NEW CONTRIBUTIONS

TO

THE KNOWLEDGE OF THE CIDARIDS

I—II

BY

TH. MORTENSEN

WITH PLATES I—XIII

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Not many years ago the Cidarids were thought to be only a small remnant of a once, in the Jurassic and the Cretaceous periods, flourishing tribe. More recent researches have given another result. It is true that several forms of Cidarids, which were predominant in those former periods, like *Rhabdocidaris* and *Diplocidaris*, have nearly or completely disappeared; but then other forms, particularly the Goniocidarids, have started developing and have become very richly represented in the seas of our days. Thus the stem of this great and noble family of sea-urchins is as vigorous as ever, only now one branch, now another has taken the lead.

In my Monograph of the Echinoidea, Part I, Cidaroidea, published in December 1928, some 150 species and varieties of recent Cidarids were described, but I expressed (p. 355) the expectation that a good many more Cidarids would be found to exist in the seas of recent days. Already now, three years after the publication of the said work, I can add some new forms, and even a new generic type.

The voyage which, owing to liberal grants from the Carlsberg and the Rask-Ørsted Fund, I could undertake in 1929—30 to Java and South Africa, Mauritius, and St. Helena, afforded opportunities for making extensive collections in those seas, particularly of Echinoderms. During the visit to Java I was enabled to undertake investigations in the Bali-Sea, the Government of the Dutch East Indies placing at my disposal for 12 days the S.S. "Dög" for this purpose. As distances are not great in this area, a good deal of work could be done, and important results were achieved. As regards the Cidarids the most important was the discovery of a new, fine *Goniocidaris* species. The record by DE MEIJERE of *Goniocidaris florigera* from this very locality in the "Siboga" Echinoidea, based on a single, old spine, is herewith shown to be erroneous, the spine belonging to the new species here described, *Goniocidaris florigera* being till now known only from the Kei Islands.

At Mauritius the dredgings I could undertake at depths of some 200—300 metres off Port Louis, by means of the excellent tug "Mauritius" placed at my disposal by the Colonial Government, yielded some fine results in regard to Cidarids, viz. numerous specimens of *Stylocidaris badia*, hitherto known in five specimens only, two very fine specimens of *Chondrocidaris gigantea*, one of them being the largest specimen known of all recent Cidarids; further some specimens of a fine new variety of *Stylocidaris bracteata*, and a few young specimens of *Acanthocidaris curvatispinis*, hitherto known in two specimens only.

In the South African Seas I did not find any Cidarids; particularly I was very disappointed in not finding any specimens of the *Goniocidaris*-species which I have indicated to exist there (Monograph, p. 154, Note). But then I had the great pleasure of receiving, after my return from the voyage, some specimens of a Cidarid from Captain E. Pace of the Trawler "Disa", which proved to be a new species of *Stereocidaris*, the existence of which was also indicated in my Monograph, p. 270. Further I found in the collections of the Fisheries Laboratory of Cape Town a specimen of a Cidarid, which proved to represent an interesting new generic type, and in the collections of the South African Museum another fine Cidarid, which proved to be *Histocidaris elegans*, not hitherto known from South African Seas. In the Durban Museum I found a specimen of *Acanthocidaris maculicollis* likewise not hitherto known from South African Seas.

At St. Helena a rich material of *Tretocidaris spinosa* and *Eucidaris clavata* was obtained besides *Cidaris cidaris* var. *meridionalis*, not hitherto known from so far South.

In the material of Ophiuroids and Asteroids returned to me after the death of my lamented friend Professor R. Koehler, Lyon, to whom it was entrusted for reporting on, there was found also a couple of Cidarids, viz. a young *Stylocidaris albidens* and another specimen which proved to be an unknown species, most probably of the genus *Stylocidaris*. It is described here under the name of *Stylocidaris cingulata*.

A number of Cidarids were collected in the Sagami Sea in 1930 by my friend Dr. Torsten Gislén, who very kindly placed them at my disposal. This material, however, proved to contain only the well known species *Goniocidaris mikado*, *G. biserialis*, *Rhopalocidaris rosea*, and *Stylocidaris Reini*.

I have further had an opportunity of examining in the Zoological Laboratory, Leiden, the material of Cidarids (and other Echinoids) collected in the Malay Archipelago by my friend Professor H. Boschma during the "Willibrord Snellius" Expedition in 1929—30. As no dredgings or trawlings were undertaken in deep water it was hardly to be expected that new or rare forms would be contained in this collection. The more agreeably surprised I was in finding in this collection a large fine specimen of a new Cidarid allied to *Phyllacanthus*, but representing a separate subgeneric or generic type. This new form is, however, not included here. The description thereof will appear in the Reports of the said expedition.

The report on this rich material of Cidarids, partly new, partly insufficiently known, forms the main part (I) of the present paper. To this are added (II) some remarks on fossil Cidarids.

I beg to express here my sincere gratitude for all the help received; from the Governments of Java and Mauritius, from Dr. Cyril van Bonde, Director of the South African Fisheries Survey, Dr. K. H. Barnard, Assistant Director of the South African Museum, Dr. E. C. Chubb, Director of the Durban Museum, and Captain E. Pace of the "Disa"; further to Dr. Torsten Gislén and Professor H. Boschma for placing their material at my disposal. But above all my thanks are due to the Carlsberg Fund and the Rask-Ørsted Fund for the grants enabling me to undertake the said voyage and thus to bring together this highly valuable new material.

I.

Notes on some recent Cidarids.

The species mentioned here are the following:

1. *Histocidaris elegans* (A. Agassiz).
2. *Goniocidaris balinensis* n. sp.
3. *Stereocidaris squamosa* Mrtsn.
4. — *excavata* n. sp.
5. *Cidaris cidaris*, var. *meridionalis* Mrtsn.
6. *Tretocidaris spinosa* Mrtsn.
7. *Acanthocidaris curvatispinis* (Bell).
8. — *maculicollis* (de Meijere).
9. *Stylocidaris badia* (H. L. Clark).
10. — *bracteata*, var. *mauritiana* n. var.
11. — *cingulata* n. sp.
12. *Kionocidaris striata* n. g., n. sp., with var. *teretispina* n. var.
13. *Eucidaris clavata* Mrtsn.
14. *Prionocidaris pistillaris* (Lamk.).
15. *Chondrocidaris gigantea* A. Agassiz.

Literary references are not given under the various species. I have thought it sufficient to give reference to the place where they are mentioned in my Monograph, complete lists of literature being given there.

1. **Histocidaris elegans** (A. Agassiz).

Monograph of the Echinoidea I. Cidaroidea, p. 72.

During a visit to Cape Town in 1929—30 I found exhibited in the South African Museum a Cidarid which was at once seen to be a *Histocidaris*. Unfortunately the specimen was without locality, but Dr. K. H. Barnard told me that there was no doubt that it belonged to the "Pieter Faure" collections and thus had been taken somewhere in the S. African seas. Not being able to undertake a careful study of the specimen there, I asked Dr. Barnard to send it to Copenhagen to me after my return from the voyage, which he did. I have thus had an opportunity of studying the specimen at leisure, and have come to the result that, in spite of some minor differences, it is to be referred to the species *Histocidaris elegans* (A. Ag.).

The specimen is a large one, measuring 66 mm h. d., 25 mm v. d. There are only 9—10 I. A. plates. The character of the test is as in typical *H. elegans*. The primary spines are rather stout, ca. 3.5 mm in diameter; none of them are complete. The large pedicellariæ are of the type shown in Pl. LXXVI, 10 of the Monograph.

What gives this specimen a rather unusual appearance for a *Histocidaris elegans* is the stoutness of the primary spines; also the somewhat smaller number of I. A.

contributes to give the specimen a somewhat coarser aspect than is usual in *H. elegans*. But as the species is, on the whole, rather variable, these small differences cannot afford sufficient reason for distinguishing this specimen as a separate variety of *H. elegans*, at least not for the present. If, when one day a richer material comes to hand, it be found that the characters here pointed out are constant, it may be better to regard it as a distinct variety — as also other forms now referred to *H. elegans* may ultimately prove to represent distinct varieties (cf. Monograph, p. 77). But that is for the future to decide.

To find this species in S. African Seas is not surprising, as it is otherwise so widely distributed in the Indo-Pacific region. But it would seem probable that it has been taken in the more northern parts of the S. African Seas, off Natal, where so many other Echinoderms of the tropical seas have been found.

2. **Goniocidaris balinensis** n. sp.

Pl. I, figs. 1—5; Pl. XI, fig. 7; Pl. XIII, figs. 11—14.

h. d.	v. d.	Apical system	Peristome	Number of		Longest spines
				I. A.	A. pro I. A.	
30 mm	22 mm	13 mm (43.3 % h. d.)	11 mm (36.6 % h. d.)	7—8	10—11	56 mm
24 -	16 -	11 - (45.8 % - -)	10 - (41.7 % - -)	6—7	10—11	50 -

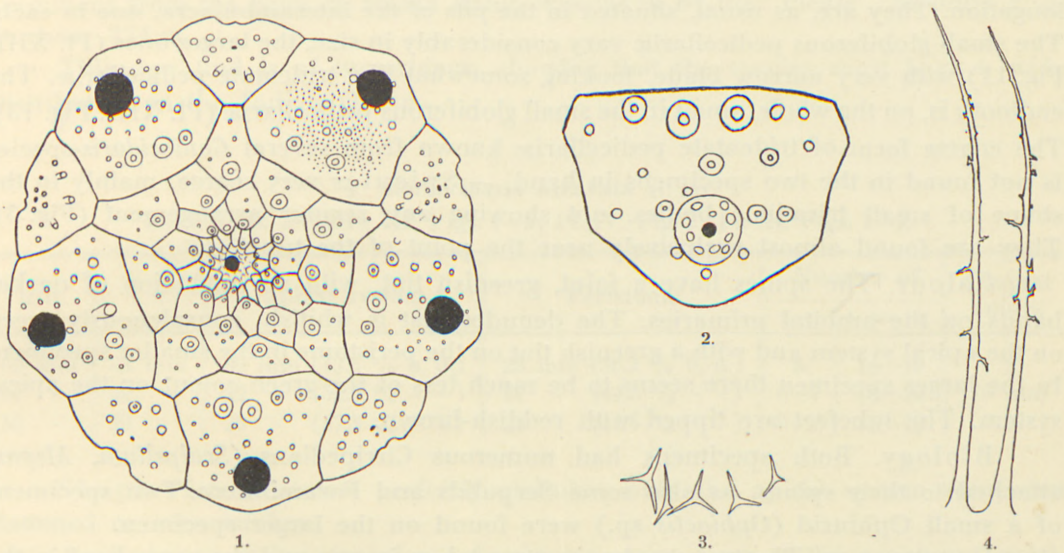
Test flattened above and below, sides subvertical; circumference round. Ambulacra distinctly sinuate. Interporiferous zone twice the width of a pore zone, sloping very gently towards the midline. Marginal tubercles rather widely separated, the inner part of the ambulacral plates covered with small tubercles of uniform size, irregularly arranged. Horizontal sutures distinctly grooved; median suture rather distinctly naked and also somewhat sunken (Pl. XI. Fig. 7).

Interambulacra. Areoles rather deep, only the two proximal ones confluent; the wall between them very narrow, except the one between the two uppermost areoles. There is a fairly conspicuous radiating striation in the outer (adradial) half of each areole. The subambital ones slightly transverse oval. No trace of crenulation observable. The median area very narrow, not half the width of an areole, slightly sunken along the midline. The scrobicular tubercles fairly conspicuous, halfmoon-shaped. Outside the scrobicular circle comes a circle of smaller tubercles, about half the size of the scrobicular ones, and then some few miliary tubercles fill up the rest of the space, leaving no naked median line, but only a small, but distinct groove or pit at the median end of each horizontal suture; no deepening at the outer, adradial end of these sutures. At the adradial side of the areoles there is hardly room for any tubercles outside the scrobicular circle.

The apical system a little less than half h. d., subpentagonal, almost flat. Ocular plates all insert; their sides rather conspicuously sinuate. Genital plates with 2—3 larger tubercles on the inner part, otherwise covered with several small tubercles.

A rather broad naked border on both genital and ocular plates. The genital openings large, near the outer edge. The specimen from which the figure of the apical system was drawn, is probably a female, in spite of the fact that its genital pores are distinctly smaller than those of the other specimen[1]. (Fig. 1). There are some scattered plates in the membrane covering the genital pore (Fig. 2), but not such a close pavement as is found in *G. florigera* (Monograph, p. 168, fig. 54). The periproctal plates with a larger tubercle at their inner edge.

Peristome somewhat smaller than the apical system, almost flat. There are 12—13 ambulacral plates in a series. The ambulacra do not join proximally, thus



Figs. 1—4. *Goniocidaris balinensis.* 1. Apical system. × 6. 2. Genital plate of female specimen, showing plates in the membrane of the genital pore. × 8. 3. Spicules from tubefeet. × 165. 4. Hairs from primary spines. × 65.

leaving free access to the mouth edge for the interradial series, which consist of 8 more or less regularly arranged plates.

The primary spines have a well developed basal disk, usually confined to the aboral side of the spine. Beyond the basal disk more or less numerous coarse thorns, which show no arrangement in longitudinal series; the basal ones are not widened so as to form repetitions of the basal disk. The shaft does not attenuate towards the point, where it widens into a distinct, star-shaped crown, which is the largest on the apical spines. The shaft may be slightly downward curving. The surface of the shaft is (in intact spines) covered by a coat of rather long, fine, non-anastomosing, somewhat thorny hairs (Fig. 4). The oral primaries are rather coarsely serrate; the third or fourth one is transitional to the ambital spines.

[1]) As the specimen had been dried before I noticed the difference in the size of the genital pores of the two specimens, I could not ascertain the sex of the specimen with the smaller pores.

Secondary spines. The scrobicular spines are 3 mm long, scarcely narrowing towards the straight cut end, which is, particularly in the larger specimen, somewhat thickened. They are slightly concave on the outer side, as seen in side view, a little thorny at the base. The marginal ambulacral spines are 2 mm long, much narrower than the scrobicular spines, likewise a little thorny at the base. At the proximal end of the ambulacra they are somewhat widened and excavate at the point. The miliary spines are very minute, not granule-like (Pl. XIII. Fig. 12).

Pedicellariæ. The large globiferous pedicellariæ almost spheroid, as is typical of *Goniocidaris*. The valves (Pl. XIII. Fig. 14) have scarcely any tubeshaped prolongation. They are, as usual, situated in the pits of the interambulacra, one in each. The small globiferous pedicellariæ vary considerably in size, the larger ones (Pl. XIII. Fig. 11) with very narrow blade, looking somewhat like tridentate pedicellariæ. The endtooth is, on the whole, small in the small globiferous pedicellariæ (Pl. XIII. Fig. 13). The coarse form of tridentate pedicellariæ known from several *Goniocidaris*-species is not found in the two specimens in hand. — Spicules very scarce, mainly in the shape of small triradiate bodies, not showing any regular arrangement (Fig. 3). They are found almost exclusively near the point of the tubefeet.

Colour. The spines have a faint, greenish tint, with an indication of darker bands on the ambital primaries. The denuded test is whitish, conspicuously green on the apical system and with a greenish tint on the peristome in the smaller specimen. In the larger specimen there seems to be much less of the green colour on the apical system. The tubefeet are tipped with reddish-brown.

