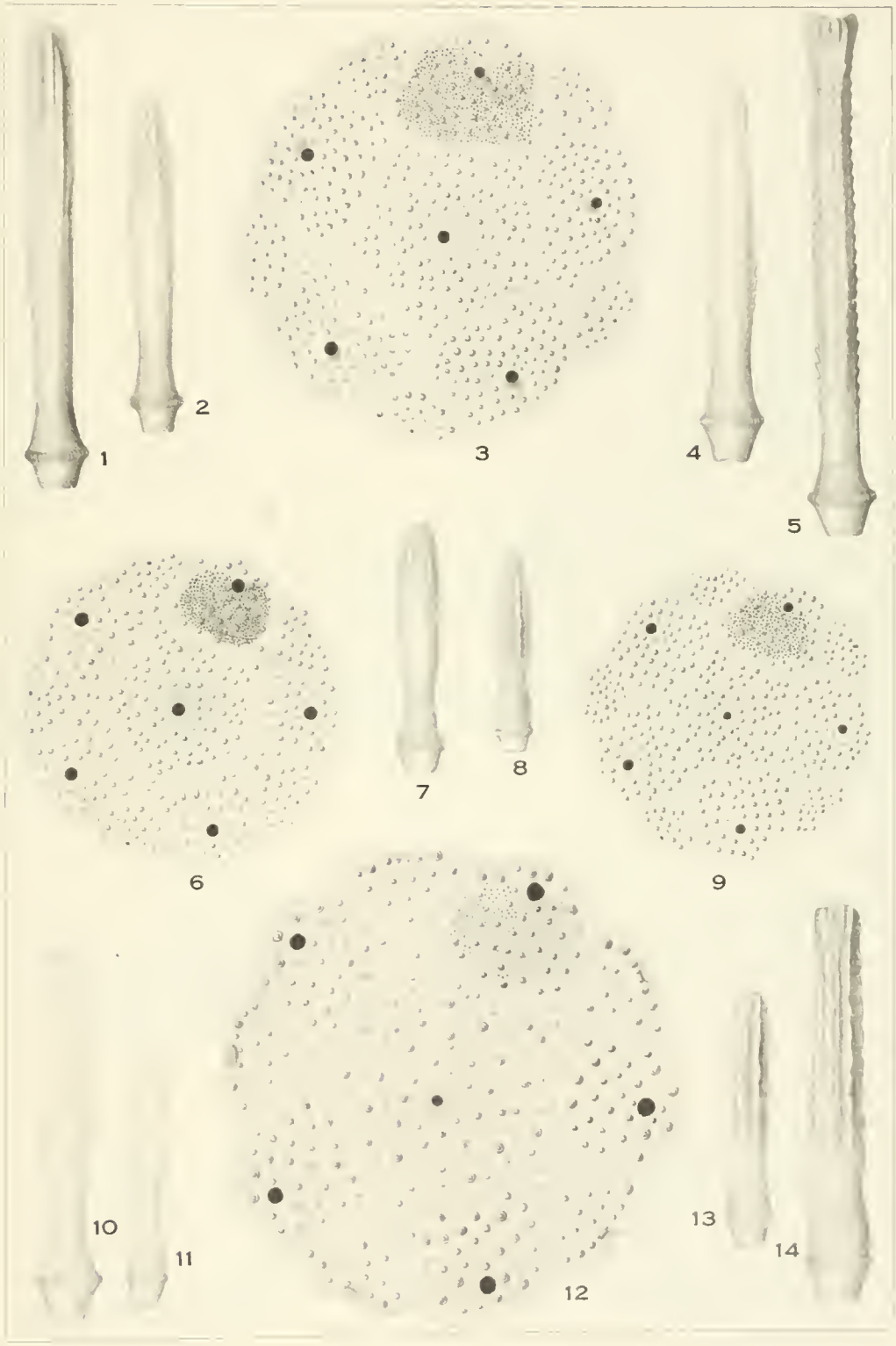

12

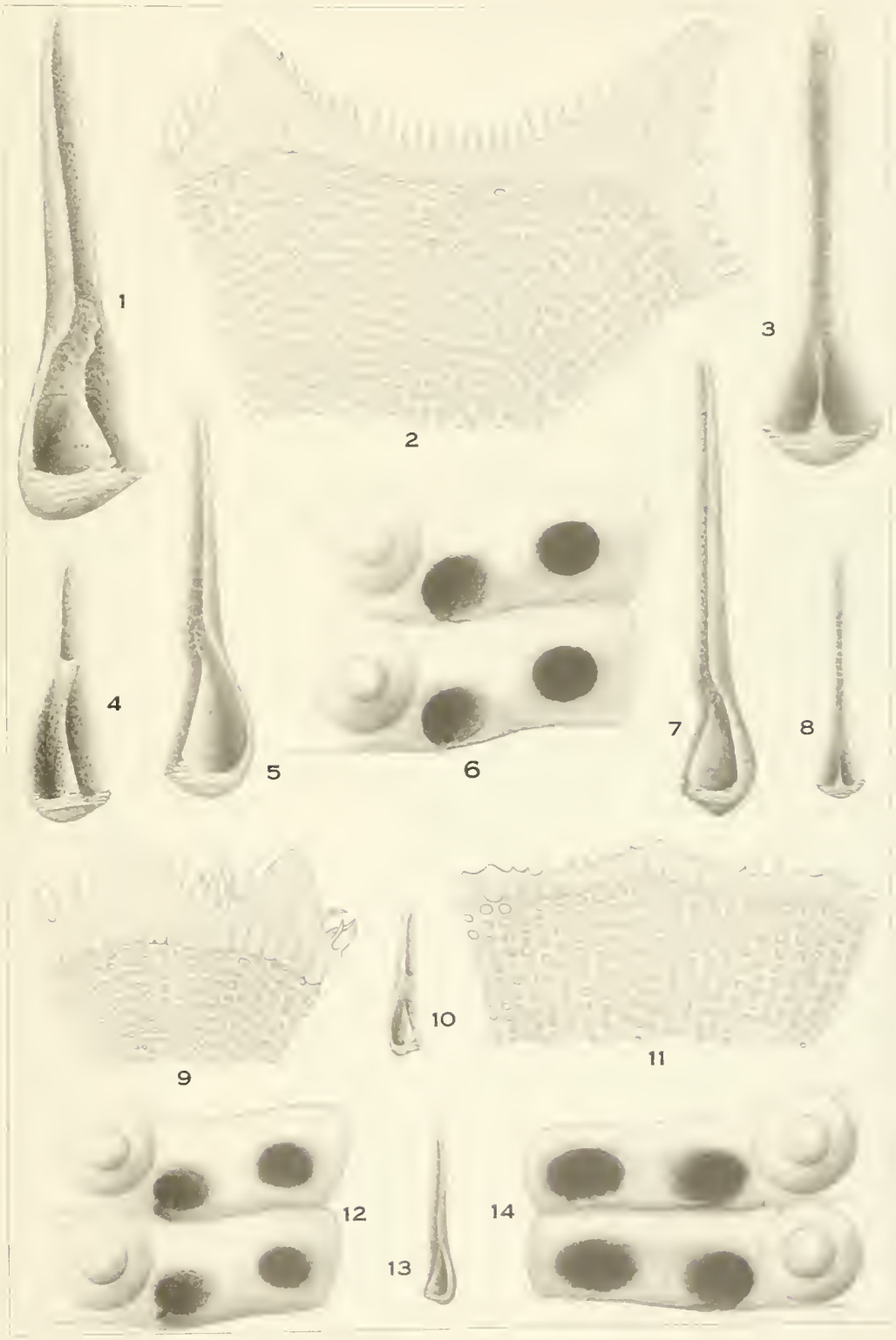
DETAILS OF STRUCTURE OF WEST INDIAN ECHINOIDS

FOR EXPLANATION OF PLATE SEE PAGE 27.