Biology. Both specimens had numerous Cirripedians (*Scalpellum, Alepas*) attached to their spines, as also some Serpulids and Foraminifera. Two specimens of a small Ophiurid (*Ophiactis* sp.) were found on the larger specimen.

Occurrence. The two specimens were taken in one and the same haul in the Bali-Sea, at 7°30′ S. 114°30′ E. ca. 150 m, on a sandy-muddy bottom, 11/IV. 1929, on board S. S. "Dog".

Remarks. This species is the nearest related to *Goniocidaris florigera*, from which it is, however, distinguished at a glance by the colour of its primary spines. A notable difference from *florigera* is also the larger number of ambulacral plates on the peristome, 12—13, against only 8—9 in the said species. It also differs markedly from it in the shape of the apical disks, which in the present species are regularly star-shaped, in the other species eccentric, shield-shaped disks. There is then no doubt that we have here another distinct species of the genus *Goniocidaris*, so richly represented in the Malay Archipelago.

In the "Siboga" Echinoidea DE MEIJERE records an isolated spine of *Goniocidaris florigera* from the Bali-Sea, 298 m ("Siboga", Station 12). I had an opportunity of seeing this spine when studying the Goniocidarids for the Monograph and came to the result that it might well be an old spine of *G. florigera*, (Monograph, p. 171). This new *Goniocidaris*-species having now been found very near the locality, where the said spine was found, it becomes much more probable that it belongs to this latter

species, with the spines of which it has likewise much resemblance. But a definite result can scarcely be arrived at. The main thing is that *G. florigera* is not actually known from any other place than off the Kei Islands, where the two known specimens were taken, one by the "Challenger" the other by the Danish Expedition to the Kei Islands.

3. **Stereocidaris squamosa** Mrtsn.

Monograph of the Echinoidea I. Cidaroidea, p. 245.

One specimen in poor condition, but otherwise in perfect accordance with the specimens from the Saya de Malha Bank, was taken by the "Pickle", 32 miles E. of Durban, 374 m.

This new find is of importance, showing that the species must have a wide distribution in the Indian Ocean.

4. **Stereocidaris excavata** n. sp.

Pl. II. Figs. 1—2; Pl. III. Figs. 1—5; Pl. IV. Fig. 2; Pl. XI. Figs. 1—2.

h. d.	v. d.	Apical system	Peristome	Number of		Longest spines
				I. A.	A. pro I.A.	
69 mm	54 mm	30 mm (43.5 % h. d.)	25 mm (36.2 % h. d.)	8	18—19	?
61 -	44 -	32 - (52.5 % - -)	27 - (44.3 % - -)	6—7	18—19	70 mm
55 -	40 -	26 - (47.3 % - -)	23 - (41.8 % - -)	6—7	18—19	?

Shape of test almost perfectly globular, only the apical system somewhat flattened or even sunken.

Ambulacra rather conspicuously sinuate, even down to the peristome, particularly in the smallest specimen. In the largest specimen they are almost straight at the aboral end. Interporiferous zone about twice, in the largest specimen even a little more than twice the width of a pore zone. Marginal tubercles not very prominent, contiguous, forming a quite regular series throughout in the largest specimen, whereas in the smallest there is a slight irregularity near the peristomial edge, some of the marginal tubercles being pushed inwards. The space inside the marginal tubercles is completely filled with secondary tubercles, not distinctly serially arranged, in the largest specimen; in the smallest, where these tubercles are less numerous, those along the marginal series form rather distinct longitudinal series. The interporiferous zone is slightly sunken towards the midline, more so in the largest specimen. Pore-zones not much sunken. In the largest specimen the inner pore is distinctly the larger. The wall and ridge not much raised (Pl. XI. Figs. 1—2).

Interambulacra. The areoles are deeply sunken, widely separated, at most the two proximal ones confluent. The scrobicular edge is not at all raised, the scrobicular tubercles — which are conspicuously larger than the surrounding tuberculation and the marginal ambulacral tubercles — being placed halfway down the areole.

The boss is very low. There is no trace of crenulation. The median area is, in the largest specimen, as broad as an areole, in the smaller somewhat less. The tuberculation is very close and uniform, leaving no naked or sunken median line; but there are a number of horizontal lines across the area, from areole to areole, producing an arrangement of the tubercles in more or less regular horizontal series. Also on the outer side of the areoles such horizontal lines are distinct in the largest specimen, and there may also be some lines radiating from the upper side of the upper areoles. Pits (impressions for the large globiferous pedicellariæ) are distinct along the upper horizontal sutures — there may be a whole series of them — and may also occur along the vertical suture.

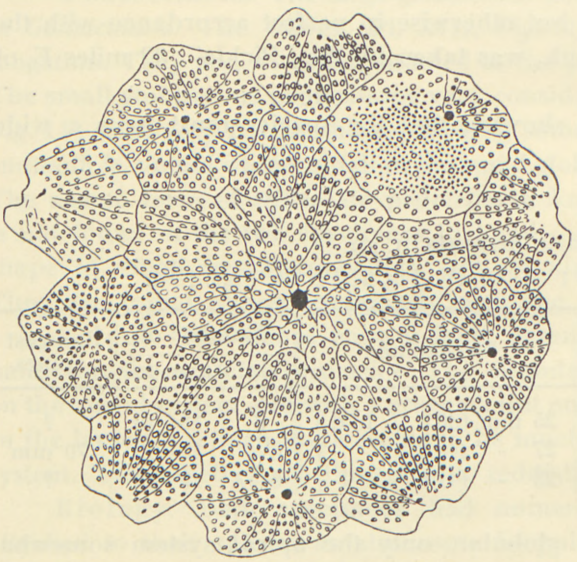


Fig. 5. Apical system of *Stereocidaris excavata*. ♀ × 2.6.

The apical system is very peculiar in the genital and ocular plates, as well as the outer periproctal plates, being conspicuously concave or rather excavate (Pl. III. Fig. 2). This is very pronounced in four of the specimens in hand, less so in the largest specimen. The oculars are all rather broadly insert. The genital plates not very large, particularly in the smallest specimen not much larger than the oculars. The genital pores are situated about in the middle of the plate, on a fairly conspicuous elevation; they are of moderate size in the female, very small in the male. Radiating lines produce a more or less conspicuous linear arrangement of the tubercles which are very close-set and of uniform, small size (Fig. 5).

The peristome is almost pentagonal, slightly elevated. There are ca. 18—20 ambulacral plates in a series; the pores form a single series, with a little irregularity here and there. The interradii are covered by a great number of small plates, arranged in transverse rows of 3—4 plates, or — in the largest specimen — not at all arranged in transverse rows, a feature rather unique in Cidarids. The interradial plates do not reach the mouth-edge.

Primary spines slender, cylindrical, with ca. 12 finely serrate, low ridges, the surface between the ridges covered by a close coat of branching, anastomosing hairs. Towards the point the ridges become somewhat more prominent, the point being thus fluted, but — on the upper spines — not crown-shaped widened. There is a conspicuous, shining, white neck, about twice the length of the collar, which latter distinctly increases in thickness towards the rather inconspicuous milled ring. The subambital primaries may be more conspicuously widened in the point; the oral

primaries are simple, more or less flaring at the point. The transition to the ambital spines is very gradual.

Secondary spines. The scrobicular spines are strongly appressed, in accordance with the position of the scrobicular tubercles. They are rather thick, 4—5 mm long, slightly narrowing towards the point which is, on the whole, square cut. They are generally more or less chisel-like excavated at the point. The marginal ambulacral spines are of the same main shape, only shorter, ca. 2—3 mm. The miliary spines are scale-like, appressed, evidently without ampullæ. The transition from the scrobicular to the miliary spines very abrupt. The miliaries remain of the same small size to the very edge of the peristome.

Pedicellariæ. The large globiferous pedicellariæ are rather numerous and conspicuous, rising above the close covering of squamiform secondary spines. They may particularly form a conspicuous line along the upper horizontal sutures. Both globiferous and tridentate pedicellariæ very closely resemble those of *Stereoc. microtuberculata* (Monograph, Pl. LXXXII. 2—4). — Spicules of the tubefeet of the usual Cidarid type.

Colour of the denuded test a creamy white; there is a faint greenish tint on the apical system. The primary spines also of a creamy-white colour, only the collar is brownish. The scrobicular and marginal ambulacral spines are of a greenish-olive colour.

Occurrence. The specimens in hand were taken off E. London, S. Africa, at a depth of ca. 120 metres, by Captain E. Pace of the trawler "Disa", who very kindly sent me these and several other interesting species of Echinoderms. I beg herewith to express my very great indebtedness to Captain Pace, whose interest in these forms also previously resulted in the discovery of a fine new Echinoderm, the seastar *Anthosticte Pacei*, which I described in my paper "On some Echinoderms from S. Africa" (Ann. Mag. Nat. Hist. 9. Ser. XVI. 1925).

It can scarcely be doubted that the large test of a S. African *Stereocidaris* figured in the Monograph, Pl. XXVII. Fig. 4 (p. 270) belongs to this species.

Anomalies. Besides the three specimens described above there are two more specimens which are more or less anomalous. Both of them have the periproct raised into a rather high rounded cone, which has much the appearance of a transformation due to some parasite, of which I have, however, been unable to find any trace on the dried specimens. In both of them also the upper part of the test is misshapen on one side.

Affinities. It is beyond doubt that this species is very nearly related to the Japanese species *Stereocidaris microtuberculata* (Yoshiwara) (cf. Monograph, p. 257). The characters of the apical system and peristome, however, offer such marked differences from the said species that it seems quite necessary to regard them as separate species. Also in the secondary spines there is a marked difference, these having in *microtuberculata* a very well developed ampulla, whereas in the S. African form there is — judging from the dried specimens in hand — no such ampulla. Then the fact

that one is known from the Japanese seas only, the other from S. African seas, is against regarding them as identical. If ultimately *St. microtuberculata* should be found to occur also in the Indian Ocean (or *St. excavata* be found to be distributed also over the Indian Ocean) it might perhaps be preferable to regard the S. African form merely as a local variety of *microtuberculata*; but with our present knowledge it seems to me the only justifiable course to regard it as a distinct species.

5. **Cidaris cidaris**, var. **meridionalis** Mrtsn.

Monograph of the Echinoidea. I. Cidaroidea, p. 298.

Six fine specimens were taken 2 miles E. of Bay Point, St. Helena, in 480 m. 24/II. 1930. They are perfectly conform with specimens from the Bay of Biscay, and I can thus have no doubt in referring them to this variety.

Considerable zoogeographical interest attaches to this find, the said variety being thus found to be distributed over the whole Eastern part of the Atlantic, from the Bay of Biscay to St. Helena. I may also mention here, quite preliminarily, that several other Echinoderms of the N. E. Atlantic were found during my researches at St. Helena in February 1930.

6. **Tretocidaris spinosa** Mrtsn.

Pl. IV. Figs. 6—12, 15; Pl. XIII. Fig. 3.

Monograph of the Echinoidea. I. Cidaroidea, p. 317.

This species was found to be quite common at depths of ca. 50—60 metres along the N. W. coast of St. Helena, particularly off Jamestown, where it was found in all sizes from fully adult and old, worn specimens down to quite small ones. The largest was 56 mm h. d., thus not quite as big as the one of 57 mm from Ascension mentioned in the Monograph, p. 317. But this, evidently, is about the maximum size of this species. Specimens of a size of ca. 50 mm h. d. generally look old and worn.

The type specimen, of 49 mm h. d. has 9—10 plates in each interambulacral series. This is rather unusual, specimens of that size having generally only 8 interambulacral plates in a series; but I have one specimen of 48 mm h. d. with 9—10 interambulacral plates, and in a specimen of 53 mm h. d. there are even 10—11 interambulacral plates.

Very noteworthy is the variation in the length of the primary spines. In adult specimens they are mostly about equal to the horizontal diameter of the test, but sometimes they are up to twice the diameter of the test. On the other hand they may be much shorter than the diameter, thus in a specimen of 48 mm h. d. they are only ca. 34 mm long. This difference in the length of the spines becomes the more conspicuous through the fact that the longer spines are on the whole more slender than

the shorter ones, and the terminal widening either absent or much less conspicuous than in the short form of spines. In the more short-spined forms the spines are often distinctly cup-shaped (Pl. IV. Figs. 6—12), recalling, in fact, the spines of the fossil *Cyathocidaris cyathifera* (Agass.) (Monograph, p. 484, fig. 150. 1), which may indicate that the fossil genus *Cyathocidaris* is a near relation of *Tretocidaris*. — Such short, cup-shaped spines may also occur singly in specimens with the other spines long and slender.

The peculiar double tubercles on the upper interambulacral plates found in the largest specimen (Monograph, p. 319, Pl. LXVII. 9) are not seen in any of the present specimens. It is therefore beyond doubt that this duplication is only an anomaly.

In the description of the ambulacra (Monograph, p. 317) it is stated that "in the specimens there is, however, at the ambitus, more or less regularly a second inner tubercle higher up on the plate, obscuring thus the regular series arrangement". It should, of course, have been "in the larger specimens". Otherwise I have nothing to add to the description of the test given in the Monograph.

Tridentate pedicellariæ are exceedingly scarce, in by far the majority of the specimens entirely absent. They are very much like those of *Tr. Bartletti*, only the slight widening of the edges in the proximal part of the blade, rather characteristic of the latter (cf. Pl. 17. 1 of my paper "On some West Indian Echinoids". Bull. U. S. Nat. Mus. 74, 1910) is not found here (Pl. XIII. Fig. 3).

The colour of the denuded test is usually a light pinkish-red, the apical system of a more intense red-brown colour.

The smallest specimen found is 7 mm h. d., with 4—5 I. A. The genital pores appear at a size of ca. 15 mm h. d.

The young specimens with the rather conspicuously brownish banded spines show a considerable general resemblance to the young specimens of *Stylocidaris badia*. But under the microscope they are very easily distinguished, particularly by the characteristic large globiferous pedicellariæ which are well developed already in the youngest specimens.

A very curious anomaly was found in a primary spine which ends in three points, there being two small side branches, each ending in a small crown like the normal point (Pl. IV. Fig. 15).

From the rich material of this species now in hand from the type locality, St. Helena, it appears that the specimens from Ascension and those from St. Helena are identical, the peculiar features in which the type-specimen differed from the Ascension-specimens (Monograph, p. 319—320), viz. the more numerous coronal plates and the terminal widening of the primary spines in the type-specimen, being only individual variations. Only I find the secondary spines of the St. Helena specimens on the whole darker than those of the Ascension specimens, and also the primary spines more distinctly banded in the adult Ascension specimens. At most the Ascension specimens can be regarded as a local colour variation.

7. Acanthocidaris curvatispinis (Bell).

Pl. V. Figs. 1—5; Pl. XI. Fig. 4; Pl. XII. Fig. 8.
Monograph of the Echinoidea. I. Cidaroidea, p. 323.

My hope of getting fresh material of this splendid, but rare and little known Cidarid by the investigations off Mauritius was only partly fulfilled. In spite of all efforts only some young specimens, five in all, two of them broken, were obtained off Port Louis, at depths of ca. 200 m. Like *Chondrocidaris gigantea* and *Prionocidaris pistillaris* it must evidently be rare, or perhaps occur in more isolated spots difficult to find, not scattered all over the bottom, as is the case with *Stylocidaris badia*. Although the two specimens previously known were taken on hooks by fishermen fishing in deep water outside the reef, it seemed to be entirely unknown to the fishermen of Mauritius at present; but then there is not so much deep-sea fishing done now as there was in former times.

h. d.	v. d.	Apical system	Peristome	Number of		Longest spines
				I. A.	A. pro I.A.	
22 mm	13 mm	10 mm (45.5 % h. d.)	9 mm (40.9 % h. d.)	6—7	10—11	55 mm
21 -	12 -	9.5 - (45.2 % - -)	8 - (38.1 % - -)	6—7	10—12	50 -
15 -	8.5 -	7 - (46.6 % - -)	6 - (40 % - -)	5—6	9—10	55 -
15 -	9 -	7 - (46.6 % - -)	5.5 - (36.6 % - -)	5—6	9—10	50 -
15 -	8.5 -	7 - (46.6 % - -)	6.5 - (43.3 % - -)	5—6	9—10	38 -

In general these specimens fit very well with the description given in the Monograph (loc. cit.). Only some minor differences, due to the different age, are to be noticed.

In the ambulacra the inner series of tubercles is not yet complete, the tubercle having appeared mostly only on one side, more or less alternating (Pl. XI. Fig. 4). The primary interambulacral tubercles are conspicuously crenulate, not only on the adapical side.

The apical system (Fig. 6) is distinctly elevated, forming a rounded cone. Already in the youngest specimens the oculars are all insert. The tubercles along the inner edge are elongate, which becomes the more conspicuous by their greenish colour against the whitish ground colour of the plate. The genital pores are beginning to appear in the youngest specimens. In these specimens there are 7—8 ambulacral plates in a series on the peristome, and 2—3 interradial plates.

The primary spines are, in the three smallest specimens, of a very light colour, whitish with conspicuous bands of reddish-brown; in the two larger specimens they are darker, but still distinctly banded, in the largest one also with numerous small spots of the same reddish-brown or purplish colour. In all the specimens the collar is thus spotted, the spots alternating with the white elevations on the longitudinal

ridges. The secondary spines are whitish, with only a narrow, faint, greenish midline.

The denuded test is whitish, with a slight greenish tint, particularly distinct between the upper areoles and on the apical system. The interporiferous zone of the ambulacra greenish-olive.

Of pedicellariæ only the small globiferous form is found, and a few tridentate ones; these latter present a rather characteristic appearance on account of the broad space devoid of holes along the margins (Pl. XII. Fig. 8).

The spicules of the tubefeet are more thorny than in *A. maculicollis*, more of the usual Cidarid type. The genital organs are, as in *maculicollis*, slender tubes with some long nearly smooth spicules (cf. Monograph, fig. 96, p. 331). The long and straight genital duct is mailed with thick, fenestrated plates. Also the Stewart's organs are thickly studded with irregular, triradiate spicules. Spicules of intestine as in *A. maculicollis*.

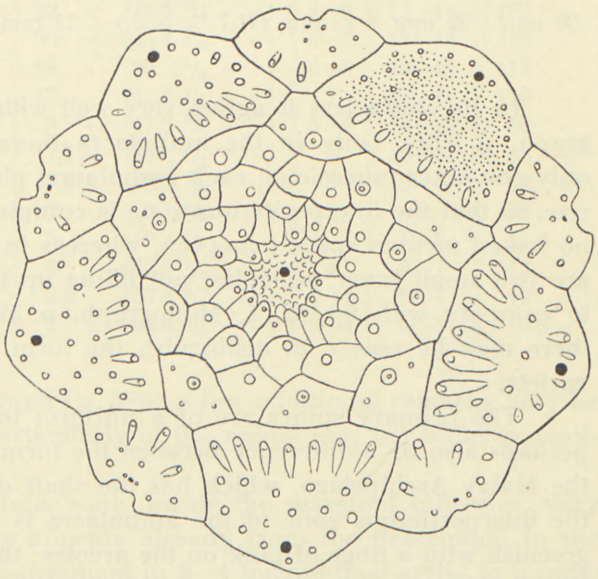


Fig. 6. Apical system of *Acanthocidaris curvatispinis*. × 8.

8. **Acanthocidaris maculicollis** (de Meijere).

Pl. V. Fig. 6; Pl. XI. Fig. 5.

Monograph of the Echinoidea. I. Cidaroidea, p. 329.

On a visit to Durban in August 1929 I found in the Museum there a specimen of an *Acanthocidaris*, unfortunately in a poor state of preservation and without exact locality. But it must have been taken off the S. African coast, probably off Natal. As I could not there undertake a more detailed examination of the specimen, I asked the Director of the Durban Museum, Dr. E. C. Chubb, to let me have the specimen sent to Copenhagen for study, which he very kindly did. I beg here to express my cordial thanks for this favour.

On studying the specimen more closely I found to my surprise that it was not, as might be expected, the Mauritius-species, *A. curvatispinis*, but *A. maculicollis*. This species was hitherto known from the Sagami Sea, the Bonin Islands and the Malay Archipelago; Koehler ("Investigator" Echinoidea. III. p. 23) has recorded it from the Indian Ocean, but without definite locality. It is then of considerable interest now to have it from off the African coast — proof that it must be distributed all over the Indo-Pacific Region, from Japan to the African Coast.

The specimen has the following dimensions:

h. d.	v. d.	Apical system	Peristome	Number of		Longest spines
				I. A.	A. pro I.A.	
36 mm	22 mm	15 mm (41.7 % h. d.)	14 mm (38.8 % h. d.)	7—8	12—13	95 mm (broken)

In its characters it agrees very well with the description of the species (Monograph, p. 329). Only in the ambulacra there is a marked difference, there being only one inner tubercle on each ambulacral plate, at the lower corner, of rather large size, so that the interporiferous zone is completely filled up by these inner tubercles, no naked median space being left, whereas in a large specimen from Amboina there are two small inner tubercles, not filling up the interporiferous zone (Pl. XI. Fig. 5 to compare with fig. 92. 1, Monograph, p. 326). If this difference proves constant there may be reason to distinguish the form from the Indian Ocean as a separate variety.

The primary spines are of a uniform brownish colour, not banded; this may perhaps also be a difference between the form from the Indian Ocean and that from the Malay Archipelago, which has the shaft distinctly banded. On the denuded test the interporiferous zone of the ambulacra is dark olive, the interambulacra faintly greenish with a tinge of pink on the areoles; the apical system a darker greenish olive. The specimen is a male, the pores being small as in fig. 94, Monograph, p. 330. Of pedicellariæ only a few samples of the small globiferous form could be found.

As no figure exists of the denuded test of adult specimens of this species, I give here a figure of the present specimen, with the test partly denuded.

9. **Stylocidaris badia** (H. L. Clark).

Pl. IV. Figs. 1, 16; Pl. VI; Pl. IX. Figs. 1—3; Pl. XII. Figs. 9—10.
Monograph of the Echinoidea. I. Cidaroidea, p. 376.

A very rich material of this species was collected at Mauritius, off Port Louis, at depths of ca. 200—300 metres outside the reef. It was evidently quite common, nearly every haul bringing specimens up, sometimes as many as 8—10 at a time. Also all different sizes were represented, from quite young ones to such as are evidently old and have reached their full size, their spines being much overgrown with sponges, Bryozoans, Foraminifera, worm-tubes, and other foreign organisms.

As hitherto only the five specimens mentioned in the Monograph (p. 376) were known it may be desirable to give here measurements of a number of specimens of the largest and the smallest sizes; measurements of specimens of medium size (38—25 mm) are given in the Monograph.

The specimen of 58 mm h. d. is the largest of all and evidently represents about the maximum size to which the species grows.

h. d.	v. d.	Apical system	Peristome	Number of		Longest spines
				I. A.	A. pro I.A.	
58 mm	38 mm	28 mm (48.3 % h. d.)	25 mm (43.1 % h. d.)	9	13—14	112 mm
55 -	37 -	26 - (47.3 % - -)	22 - (40 % - -)	8—9	13—14	135 -
49 -	35 -	24 - (49 % - -)	22 - (44.9 % - -)	8—9	13—14	100 -
46 -	30 -	22 - (48 % - -)	20 - (43.4 % - -)	6—8	13—14	115 -
45 -	32 -	21 - (46.6 % - -)	18 - (40 % - -)	8—9	13—14	115 -
41 -	27 -	19 - (46.3 % - -)	17 - (41.5 % - -)	7	12—14	110 -
19 -	10 -	10 - (52.6 % - -)	8 - (47.5 % - -)	5—6	10—12	60 -
16 -	8.5 -	8 - (50 % - -)	7.5 - (46 % - -)	5	10—11	63 -
14 -	7.5 -	7.5 - (53.6 % - -)	7.5 - (53.6 % - -)	5	10—11	49 -
12.5 -	7.2 -	7 - (56 % - -)	7 - (56 % - -)	5	8	20 -
10 -	5 -	5.5 - (55 % - -)	5 - (50 % - -)	4—5	7—8	21.5 -
8 -	4 -	5 - (62.5 % - -)	5 - (62.5 % - -)	4	6—7	13 -
6.5 -	3.2 -	3.5 - (53.8 % - -)	3.5 - (53.8 % - -)	3—4	6—7	12 -
4.5 -	2.5 -	3 - (66.6 % - -)	3 - (66.6 % - -)	3—4	4—5	6.5 -

To the description in the Monograph (p. 376) a few additional remarks may be made; also some additional figures, particularly of the naked test, not hitherto available, are given (Pl. IX. Figs. 1—3).

The tubercles of the interporiferous zone, inside the marginal tubercles, vary to a rather considerable degree, — as appears already from the description in the Monograph — from a quite regular arrangement in 2—4 longitudinal series to a quite irregular arrangement. There may also, though rarely, be a distinct, naked median space, the more conspicuous because of the white colour of the ambulacral midline.

The crenulation of the upper primary tubercles is rather variable, often it has completely disappeared, particularly in the larger specimens; it is, on the whole, more distinct in the younger specimens. The median interambulacral space may, in the largest specimens, be almost as wide as the areoles; it is almost completely covered with small tubercles.

The genital pores are quite small, also in the females, corresponding to the fact that the eggs are quite small. The pores are about to appear in specimens of ca. 15 mm h. d. In specimens of this size the oculars are still distinctly exsert, or just beginning to touch the periproct. In a specimen of 10 mm h. d. I find, however, Ocular V just in touch with the periproct and Oc. I. nearly so.

In the largest specimens there are ca. 18 ambulacral plates in a series on the peristome, and 8—9 mostly very regular interradial plates. In a specimen of 10 mm h. d. there are 7—8 ambulacral and 3—4 interradial plates. As a rule the peristome is conspicuously conically elevated.

The length of the primary spines varies to a rather considerable degree, as appears rather strikingly from the above measurements, where in the specimen of 14 mm h. d. the longest spines are 49 mm, while in the specimen of 12.5 mm h. d. they are only 20 mm. In a specimen of 34 mm h. d. the longest spines are 85 mm,

while in the specimen of the same size recorded in the Monograph the spines reach the length of 103 mm. Such relatively short-spined specimens are, however, exceptional.

As the spines measured are always fully formed, and cannot, therefore, grow any longer, one may perhaps wonder how the spines can attain the much greater length in the larger specimens than do those of the younger specimens. The explanation is the very natural one that the spines which are the longest in the young and the old specimens are not the same. Thus in the specimen of 10 mm diameter the longest spine is no. 4 from below; in the specimen of 19 mm it is no. 5, and in the specimen of 55 mm the longest spine is no. 7. When, however, in this latter specimen spine no. 4 has a length of ca. 50 mm, no. 5 a length of ca. 80 mm, thus rather longer — at least for no. 4 — than what can be accounted for by the normal amount of variation, this must mean that these spines have been regenerated. As a matter of fact, young regenerating spines are often seen among the old spines in adult specimens. Whether the old spines are directly cast off, through autotomy, by the sea-urchin itself, or they are lost through injury of some kind, is, as a rule, not to be ascertained. But that such autotomy does take place is beyond doubt (cf. Monograph, p. 27).

Secondary and miliary spines without glandular ampulla.

The large globiferous pedicellariæ are, on the whole, very scarce, and in adult specimens more often totally absent; in younger specimens they are more common. The tridentate pedicellariæ are richly developed, particularly in the younger specimens; they are in two forms, one with shorter valves, slightly outward curved in the basal part and therefore very widely apart, joining only in the point, the other with the valves curved inward above the base and therefore much less apart (Pl. XII. Figs. 9—10); the valves are also somewhat coarser in the former, in which also the stalk is very much shorter than in the second form. — The spicules of the intestine of the form typical in the genus *Stylocidaris*.

The naked test, when well cleaned with hypochlorite of sodium, is of a creamy white colour, in remarkable contradistinction to the dark colour of the test as covered with its skin and spines; there may be a more or less distinct pinkish tint on the upper part of the corona, particularly in the peripheral part of the areoles. The marginal tubercles of the ambulacra somewhat darker, greenish-olive, the tubercles inside the marginal ones may be pinkish, but generally the interporiferous zone is whitish. The apical system is somewhat darker, reddish-brown or more olive. It is rather more intensely coloured in the young than in the adult specimens.

Several specimens were opened on October 12th and found to be unripe; but it looked as if the eggs would be very small and clear, which might indicate that this species has a pelagic larva. — In the intestine I have found remains of hard-shelled bottom organisms, particularly of Bryozoans; also sponges.

A curious anomaly was observed in a primary spine, it being bifid at the point (Pl. IV. Fig. 16), much like the one of *Schizocidaris assimilis* figured in the Monograph, Pl. XVII. 9.

The species is only known to occur at Mauritius.

10. **Stylocidaris bracteata**, var. **mauritiana** n. var.

Pls. VII—VIII; Pl. IX. Figs. 10—11; Pl. XII. Figs. 3—5, 7.

h. d.	v. d.	Apical system	Peristome	Number of		Longest spines
				I. A.	A, pro I.A.	
45 mm	28 mm	21 mm (46.6 % h. d.)	18 mm (40 % h. d.)	8—9	12—13	91 mm
42 -	28 -	21 - (50 % - -)	17 - (40.5 % - -)	8	14—15	ca. 80 -
39 -	23 -	19 - (48.7 % - -)	15 - (38.5 % - -)	8	14—15	81 -
38 -	22.5 -	18 - (47.4 % - -)	16.5 - (43.4 % - -)	7—8	13—14	86 -
33 -	19 -	17 - (51.5 % - -)	15 - (45.5 % - -)	7	14—15	81 -
32 -	19 -	16 - (50 % - -)	15.5 - (48.4 % - -)	7	13—14	94 -
26 -	15 -	13 - (50 % - -)	11 - (42.3 % - -)	6—7	13—14	73 -

In regard to shape and structure of test and spines this form agrees so closely with the typical *Stylocidaris bracteata*, as described in the Monograph (p. 359) that it would be quite superfluous to give a full description of the present form; it will suffice to state the few points in which there is any noticeable difference.

The size appears to be, on the whole, somewhat larger in the Mauritius-form than in the typical *bracteata*, which latter hardly exceeds 35 mm h. d., whereas the present form attains a size of at least 45 mm h. d., and probably more, since the uppermost spines in the specimen of that size are as yet quite young and undeveloped. In conformity with this larger size the median space of the interambulacra is somewhat wider than in the typical form, and the part adradially to the areoles is broader with more numerous small tubercles, but this difference is simply due to the difference in size.