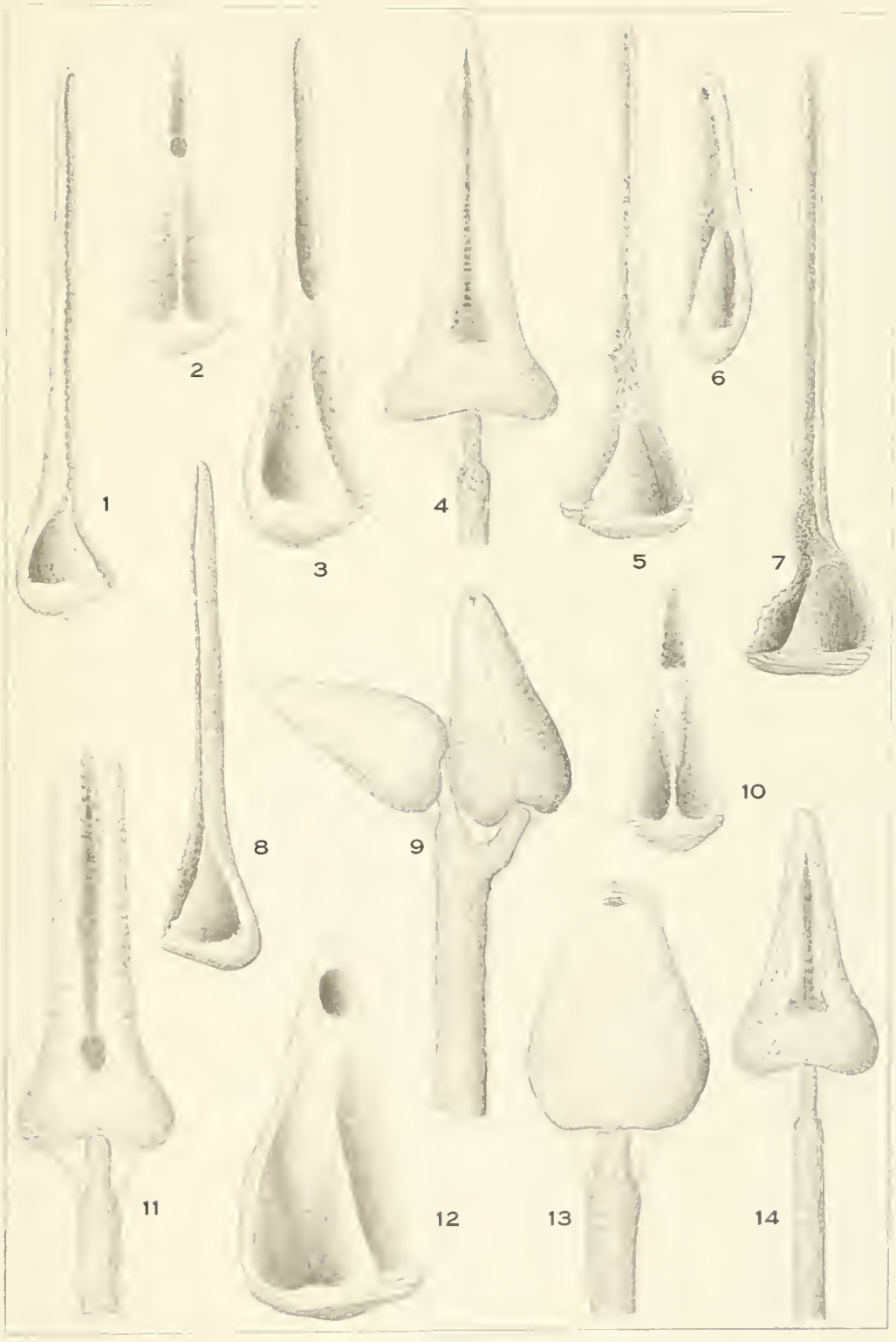
DETAILS OF STRUCTURE OF WEST INDIAN ECHINOIDS

FOR EXPLANATION OF PLATE SEE PAGE 27.



DETAILS OF STRUCTURE OF WEST INDIAN ECHINOIDS

FOR EXPLANATION OF PLATE SEE PAGE 27.



DETAILS OF STRUCTURE OF WEST INDIAN ECHINOIDS

FOR EXPLANATION OF PLATE SEE PAGE 28.