The only real differences from the typical form are in the colour and in the pedicellariæ. The primary spines are banded on the shaft, and spotted on the collar as in *bracteata*, but whereas the bands and spots are red or red-brown in the typical form, they are brownish-olive in the present form and also the ground colour is greenish, in the typical form cream-whitish or yellowish. The larger primaries are rather distinctly curved (the concavity on the oral side), but this is also indicated in the typical form, only less distinctly on account of the smaller size. The secondary spines are pinkish, more conspicuously so than in the typical form. More conspicuous is, however, the difference in the colour of the naked test. Whereas in the typical form the interporiferous zone of the ambulacra is a dark olive, forming five conspicuous, dark, radiating lines, in the present form the interporiferous zone is a light pinkish. Also the apical system has a faint pinkish tint, not olive-purplish as in the typical form. Further the peristome is simply whitish, whereas in the typical form it has a distinct greenish tint.

As in the typical form there is a conspicuous brownish spot at the median and outer end of each horizontal interambulacral suture and at the corner of each ocular plate; sometimes there is a series of such spots along the interambulacral midline and along the edges of the genital plates. These spots are very resistent and remain distinct even after the test has been cleaned with hypochlorite of sodium.

Large globiferous pedicellariæ, which in the typical form occur rather frequently at the brown spots in the interambulacra, could not be found in any of the specimens at hand of the present form. On the other hand, there is generally found at these spots a peculiar form of tridentate pedicellariæ, short-stalked and with widely gaping valves which, in the larger samples, are coarsely dentate (Pl. XII. Fig. 4); this kind of pedicellariæ is not found in the typical form. Sometimes, however, the usual, more slender-valved tridentate pedicellariæ (Pl. XII. Fig. 3) occur at the brown spots, as elsewhere on the test. This latter form of tridentate pedicellariæ is more like that of the typical form, though in the latter the valves are generally more apart (Pl. XII. Fig. 6); as a rule they are also much smaller in the typical *bracteata*, but they may also here reach a considerable size, up to ca. 1.5 mm length of head, as in the Mauritius-form, only in the latter those of such large size (or even up to nearly 2 mm) are much more common. The irregular globiferous pedicellariæ found in the typical form (Monograph, p. 361, Pl. LXXXV. Figs. 4—5) were not found in the Mauritius specimens.

A parasitic Gastropod (*Mucronalia* sp.) is found rather commonly on this Cidarid, attached at the base of the primary spines, mainly those on the oral side. Also a crab, *Eumedonus* sp., was found on one of the specimens.

13 specimens of this Cidarid were taken at depths of ca. 200—300 metres off Port Pouis, Mauritius, in October 1929. They are all of them very closely alike in all their characters, so that it is quite evident that we have here a very well marked form. It is, in any case, very closely related to *Stylocidaris bracteata;* perhaps it should rather be regarded as a separate species, but as the differences from *bracteata* are rather unimportant, I think it preferable to designate it only as a variety of that species. Whether it is merely a local variety or it is widely distributed over the Indian Ocean remains to be ascertained through future investigations.

11. **Stylocidaris cingulata** n. sp.

Pl. I. Fig. 6; Pl. XI. Fig. 6; Pl. XIII. Figs. 8—10.

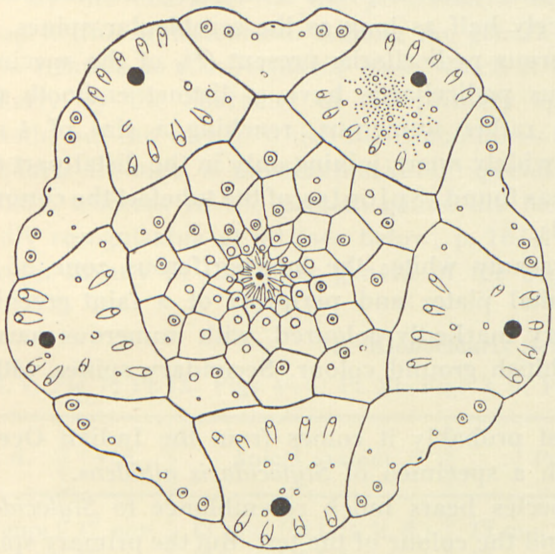
h. d.	v. d.	Apical system	Peristome	Number of		Longest spines
				I. A.	A. pro I.A.	
22.5 mm	13 mm	12 mm (53.3 % h. d.)	11 mm (49 % h. d.)	4—5	14—15	46 mm

Test much rounded, only the periproct conspicuously raised.

Ambulacra rather broad, $^2/_5$ the width of the interambulacra, distinctly sinuate. Interporiferous zone about the width of a pore zone. Marginal tubercles not very prominent, nearly contiguous. A single small secondary tubercle occurs rather irregularly at the lower edge of the plates, often together with a miliary tubercle, the two being sometimes placed so close together as to form one elevation. Median line slightly sunken. The pores are rather distant, the outer one distinctly the larger. The wall is broad, of a somewhat unfinished character, flattened in the lower part,

raised, sometimes into a more or less sharp edge, in the upper part; the ridge low. The lower furrow is straight and sharp, a somewhat unusual feature (Pl. XI. Fig. 6).

Interambulacra. Areoles rather large, not at all sunken; the upper ones are widely separated, and even the proximalmost ones are not confluent. No trace of crenulation on the primary tubercles. Scrobicular tubercles not prominent. Median area narrow, only about half the width of an areole; there is thus very little room for secondary tubercles outside the scrobicular circle, there being in the main only a single circle of them, alternating with the scrobicular tubercles; on the adradial



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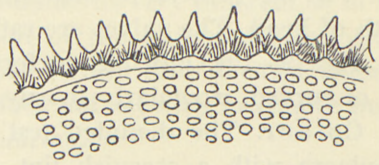

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Fig. 7—8. *Stylocidaris cingulata.* 7. Apical system. × 6. 8. Part of section of primary spine. × 100.

edge there are no secondary tubercles outside the scrobicular circle. The scrobicular circle of the uppermost fully formed plate is somewhat drawn out adapically.

Apical system (Fig. 7). The genital plates are rather narrow, corresponding with the unusual width of the ocular plates, which latter are all broadly insert. Tubercles are, on the whole, scarce on the apical system. There is a series of tubercles along the outer edge of the oculars, and some conspicuously elongate tubercles along the inner and outer edge of the genital plates. Otherwise these plates are almost bare, excepting the madreporite, which has several tubercles scattered among the hydropores. Genital pores of moderate size, not close to the edge; very probably the specimen is a female, and apparently it is fullgrown. Periproct conspicuously elevated, with numerous well-sized plates, most of them with a single tubercle each.

Peristome somewhat smaller than the apical system, slightly raised. There are 12 ambulacral plates in a series, the pores forming a regular series. 5—6 regularly shaped interradial plates, the series widely excluded from the mouth edge.

Primary spines up to twice as long as the diameter of test, tapering gently to a simple point. They are very smooth; in the specimen in hand they are rather

worn, but in places they show the surface intact; it is very finely striated, without any hairs. As seen in sections (Fig. 8) the striæ are so close together that there is no room for hairs. Towards the point of the spine there are usually some low, quite smooth ridges. The collar is about one millimetre long, slightly widening towards the inconspicuous milled ring. There is no distinct neck. The oral primaries are quite simple, scarcely flattened or widened, but with rather conspicuous ridges, particularly spine no. 2 is distinctly ridged in its distal half.

The secondary spines are 3—4 mm long, of the normal, simple shape, flattened, slightly narrowing towards the rounded point. The marginal ambulacral spines of the same main shape, scarcely half as long as the scrobicular spines.

Pedicellariæ. No large globiferous pedicellariæ present ($^3/_4$ of the specimen was denuded). The small globiferous pedicellariæ have a distinct endtooth (Pl. XIII. Fig. 8). Tridentate pedicellariæ rather numerous, reaching a size of 1 mm length of head. The valves are rather widely apart, joining only in the distal part (Pl. XIII. Figs. 9—10).Only this one form was found. Spicules of the tubefeet the common type of curved, irregularly thorny rods.

Colour. The denuded test a creamy white; the interporiferous zone of the ambulacra with a greenish tint. Genital plates and periproct of a faint greenish-olive tint. The primary spines are very markedly coloured, with numerous narrow bands of red, alternating with the whitish ground colour. Secondary spines with a narrow median greenish-olive stripe.

The locality is uncertain. Most probably it comes from the Indian Ocean, as indicated by its lying together with a specimen of *Stylocidaris albidens*.

Remarks. Superficially this species bears much resemblance to *Stylocidaris tiara*, both in regard to the structure and the colour of the test. But the primary spines are so strikingly different from those of that species, and, indeed, of any other known species, that there cannot be the slightest doubt that we have here a distinct new species. Also the tridentate pedicellariæ differ conspicuously from those of *St. tiara*, as seen on comparing the figures here given (Pl. XIII. Figs. 9—10) with those of the latter species (Monograph, Pl. LXXXV. 24—25).

In the absence of large globiferous pedicellariæ it cannot be ascertained definitely whether this species belongs to the genus *Stylocidaris*, but its general appearance makes it rather certain that it does belong to that genus. At least, there is nothing to disprove it.

The only other species with similar red bands on the primary spines, *Stylocidaris annulosa* Mrtsn., is in every other regard so different from the present species that it is entirely out of question that there could be any nearer relation between them.

Kionocidaris[1]) n. g.

Pores not conjugate, the wall slightly elevated. Pores on peristome in a single, regular series. Primary tubercles perforate, the upper ones crenulate. Madreporite not enlarged. Primary spines thick, slightly tapering, perfectly smooth, finely striated, with regular series of pores in the outer part of the shaft. Large globiferous pedicellariæ without endtooth; (limb on stalk?). Small globiferous pedicellariæ strongly developed, with small opening and a small endtooth. Tridentate pedicellariæ slender.

Genotype: *Kionocidaris striata* n. sp.

By the character of the pedicellariæ this genus is shown to belong to the group of the *Stylocidarina*. Among the genera of that group it would seem to have some relation to *Centrocidaris*, from which it is, however, distinctly separated, particularly by the character of the primary spines. In both genera the spines are smooth, but the way in which this smoothness is obtained is very different — in *Centrocidaris* through a most remarkable specialisation of the hair-coat (Monograph, p. 426), whereas in the present genus the hair-coat on the fully formed spines is hardly recognisable at all (see below, p. 167). It does not seem to have any nearer relation to any of the other genera of the *Stylocidarina*.

12. Kionocidaris striata n. sp.

Pl. V. Fig. 7; Pl. IX. Figs. 4—6; Pl. XI. Figs. 3, 9; Pl. XII. Figs. 1—2; Pl. XIII. Figs. 4, 6—7.

	h. d.	v. d.	Apical system	Peristome	Number of		Longest spines
					I. A.	A. pro I.A.	
1.	27 mm	17 mm	13 mm (48.1 % h. d.)	13 mm (48.1 % h. d.)	6—7	12—13	36 mm
2.	27 -	17 -	12.5 - (45.5 % - -)	12 - (43.6 % - -)	6	12—13	56 -

Specimen no. 1 is the type; specimen no. 2 is the var. *teretispina* Mrtsn.

Test rather low; in the type slightly flattened above, but not below; in specimen 2 also flattened below. Sides beautifully arched. Circumference regularly round.

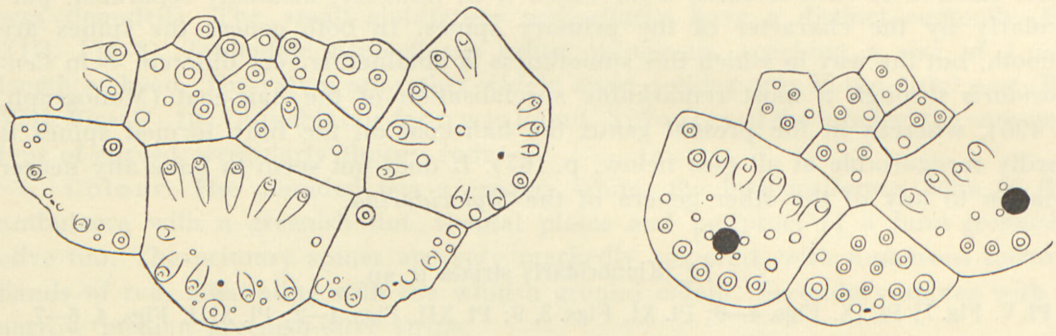
Ambulacra narrow, distinctly sinuate. Interporiferous zone about twice the width of a pore zone. Marginal ambulacral tubercles in a perfectly regular series, fairly prominent, contiguous, somewhat indistinctly mamelonate. The space inside the marginal tubercles very narrow, leaving room only for a single, incomplete series of tubercles, placed now on one, now on the other side of the midline. As a rule there is a miliary tubercle (bearing pedicellariæ) at the lower, inner side of each marginal tubercle. Pore-zone not sunken. The pores are small, equal-sized; the separating wall narrow, slightly elevated; the ridge low, indistinctly set off (Pl. XI. Fig. 3).

Interambulacra. Areoles not at all deepened, well separated, only the two proximal ones confluent; even these latter hardly at all transversely elongate. The two to three uppermost primary tubercles rather large, the following ones diminishing

[1]) ὁ κίων-column.

markedly in size downwards, the proximalmost ones being very small. The two or three upper ones distinctly crenulate on the aboral side. Scrobicular circle not at all raised, the tubercles scarcely larger than the marginal ambulacral tubercles. Outside the scrobicular circle only a few scattered small tubercles, the midline being naked, and also rather distinctly sunken. There are also in the type specimen, at the ambitus, some few small tubercles between the adjoining scrobicular circles on the wall separating the areoles. On the adradial side of the areoles there is scarcely room for any tubercles outside the scrobicular circle. The median area is, at the ambitus, scarcely half the width of an areole.

Apical system. (Figs. 9—10). Oculars all narrowly insert. Both genital and



9. 10.

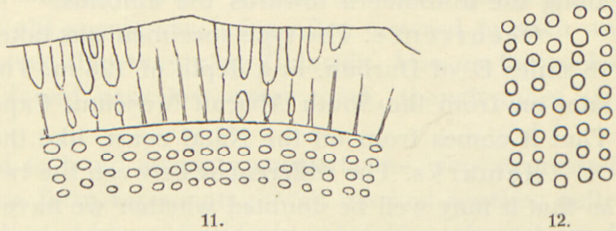
Figs. 9—10. Part of apical system of *Kionocidaris striata*, type specimen (9) and of the var. *teretispina* (10). × 6.

ocular plates in the type specimen rather bare; there is a series of tubercles (spines) along the outer edge of both and along the inner edge of the genital plates, and a single tubercle at the inner end of the ocular plates. Otherwise the plates are bare and there is thus a conspicuous bare belt all round the apical system, interrupted only by the madreporite, which has spines all over. This latter plate is not larger than the other genital plates. In specimen 2 the genital and, particularly, the ocular plates are more closely tuberculate. The tubercles at the inner edge of the genital plates are very conspicuously elongate. Genital pores at a fair distance from the outer edge of the genital plates; they are very small in the type specimen, which must then, evidently, be a male. The size of the pores is so unusually small that they convey the impression that they are just about to be formed; but with the size of the specimen this would mean an appearance of the pores so late as to be perfectly unique in the whole Cidarid family, which is very improbable. (Usually the genital pores appear at a size of 12—15 m h. d., in some forms much earlier). Specimen 2 has genital pores a good deal larger; evidently this is a female. — The periproct is somewhat raised; each plate carries a number of tubercles.

The peristome, which is of the same size as the apical system, is rather con-

spicuously elevated. There are 10—11 ambulacral plates in a series, and 4—5 interradial plates in a regular series, not reaching the mouth.

The primary spines are comparatively thick and robust, of a very characteristic column-like appearance, tapering gently towards a simple point; they are perfectly smooth (Fig. 11), but longitudinally striated with ca. 25 fine, low ridges without any kind of serrations. Between the ridges the surface of the shaft, in fully formed spines, is very finely porous, the pores being arranged in fairly regular longitudinal series (Textfig. 12; Pl. XI. Fig. 9). In the basal (thickest) part of the shaft the pores disappear. This peculiar pore-structure originates through the fine longitudinal striæ, elevations from the outer layer, joining at more or less regular intervals. In not fully formed spines (best seen in specimen 2) the striæ have not yet united to form the pores; they carry along their free edge numerous fine, hair-like outgrowths; these "hairs" it is which gradually widen and coalesce with those from the neighbour-striæ, leaving holes — the pores — between them. In such not fully formed spines the spaces between the ridges may still be rather deep. At the point of the spines the ridges become somewhat more prominent; the point is, however, not widened; it has a small central peg. Towards the base the spine decreases a little in thickness, but forms no distinct neck; the collar is short, ca. 1 mm long. The milled ring is not prominent. In specimen 2 the primary spines are more slender (and longer).



11. 12.

Figs. 11—12. *Kionocidaris striata.* Part of transverse section of primary spine (11). Arrangement of pores on surface of spines (12). × 100.

Oral primaries simple, slightly flattened, striate, but not serrate; transition to the ambital spines quite gradual.

The secondary spines are of quite simple shape, flat, narrowing a little towards the rounded point. The scrobicular spines are ca. 4 mm long, the marginal ambulacral spines ca. 2 mm long. They are not strongly appressed.

Pedicellariæ. The large form of globiferous pedicellariæ is very scarce; only the isolated valves of one sample were found in the type specimen among the pedicellariæ dissolved by the treating of part of the test by means of hypochlorite of sodium. The stalk could not be identified with certainty, and thus it remains uncertain whether it has a limb of free, projecting rods. The valves are small, but of the form typical of the *Stylocidarina* (Pl. XIII. Fig. 6). The small globiferous form is strongly developed, both as regards number and size, up to nearly 1 mm length of head; the stalk varies very considerably in length, from quite short up to 2 mm. The valves (Pl. XIII. Figs. 4, 7) have only a small opening, with a small endtooth. In specimen 2 they are more elongate and with the endtooth more strongly developed and also usually with some serrate crests in the blade, which are not found in the

type (Pl. XIII. Fig. 5). The tridentate pedicellariæ reach a considerable size, up to 1.5 mm length of head. They occur in two, not very distinct, forms, one with narrow blade, slightly incurved above the base, the other with somewhat widened blade and not incurved above the base (Pl. XII, Figs. 1—2). In specimen 2 only small samples of the form with the narrow valves were found. The spicules are irregularly spinous rods of the typical Cidarid form.

Colour of the denuded test of the type specimen white, only the upper primary tubercles and the apical system of a more creamy colour. A small dark spot in the middle of the genital plates. Primary spines of the type specimen of a uniform creamy colour, in the second specimen they are more white, with a faint indication of pink bands. The secondaries white, with a narrow median stripe of greenish-olive. In specimen 2 the apical system is a uniform olive colour, a tinge of this colour continuing along the ambulacra towards the ambitus.

Occurrence. The type specimen was taken by the "Pickle" off the Natal coast, 18 miles E. of Durban, at a depth of 126 m. The second specimen, which I received later on from the South African Museum, Cape Town, is labelled only "Durban". That it comes from off the Natal coast, like the type, can hardly be doubted.

Remarks. The differences between the two specimens are rather considerable, so that it may well be doubted whether we have not here in fact two separate species before us. It is particularly in the primary spines that we find noteworthy differences, as described above. As a matter of fact it is only in one of the spines of the second specimen that the pores, so characteristic of the type, are faintly observable. Then the colour of the primary spines and of the test is different from the type; also the globiferous pedicellariæ offer a considerable difference. Thus there is much that speaks in favour of the two specimens representing two different species. It is the fact that there are only two specimens, one of them, specimen 2, being in a rather poor condition, which makes me hesitate in making each of them the type of a separate species. Under normal conditions I should have left them simply in the same species until further material should come to hand and show whether they are really two species or individual variations of the same species. But as we must reckon with the existence of a man like Prof. Embr. Strand, whose main "scientific" activity consists in finding in other people's works descriptions of aberrant specimens, which he then names with his own name attached as the author (nom. nov. Strand) to make himself famous by establishing so many names, I shall think it better to prevent his doing so in this case and shall designate specimen 2 as the type of a separate variety, **teretispina** n. var., leaving it to the future to decide whether it represents only an individual variation (? sexual difference), a variety, or a separate species.

13. Eucidaris clavata Mrtsn.

Pl. IV. Figs. 3—5.

Monograph of the Echinoidea. I. Cidaroidea, p. 408.

This species I found to be very common at St. Helena at depths of ca. 20—60 metres, particularly off Jamestown. In places the bottom is here at depths of ca. 20—30 metres covered with large colonies of the sponge *Chondrosia plebeia* O. Schmidt, and this appeared to be a favourite locality for the Cidarid, which was usually found lodging in the larger holes and cavities of the sponge. But the Cidarid was also common on all other kinds of bottom, e. g. among the mussels *Arca* sp. overgrown with *Cirripathes* which cover the bottom in places at depths of ca. 40—50 metres. The specimens found here generally had their spines much overgrown by incrusting Lithothamnions or similar red algæ. Specimens from shallower water usually had their spines much overgrown with various small algæ, old specimens being often covered to such an extent that it was difficult enough to see that they were Cidarids. Also on the rocks specimens of the Cidarid could be found near low water mark, though more exceptionally.

The rich material thus brought to hand strongly supports the view expressed in the Monograph that this St. Helena form represents a well marked species, quite distinct from the West Indian — West African *Eucidaris tribuloides*, characterised above all by its thick, club-shaped, uniformly dark-brownish coloured primary spines. Only in the few specimens from the rocks at low water mark the spines are somewhat more slender than usual, but in these specimens also they are more or less club-shaped, and there can be no doubt that they belong to *E. clavata*, not to *E. tribuloides*.

The largest specimen found measures 51 mm h. d.; this specimen, as also the specimens of ca. 40—45 mm h. d., looks very old and worn, so that a size of ca. 50 mm h. d. is evidently the maximum size of this species. It is quite curious to see in these old specimens among the old spines totally covered by foreign organisms, particularly incrusting Lithothamnions, here and there a quite fresh spine, newly regenerated. In all probability then this species, as is the case in at least some other Cidarids, is able to drop such spines as are too much worn, and to form new ones instead.

The youngest specimen found was 3 mm h. d., with 4 I. A. plates in a series. The specimen of 51 mm h. d. has 9—10 I. A., which is also the maximum number, as is evident from the fact that the spines of the uppermost plates are fully formed, while no sign of young spines is found adapically to them. The genital pores appear at a size of ca. 13 mm h. d.

I have nothing to add to the description given in the Monograph, except that I have now found the tridentate pedicellariæ also. They are, however, exceedingly scarce, not at all represented in by far the majority of the specimens. They are quite like those of *E. tribuloides* (Monograph. Pl. LXXXVI. 16).

A curious anomaly has been observed in some few cases, one or other of the primary spines being bifid (Pl. IV. Figs. 3—5). In one specimen a Polynoid worm was found on an ambulacrum near the peristome, such as was also found on one of the "Scotia" specimens (Monograph, p. 411).

14. **Prionocidaris pistillaris** (Lamarck).

Pl. IX. Figs. 7—9; Pl. XI. Fig. 8.

Monograph of the Echinoidea. I. Cidaroidea, p. 452.

This species was found to occur fairly commonly among the rocks at the breakwater of the Durban Harbour, where it could be collected at good low tide. It is very noteworthy that only this species, not *Pr. baculosa*, occurs here. The latter then evidently has its southern limit farther north; exactly where is not known.

The new material of *pistillaris* thus available fully bears out the result reached in the Monograph (loc. cit.) that *pistillaris* is a distinct species, well separated from *baculosa*. To the characters pointed out in the Monograph I may now add some characters from the test, good preparations of denuded tests being now available (Pl. IX. Figs. 7—9).

In the ambulacra the interporiferous zone is somewhat broader than in *baculosa*, fully twice the width of a pore-zone in *pistillaris*, scarcely twice that width in *baculosa*. More conspicuous is, however, the difference in the interambulacra, the primary tubercles being well separated, even the proximalmost ones, the scrobicular tubercles on the separating wall not smaller than the others, and both circles remaining distinct; in *baculosa* the separating wall is much narrower, and the tubercles thereon markedly smaller than the others (Pl. XI. Fig. 8, to compare with Pl. LIII. 8 and 11 of the Monograph). Also the median area of the interambulacra is somewhat broader than in *baculosa*.

One specimen from Durban is remarkable in its primary spines being flattened in the distal part and slightly widened, so as to be perfectly oar-shaped.

The colour of the denuded test also differs conspicuously from that of *baculosa*. The primary tubercles are a beautiful pink in *pistillaris*, cream-coloured or greenish in *baculosa*. The marginal ambulacral tubercles are of the same light greenish colour as the interambulacra and apical system, the pore zones reddish-brown; in *baculosa* the marginal ambulacral tubercles are dark olive, usually much darker than the test, and the pore-zones more brownish-olive.

During the investigations at Mauritius, spines of *Prionocidaris pistillaris* were usually found in the dredgings in deep water, ca. 200—300 metres, outside the reef, and mostly large and fine samples of spines — but never a living specimen of the sea-urchin itself. This shows that it probably lives in very restricted localities in the deeper water, not scattered all over like *Stylocidaris badia*.

15. Chondrocidaris gigantea A. Agassiz[1]).

Pl. III. Fig. 6; Pl. IV. Figs. 13—14; Pl. X. Figs. 1—2.
Monograph of the Echinoidea. I. Cidaroidea, p. 492.

During my visit to Mauritius in September—October 1929 I had the pleasure of dredging two large specimens of this species off Port Louis, a little outside the reef, at a depth of ca. 200 metres. Whereas loose spines were found very often, it was only one haul that yielded any specimens, and that gave both the specimens, hanging in the tangles. Both specimens are very large, larger, in fact, than any specimens hitherto recorded; one of them, 115 mm in diameter of test, is even the largest specimen of any recent Cidarid recorded till now, the largest one hitherto recorded being a *Phyllacanthus irregularis* of 110 mm h. d. in the Western Australian Museum, Perth (Monograph, p. 522).

I shall give here the dimensions of the two specimens.

h. d.	v. d.	Apical system	Peristome	Number of		Longest spines
				I. A.	A. pro I.A.	
115 mm	73 mm	48 mm (41.7 % h. d.)	39 mm (33.9 % h. d.)	10—11	15—16	125 mm
104 -	67 -	41 - (39.4 % - -)	38 - (36.5 % - -)	9—10	15—16	150 -

The largest specimen, which had lost several of its spines, has been denuded, and I think it desirable to give here some figures of this magnificent Cidarid, the more so as the denuded specimen (belonging to the Museum of Comp. Zoology) represented in the Monograph, Pl. LXIV. 1—2 is much smaller, 73 mm h. d., and, being incompletely cleaned, does not show all the details (particularly the apical system) as clearly as desirable.

It is to be noted that the apical system is distinctly sunken; in the other specimen it is not sunken, the aboral side being simply flattened. The small elevated part on the madreporite is an anomalous growth, probably due to some parasitic organism. In the interporiferous zone of the ambulacra the tubercles are very numerous, ca. 12 in a double series between each two opposite marginal series at the ambitus. There are ca. 18 ambulacral plates in a series on the peristome. The skin between these plates was thick and raised, almost cushion-like.

On p. 494 of the Monograph it is mentioned that "on a spine from the large specimen in the Paris Museum the hairs in places form a very dense velvety coat, especially on the basal part". This I find to be the case also on some of the spines of the present specimens; there can thus be no doubt that this is a character of the

[1]) In the Monograph of the Cidaridæ, p. 492, the author name of *Chondrocidaris gigantea*, A. Agassiz, is given in parenthesis, as is also that of *Chondrocidaris brevispina*, H. L. Clark, p. 497. This is, of course, a printers error for which I can offer no better excuse than that I have overlooked it. These author names should be without parentheses.

fully developed and untouched spine (Pl. IV. Figs. 13—14). It is only in the basal part of the spine, about the third part of its length, that this thick, velvety or rather woolly hair-coat is developed; then the hairs decrease rapidly in length and become quite short and simple, as shown in Fig. 157, p. 494 of the Monograph. The long hairs of the basal part of the shaft — which cover also the thorns almost to their point — are up to 2 mm long, very slender, perfectly smooth, ending in a simple point or rarely irregularly bifurcate at the point. They are more or less undulating, sometimes bent in the middle, the neighbouring hairs following each other fairly closely in their undulations or bendings so as to form a close, regular coat (Fig. 13). At the base they are slightly thickened.

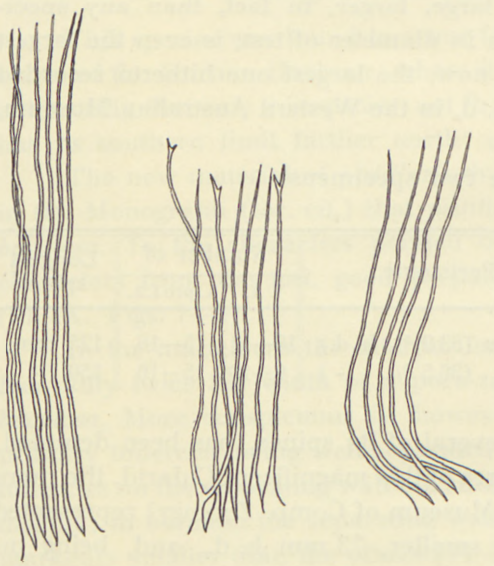


Fig. 13. Hairs from primary spines of *Chondrocidaris gigantea*. × 40.

Having found this structure to be characteristic of the spines of *Chondroc. gigantea*, we may conclude with full certainty that the thick red coat of hairs on the basal part of the shaft of the spines in *Chondroc. brevispina* is likewise the normal hair-covering of these spines, not an epizoic sponge, as it has been assumed to be (cf. Monograph, p. 498).

In none of the specimens in hand there could be found any large globiferous pedicellariæ, this kind of pedicellariæ thus being as yet unknown in the present species.

On the larger specimen were found a pair of specimens of an *Ophiothela* (probably *Ophiothela danæ* Verrill) on the base of the primary spines, inside the scrobicular spines.

The two specimens in hand corroborate the result reached by both H. L. Clark and myself, after the examination of the previously known material of this species, that it is impossible to distinguish the Mauritius specimens from those from off the Hawaiian Islands, so that, in spite of the remarkable discontinuous distribution, we must recognise the two so widely separated populations as belonging to one and the same species.

In this connection it is of considerable interest that the "Dana" Expedition found in a dredging off New Caledonia (St. 36112. 21°20′ S. 165°24′ E. 200 m) a fragment of a Cidarid spine which can with almost full certainty be identified as *Chondrocidaris gigantea;* it is merely somewhat more slender than any of the spines at my disposal. This would seem to show that the species must occur also at New Caledonia, and is thus not confined solely to the Hawaiian Islands and Mauritius.

A few additional remarks may be made here.

The Stewart's organs. When speaking of these organs in the Monograph, p. 35, I regret having entirely omitted to mention that LUDWIG, in his paper "Über Asthenosoma varium Grube und über ein neues Organ bei den Cidariden" (Zeitschr. f. wiss. Zool. XXXIV. 1879, p. 29), without knowing the paper by Stewart (On certain organs of the Cidaridæ. Trans. Linn. Soc. 2. Ser. Zool. I. 1877), where these organs were first described, gave a careful description and a very good figure of these organs in *Eucidaris tribuloides*, which he designates as "radiäre Blindsäcke des Kauapparates". He has found these organs well developed in several other Cidarids which he could examine — and states (as I have also found — cf. my Report on the Echinoidea of the Swedish S. Polar-Expedition, p. 17) that in "*Goniocidaris*" *canaliculata* they are entirely devoid of calcareous spicules, which are otherwise generally very well developed (of the triradiate type). Also in *Diadema setosum* he has found similar, only simply sac-shaped organs. As to their function he makes no suggestion.

I must take this opportunity of mentioning and correcting a very curious — and perfectly inexcusable — lapsus which has slipped into my "Handbook of the Echinoderms of the British Isles", p. 262 and 278 (also in my book "Echinodermer" in "Danmarks Fauna", p. 166), viz. that the Echinothurids have Polian vesicles — instead of Stewart's organs! Of course, I never dreamt of claiming that these organs of the Echinothurids should have anything at all to do with Polian vesicles; it is nothing but a lapsus, caused probably by the sausage-shape of these organs in the Echinothurids, giving them a certain superficial resemblance to the Polian vesicles of Holothurians, but not a bit more excusable for that.

In speaking of the Stewart's organs of Cidarids I have mentioned (Monograph, p. 35) the erroneous statement by A. AGASSIZ ("Revision of the Echini, p. 694) of the occurrence of gills in Cidarids. In this connection I ought to have mentioned that the SARASINS also, in their "Anatomie d. Echinothuriden u. die Phylogenie d. Echinodermen" (Ergebnisse Naturwiss. Forschungen auf Ceylon I. 3. 1888, p. 134) suggest that the Cidarids may have gills in the young stages, likewise regarding, as did AGASSIZ, the five interradial slits in the peristomial membrane as "hypothetische Kiemeneinschnitte". There is not the slightest foundation for this suggestion of the SARASINS, no more than there is for the statement of AGASSIZ. There is no trace of gills in Cidarids, neither in the young nor in the adult specimens.

Cidaris grandis Stewart. My friend Professor H. L. CLARK has called my attention to the fact that mention is not made of this name in my Monograph. I regret having overlooked this name, about which there is, otherwise, nothing to say but that it is a nomen nudum, and that there is no possibility, nor, indeed, any desirability of finding out which Cidarid is meant by it.

Enemies of Cidarids. On p. 41 of the Monograph I have mentioned the various cases known of enemies attacking Cidarids. To these a new and interesting case may be added. Professor R. LEGENDRE, Director of the Biological Station at Concarneau, has informed me that a specimen of *Lophius piscatorius* has been taken

there, which had "dans sa gueule un *Cidaris cidaris* brisé, ses piquants en partie broyés". Also the seastar *Palmipes membranaceus* has been observed by him to be eaten by *Lophius piscatorius*.

Stylocidaris affinis. In the Monograph, p. 340, it is stated that the largest specimen on record of this species is 43 mm in horizontal diameter. I was, therefore, very surprised in receiving from Professor MERCIER, Caën, a specimen of 54 mm h. d. In his paper, mentioned below, p. 175 "Etude des variations chez *Dorocidaris papillata* Leske et *Dorocidaris affinis* Philippi" MERCIER records a still larger specimen, of 61 mm h. d. These specimens are from the Mediterranean, where this species evidently, on the whole, reaches a larger size than it does in the West Indies, another fact speaking in favour of regarding the West Indian form as a separate variety (cf. Monograph, p. 340).

II.

Notes on some fossil Cidarids.

1. On some Cidarid names.

It appears to be a matter of considerable difficulty to attain conformity in the nomenclature of fossil and recent Cidarids (and other Echinoids also, of course). In my Monograph of the Cidarids I made great efforts to build up a sound basis for a conform nomenclature — but already now divergent views have been expressed in this regard. It is the names *Dorocidaris — Cidaris — Stylocidaris, Plegiocidaris — Histocidaris*, and *Phyllacanthus — Leiocidaris* which have come under consideration.

First I may say in general that there ought not to be any dispute about the fact that complete knowledge can be gained only of the recent forms. It is only from these that we can judge of what characters must form the foundation of classification. It has been demonstrated incontestably that, besides the characters of the test — which must, of course, remain of foremost importance — the microscopical characters of spines and pedicellariæ are of great classificatory value, and that without taking those characters into consideration it would be quite impossible to obtain a reasonable classification of the numerous recent forms. Consequently it must be acknowledged that the fossil forms in which we do not — except in very exceptional cases — know those finer microscopical structures, are only insufficiently known, and that in those, unfortunately very numerous, cases where the test structures and the spines do not afford sufficient evidence for the classificatory position, the true generic position of such species remains problematic. This refers e. g. to the numerous "*Plegiocidaris*"-species, which have only this in common that they have crenulated tubercles and non-conjugate pores.

There is, of course, nothing to blame the authors on fossil Echinoids for, when they unite all such forms in one "genus", since it is impossible to get hold of other characters by which to separate them further. Only it must be claimed that they agree that such "genera" are unnatural, mere lumber-rooms into which are thrown all such forms that cannot be further distinguished, and particularly it must be claimed that the specialists in fossil Echinoids are not competent, on the basis of the insufficiently known fossils, to interfere with the classification of the recent forms, all the characters of which are available to us.

In a paper "Etudes des variations chez *Dorocidaris papillata* Leske et *Dorocidaris affinis* Philippi. Notes échinologiques IX." (Bull. Inst. Océanogr. No. 570. 1931) by J. Mercier the genus *Stylocidaris* is not recognised but united with *Dorocidaris*, as the characters of the test do not warrant a generic distinction between them; also the characters of the pedicellariæ "assez relatives du reste" are regarded as insufficient for generic division "à plus forte raison pour la classification générale

d'animaux dont la majeure partie est fossile et dont le système de vestiture a disparu". A discussion, of course, is hopeless. What has been said above covers the matter. It should only be emphasised that the characters of the pedicellariæ, particularly in the case in question, are decidedly not relative, as anybody who has ever seen a large globiferous pedicellaria of *Cidaris cidaris* (which is the true name of *Dorocidaris papillata*) and of *Stylocidaris affinis* must agree. A glance at these pedicellariæ at once distinguishes the two forms and shows that, in spite of the general resemblance of their test-characters, they are not nearer related to one another.

When MERCIER further speaks of "les difficultés que l'on recontre en n'ayant souvent à sa disposition pour la reconnaissance des Echinides actuels, que des diagnoses portant surtout sur les charactères du système de vestiture" (p. 4) I would remark that he will find all characters, from the test and the "système de vestiture", fully mentioned and figured in my Monograph. If he has not been able to consult this main work on recent Cidarids, he might perhaps rather have omitted criticising what he does not know.

In a paper by MARIA LANDI "Gli Echinidi neogenici di Montegibbio" (Giorn. di Geologia. Bologna. 2. Ser. IV. 1929) the genera *Plegiocidaris*, *Cidaris* and *Dorocidaris* (to mention only the Cidarids) are taken in the same sense as in LAMBERT & THIÉRY's "Essai de nomenclature raisonnée", thus *Plegiocidaris* being stated to be found in recent seas in worldwide distribution and at depths of 200—3550 m, and similarly *Dorocidaris* etc. Particularly *Plegiocidaris* is an obvious case. It has been proved beyond dispute that the typical *Plegiocidaris* is so strikingly characterised by its peculiar peristome and the peculiar shape of its spines that it can only be designated as nonsense to refer the recent *Histocidaris*- and *Aporocidaris*-species to it, as is done by LAMBERT & THIÉRY. But although Dr. LANDI has seen my Cidarid Monograph and quotes it, she cannot have taken the trouble to look at the status of this genus, but simply continues the absurdities of LAMBERT & THIÉRY. No wonder she finds that "tutti questi generi hanno una distribuzione cosi ampia, che uno studio su questa base non condurrebbe a resultati degni di nota". From my paper "The Geographical Distribution of Cidarids" (Arch. Zool. Ital. XV. 1930), as also from the chapter "Zoogeographical Distribution" of my Monograph (p. 529—541), Dr. LANDI will gather that the study of the geographical distribution of Cidarids, when properly distinguished, does give noteworthy results — so noteworthy, indeed, that we must see herein a very strong support and a direct proof of the correctness of my classification of the Cidarids.

I would add the remark that the statement of Dr. LANDI (p. 12) that *Dorocidaris margaritifera* Meneghini is so closely related to *Eucidaris tribuloides* that it may be regarded as "una mutazione ascendente" of the latter species, is a very bold assertion, as *Dorocidaris margaritifera* is known only from isolated spines, which are not at all so characteristic as to prove beyond any doubt its close relationship to *Eucidaris tribuloides*. Also the further statement that this latter species is now extinct in the Mediterranean is without any real foundation. There is not the slightest proof that *Eucidaris*

tribuloides ever lived in the Mediterranean, as the erroneous identifications by COTTEAU and LAMBERT of some isolated spines as belonging to that species (cf. Monograph, p. 407) could hardly be regarded as proof of the former existence of *E. tribuloides* in the Mediterranean.

Quite lately CHECCHIA-RISPOLI ("Illustrazione di alcuni Echinidi del Maestrichtiano della Tripolitania raccolti da Ignazio Sanfilippo". Mem. Soc. Geol. Ital. I. 1931, p. 8) in discussing the names *Phyllacanthus — Leiocidaris* follows LAMBERT & THIÉRY in regarding the former name as not acceptable and adopts instead the name *Leiocidaris* Desor.

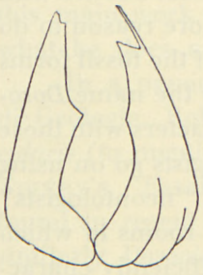
It would be quite useless here to reassume the discussion of these names, as nothing will result from it but that each will adhere to his own opinion. I think the only way will be to keep both names in use, namely in this way that *Phyllacanthus* is used for the recent forms and *Leiocidaris* for the fossil forms with conjugate pores and smooth (perforate) tubercles. There is all the more reason to do so, since we shall probably never be able to prove definitely that any of the fossil forms are really congeneric with the recent *Phyllacanthus.* In the same way the name *Dorocidaris* may be kept in use for the fossil forms agreeing in their test characters with those of the recent *Dorocidaris papillata* = *Cidaris cidaris.* Also let palæontologists go on using *Plegiocidaris* and *Cidaris* in the sense they are now used to, and we "neontologists" will take these designations for what they are worth, namely lumber-rooms in which are thrown together all those numerous fossil forms which are not sufficiently characterised by the characters of their tests and spines and, therefore, for want of the microscopical characters necessary for that purpose, cannot be classified more definitely. But, on the other hand, we neontologists must claim that the palæontologists do not interfere with the nomenclature of the fully known recent forms on the basis of their imperfectly known fossils, introducing changes which, like most of those introduced by LAMBERT & THIÉRY, are not only absurd nonsense but also give rise to no end of confusion and do great harm to science. This applies to the Cidarids as well as to those of the other regular Echinoids in which the microscopical characters of pedicellariæ and spicules are of primary classificatory importance. Neglect of these characters has led e. g. to refer to the genus *Toxocidaris* the common mediterranean sea-urchin designated by all students of recent Echinoids *Paracentrotus lividus,* an absurdity which can result only in most regrettable confusion.

As for *Plegiocidaris* it would be preferable to use this name only for such species as can be said with a reasonable degree of certainty to be congeneric with the genotype, *Plegiocidaris coronata,* so well characterised by its pluriseriate peristomial ambulacral plates and its peculiar clubshaped primary spines (cf. Monograph, p. 475), and establish a new "genus" for the numerous other forms referred to *Plegiocidaris* on account of the insufficiently distinctive characters: crenulate tubercles, non conjugate pores. But I leave that to the palæontologists.

2. On some pedicellariæ of fossil Cidarids.

In mentioning (Monograph, p. 33) the various records of pedicellariæ of fossil Cidarids I regret having overlooked the record by G. Stefanini (Fossili terziari della Cineraica. Paleontogr. Italica. XXVII. 1921, p. 110. Tav. XVI. 1. c.) of the find of a tridentate pedicellaria in *Porocidaris Schmideli* (Münst.). I reproduce here (Fig. 14) the figure of it given by Stefanini; it does not give any information beyond the fact that it is a pedicellaria.

In fig. 20 d—f, Monograph, p. 33, I have reproduced some figures of a very remarkable Cidarid-pedicellaria, after Dr. Brünnich-Nielsen (Nogle Echiniderester fra Danmarks Senon og Danien. Medd. Dansk Geol. Foren. VI. 29, 1925. Pl. I. 20—21, 23), stating that, unfortunately, it cannot be said with certainty to which species they belong. This still holds good; however, a reasonable suggestion can be made as to the Cidarid to which these pedicellariæ belong. Dr. Brünnich-Nielsen informs me that he finds them only in such places where *Tylocidaris baltica* is found, and he thinks they must belong to that species. This seems not at all improbable, and it would be very satisfactory to find this unique kind of pedicellariæ connected with such an isolated type of Cidarids as is *Tylocidaris*.



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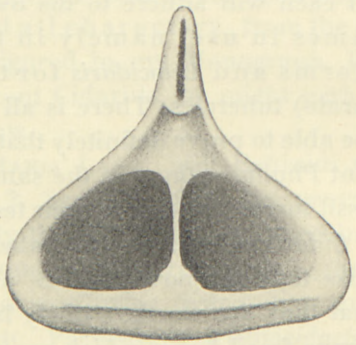


15.

Fig. 14. Pedicellaria of *Porocidaris Schmideli*. After Stefanini. (Enlargement not stated).

Fig. 15. Valve of large globiferous pedicellaria, seen from the inside, of *Tylocidaris baltica* (?). × 20.

Brünnich-Nielsen designates it as a tridentate pedicellaria. This, however, is not correct. Through the kindness of Dr. Brünnich-Nielsen I have had an opportunity of examining more closely a few valves of these pedicellariæ, and one of them is in so fine a condition as to show the true character of this pedicellaria (Fig. 15). In the remarkably small blade there is a very distinct longitudinal slit, sharply limited below by an elevated, rounded ridge. This slit cannot be anything but the opening for the poison gland of a globiferous pedicellaria. We have thus here a very interesting type of a large globiferous pedicellaria, quite different from those of any recent Cidarid. The general shape of these pedicellariæ recalls the globular large globiferous pedicellariæ of the genus *Goniocidaris;* it is also worth recalling that a long, narrow, slitlike opening is found in the small globiferous pedicellariæ of some Goniocidarids, particularly in the genus *Schizocidaris*. But, as a whole, a type of pedicellariæ like this fossil form is unknown in recent Cidarids. By the rather isolated position of *Tylocidaris* (imperforate tubercles!) it would be quite natural to find its pedicellariæ also

to be of a very unusual character. Of course, there is no certainty as yet that these pedicellariæ do belong to *Tylocidaris;* but, apart from the coincidence emphasised by Brünnich-Nielsen of their occurrence in layers where *Tylocidaris baltica* is predominant, there is another fact in favour of this suggestion. My friend, Dr. J. P. J. Ravn, has called my attention to some shallow depressions occurring sometimes among the secondary tubercles on the upper part of the test in *Tylocidaris baltica.* The idea easily suggests itself that these are places where the large, globiferous pedicellariæ were seated, as we may also in *Goniocidaris* and *Stereocidaris* find similar impressions of the large, globiferous pedicellariæ.

I have also examined the remarkable small pedicellariæ from Herfølge, figured by Dr. Brünnich-Nielsen, reproduced in the Monograph, p. 33, fig. 20 g. Though the figure is correct enough, it does not give the full shape of this pedicellaria quite correctly. It is perfectly evident that the point of the three valves is broken off; therefore they have ended in a point, not abruptly cut off, as the figure shows it, and the pedicellaria has thus been much like other Cidarid pedicellariæ of long and slender type, as e. g. of *Stereocidaris sceptriferoides,* var. *lanceolata* (Monograph, Pl. LXXXI. 9). I can scarcely doubt that the same will apply to the pedicellaria of "*Anaulocidaris*" *Faurai* represented in the same figure 20, c, of the Monograph, from Lambert's "Revision des Echinides fossiles de la Catalogne" (1927).

3. The genus Ancylocidaris A. K. Miller.

I 1929 A. K. Miller published in the American Journal of Science, 5. Ser. Vol. XVIII, p. 334—336 a paper "Ancylocidaris, a new Echinoid genus from the Sundance of West-Central Wyoming" containing the description of a small Echinoid from the locality named, belonging to the Jurassic period. The single specimen known is only 9 mm in diameter; it is a bare test of depressed spheroidal shape on which no trace of tubercles or other surface structures is seen, only the limits of the coronal plates and the ambulacral pores being distinct. (Fig. 16). The interambulacral plates have a very characteristic downward bend; the ambulacral plates are simple, with the pores close to the outer edge. It is named *Ancylocidaris spenceri,* and is referred to the Cidaridæ, with which Jackson appears to agree.

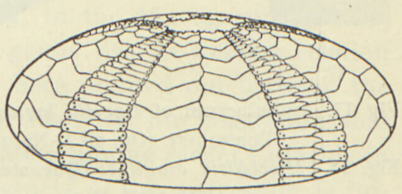


Fig. 16. *Ancylocidaris spenceri.* × 6. From A. K. Miller.

I cannot agree at all that this little Echinoid is to be referred to the Cidarids. The depressed shape of the test is most unusual for a Cidarid. The number of interambulacral plates, 15 in a specimen of 9 mm diameter is as extraordinary for a Cidarid as is their shape; and even if it is only an inner impression of the test (?) one would also expect to find at least a faint indication of the large primary tubercles which must have existed if it be a Cidarid; but not a trace of them is seen. Likewise

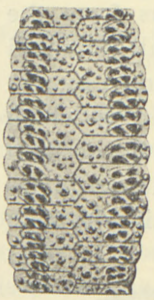
the shape of the ambulacral plates, their produced median end, and the markedly oblique position of the pores, is very unlike any Cidarid, as also the fact that only three ambulacral plates correspond to each interambulacral plate, is very unusual.

Thus, as there is nothing in its known features which speaks for its being a Cidarid, whereas all the characters observable are most un-Cidarid-like, I cannot accept this form as a Cidarid. To what family it should be referred it is impossible to tell definitely in view of the absence of nearly all distinctive features. The arrangement of the pores in a regular single series rather indicates an Orthopsid — but until its characters become better known, its affinities must remain problematic.

4. The genus Engelia Tornquist.

This genus was established by TORNQUIST in his paper "Die Diadematoiden des württembergischen Lias". (Zeitschr. d. Deutschen Geol. Gesellsch. 60. 1908, p. 408) for *Cidaris amalthei* Quenstedt. He points out that this Diadematid is unique in uniting the imbrication of the coronal plates of palæozoic Cidarids with an ambulacral structure of diadematoid type, each plate having two pairs of pores.

LAMBERT & THIÉRY in their "Essai de nomenclature raisonnée des Echinides" (p. 195) accept the genus as belonging to the tribus *Orthopsinæ* of the Pedinids, but are of opinion that TORNQUIST mixed up two different types in it, so that in reality only the ambulacral structure of the genus is known.



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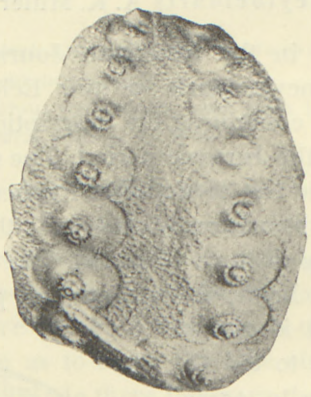


18.

Fig. 17. Ambulacrum of *Engelia laqueata* (Quenst.). From TORNQUIST (Op. cit.). Natural size.

Fig. 18. *Miocidaris amalthei* (Quenstedt). From LÖRCHER (Op. cit.). Natural size.

Recently ERNST LÖRCHER ("Neue Seeigelfunde aus dem Jura Württembergs". N. Jahrb. f. Mineral. Beilageband 64. Abt. B. 1930, p. 262) maintains the genus *Engelia* in the original sense of TORNQUIST, but as a Cidarid, related to *Miocidaris* but differing from that genus by its ambulacral structure "denn uns scheint die Ausbildung der Ambulacralzonen (as shown in the figures 3—4, Pl. XVI of TORNQUIST's paper —) Grund genug zu sein, um diese Gattung von *Miocidaris* zu trennen".

Assuredly this ambulacral structure is reason enough to separate *Engelia* from *Miocidaris*, so much, indeed, that it does not belong to the Cidarids at all, but to the Diadematids or Pedinids — as quite rightly seen by TORNQUIST and by LAMBERT &

THIÉRY. On the other hand, it is equally true that the interambulacra and the spines show it to be a Cidarid. The solution of the problem is, as well seen by LAMBERT & THIÉRY, but evidently not understood by LÖRCHER, that two entirely different forms are confounded by TORNQUIST in his diagnosis of the genus *Engelia*, viz. the interambulacrum of *Cidaris amalthei* Quenstedt, which is decidedly that of a *Miocidaris*, and the ambulacrum of a Diadematid (or Pedinid), figured by TORNQUIST. I reproduce here the fine interambulacrum figured by LÖRCHER, and the ambulacrum after TORNQUIST (Figs. 17—18).

To prove that these two widely different structures belong together it would be an absolute requirement to find them in direct connection, but this has (of course) never been done. In the original description of *Cid. amalthei* by QUENSTEDT (Die Juraformation. 1858. p. 198. Taf. 24. 42—44) only part of two interambulacral plates and some fragments of primary spines are figured. In the same author's "Petrefactenkunde Deutschlands" III. 1872—1875, p. 155 he suggests that the ambulacrum figured on Taf. 67. fig. 98, under the name of *Cidaris laqueata*, belongs together with the interambulacrum and spines designated as *Cidaris amalthei*. This suggestion is adopted by TORNQUIST (Op. cit. p. 426) and now again by LÖRCHER — but without any new evidence whatever of their belonging together. I entirely agree with LAMBERT & THIÉRY that two different types are confounded in the "genus" *Engelia*, first by TORNQUIST and now again by LÖRCHER. But I cannot agree with either of these authors in taking *Cidaris amalthei* Quenst. as the type of the genus *Engelia*. As rightly seen by both LAMBERT & THIÉRY and by LÖRCHER it is the ambulacral structure that characterises the genus *Engelia* — it is, as a matter of fact, all that is known of it. But then it must be the *Cidaris laqueata* Quenst., under which name this ambulacrum was originally described, that becomes the type of the genus *Engelia*.

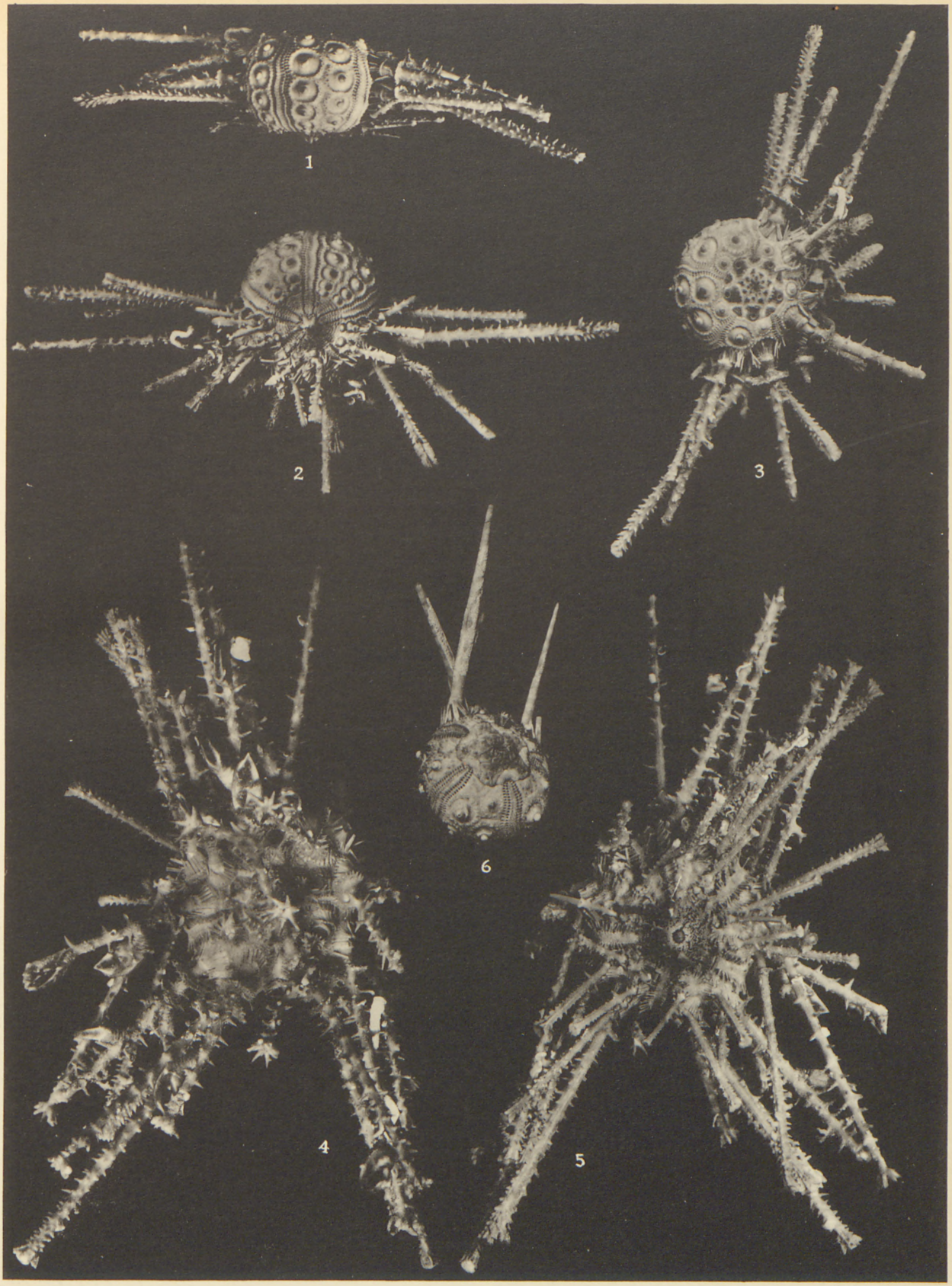
5. The genus Cyathocidaris Lambert.

As explained above (p. 155) the primary spines of *Tretocidaris spinosa*, mainly the subambital ones, not rarely assume a shape that strikingly recalls that of the fossil, cretaceous, *Cyathocidaris cyathifera* (L. Agassiz). In the Monograph (p. 484) I have adopted the view of LAMBERT that this fossil genus has its nearest relation among recent Cidarids in *Eucidaris*. The resemblance here pointed out between the *Cyathocidaris* spines and those of *Tretocidaris spinosa* leads to the suggestion that *Cyathocidaris* may more probably have its nearest relation among recent Cidarids in the genus *Tretocidaris*. To give direct proof of the correctness of this suggestion is impossible, at present at least, on account of the insufficient knowledge we possess of the structural details of *Cyathocidaris*. But what we do know of the test structure of *Cyathocidaris cyathifera*, the only species of the genus *Cyathocidaris* of which anything at all is known of the test, is, at least, not opposed to its suggested relation to *Tretocidaris* (cf. LAMBERT. Etude sur les Echinides Crétacés de Rennes- les Bains et des Corbières.

Bull. Soc. Etudes scientif. de l'Aude. T. 22. 1911; p. 45. Pl. II. 24, 27). Since the main character distinguishing *Tretocidaris* from the other genera of the group *Cidarina*, viz. *Cidaris* and *Calocidaris*, is the peculiar reduction into a small pore of the opening of the large globiferous pedicellariæ (cf. Monograph, p. 286, 314), there is no great probability that we shall ever learn how this character was in *Cyathocidaris*. But the fact that it has now been possible to ascertain the main character of the large globiferous pedicellariæ probably belonging to *Tylocidaris*, warns us to be careful and not deny the possibility of discovering the microscopical structures so important to the classification of the Cidarids, also in the fossil forms, and thereby gradually finding out the real affinities of the numerous fossil forms, whose test characters do not afford the clue to their true place in the natural system.

Plate I.

Figs. 1—5. *Goniocidaris balinensis* Mrtsn.
1—3. Paratype; half denuded. Side view (1), oral side (2), aboral side (3).
4—5. Type specimen. Aboral side (4); oral side (5).
Fig. 6. *Stylocidaris cingulata* Mrtsn. Type specimen; half denuded. Aboral side.
All figures natural size.



J. v. Huth fot.

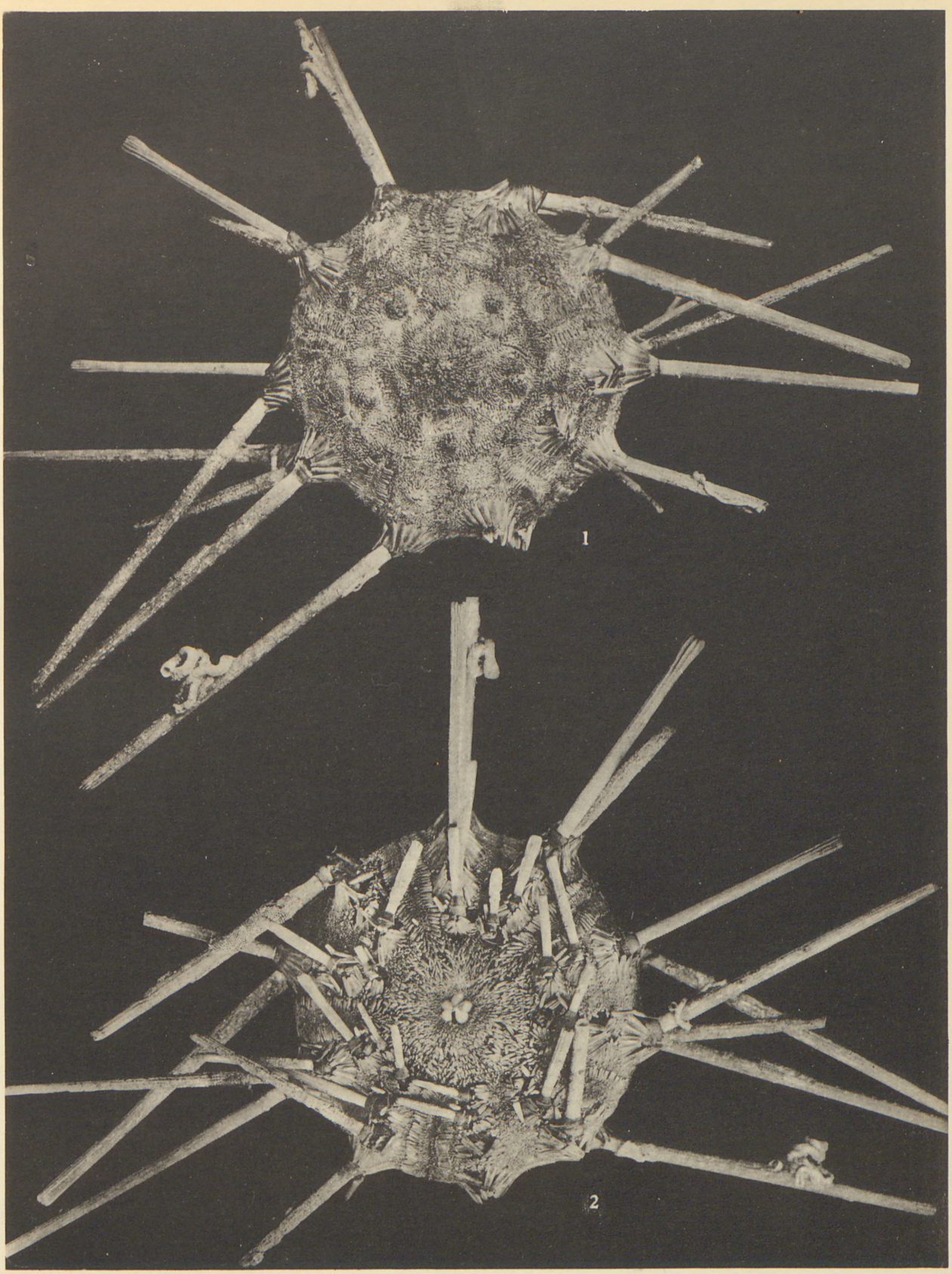
Pacht & Crones Eftf. Fototypi.

Plate II.

Stereocidaris excavata Mrtsn.

Fig. 1. Large specimen; aboral side.
- 2. Same — ; oral side.

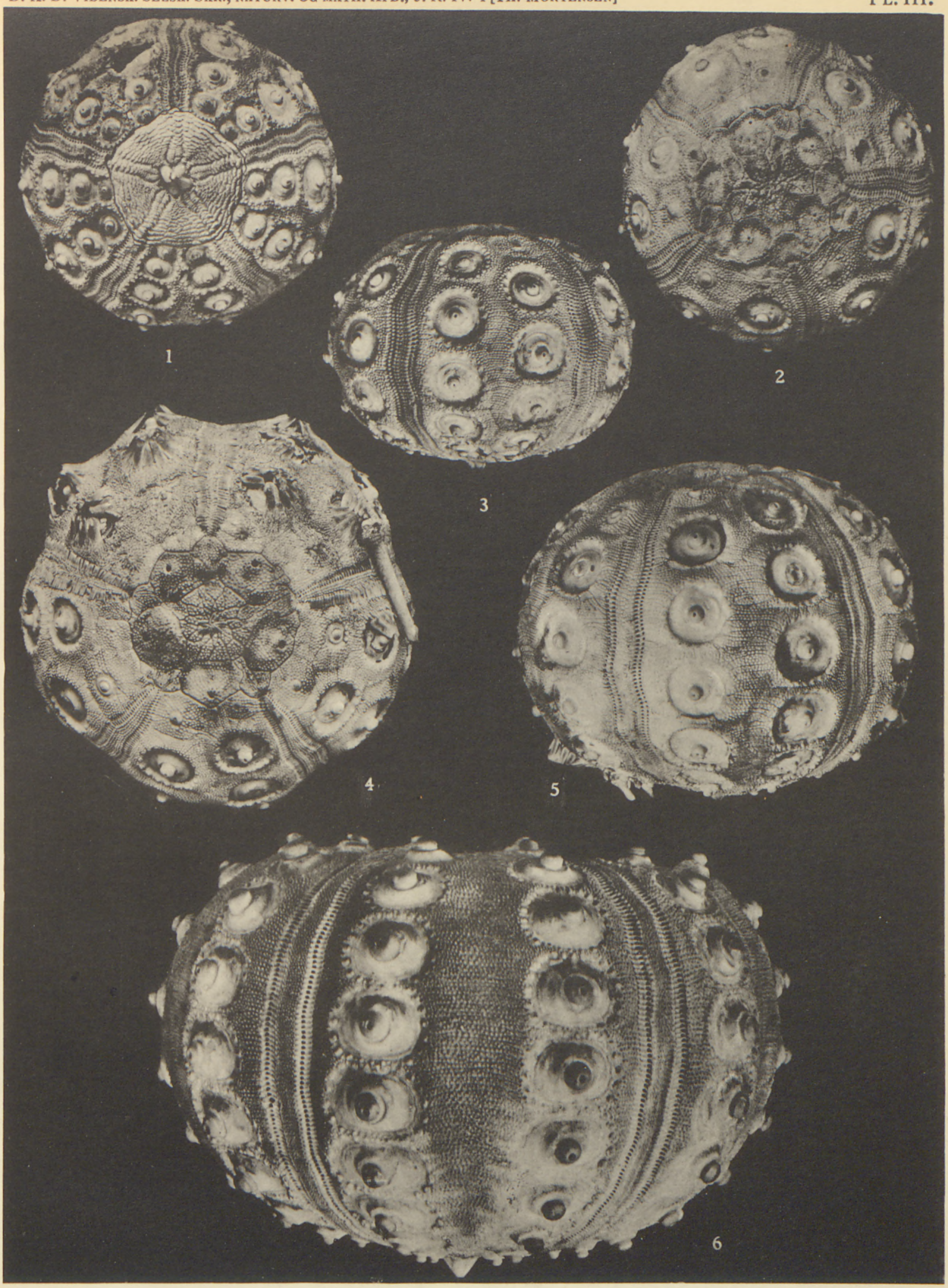
Natural size.



J. v. Huth fot. Pacht & Crones Eftf. Fototypi.

Plate III.

Figs. 1—5. *Stereocidaris excavata* Mrtsn. Denuded tests.
1—3. Smaller specimen, from the oral side (1), the aboral side (2), and in side view 3 .
4—5. Larger specimen, from the aboral side (4) and in side view (5).
Fig. 6. *Chondrocidaris gigantea* A. Agass. Denuded test, side view.
All figures natural size.

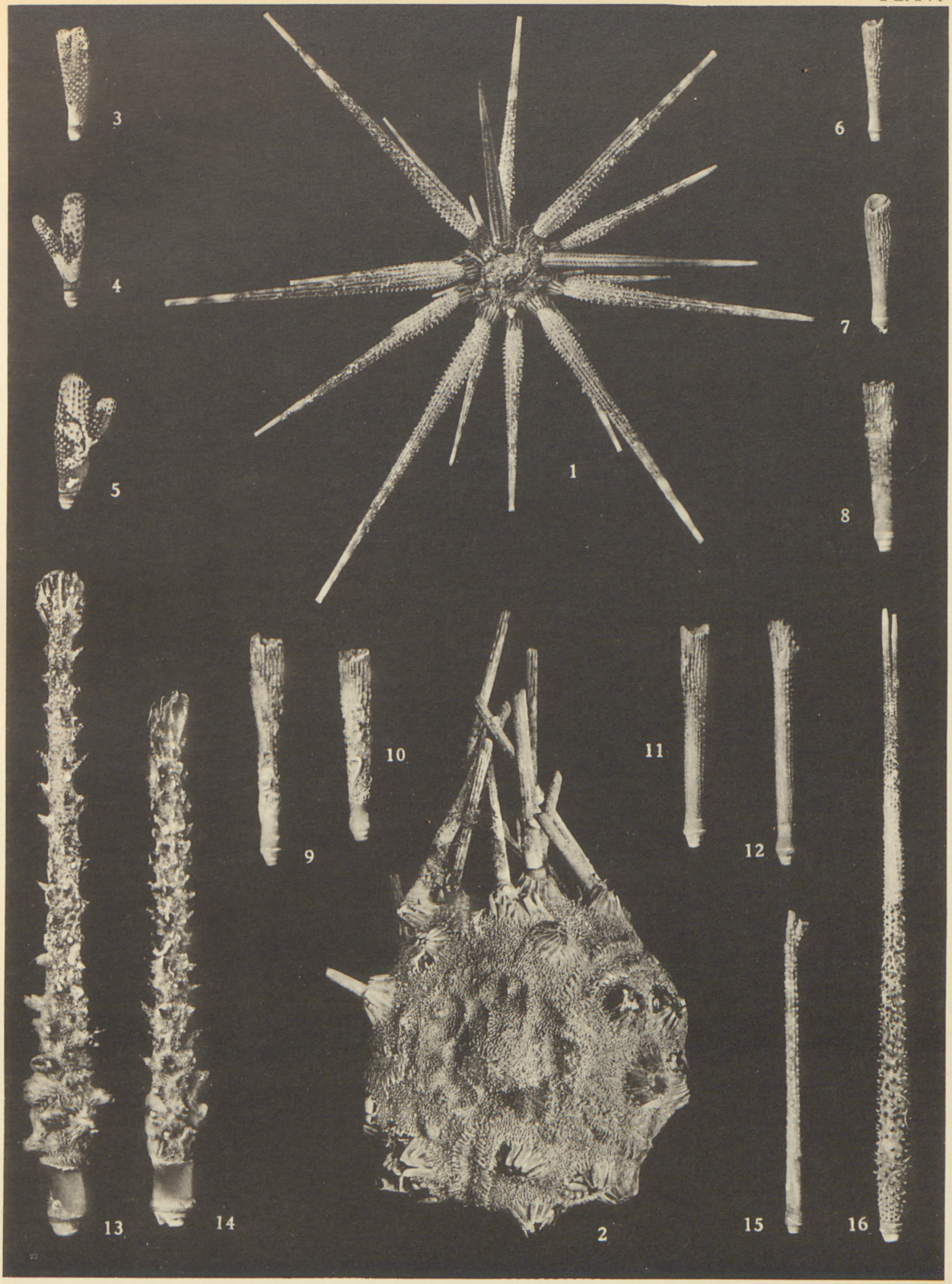


J. v. Huth fot. Pacht & Crones Eftf. Fototypi.

Plate IV.

Fig. 1. *Stylocidaris badia* (H. L. Clark). Young specimen. Aboral side.
- 2. *Stereocidaris excavata* Mrtsn. Aboral side.
- 3— 5. Abnormal, branching primary spines of *Eucidaris clavata* Mrtsn.
- 6—12. Primary spines of *Tretocidaris spinosa* Mrtsn.
- 13—14. — — - *Chondrocidaris gigantea* A. Agass.
- 15. Abnormal, branching primary spine of *Tretocidaris spinosa* Mrtsn.
- 16. — bifid — — - *Stylocidaris badia* (H. L. Clark).

All figures natural size.



J. v. Huth fot.

Pacht & Crones Eftf. Fototypi.

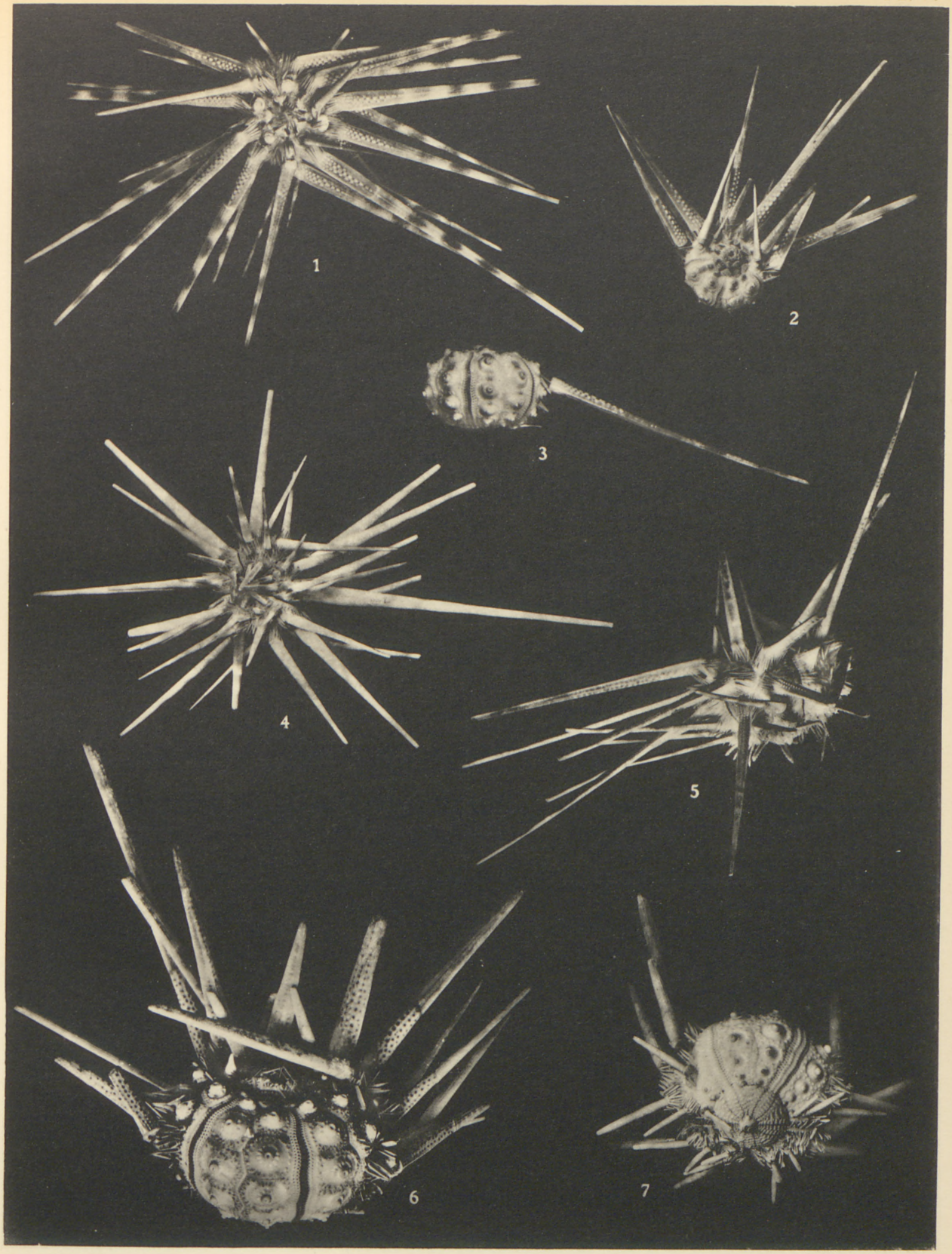
Plate V.

Figs. 1—5. *Acanthocidaris curvatispinis* (Bell). Young specimens. Aboral side (1); aboral side of half denuded specimen (2); side view of denuded specimen (3); oral side (4); side view (5).

Fig. 6. *Acanthocidaris maculicollis* (de Meijere); half denuded. Side view.

- 7. *Kionocidaris striata* Mrtsn. Type specimen; half denuded. Oral side.

All figures natural size.

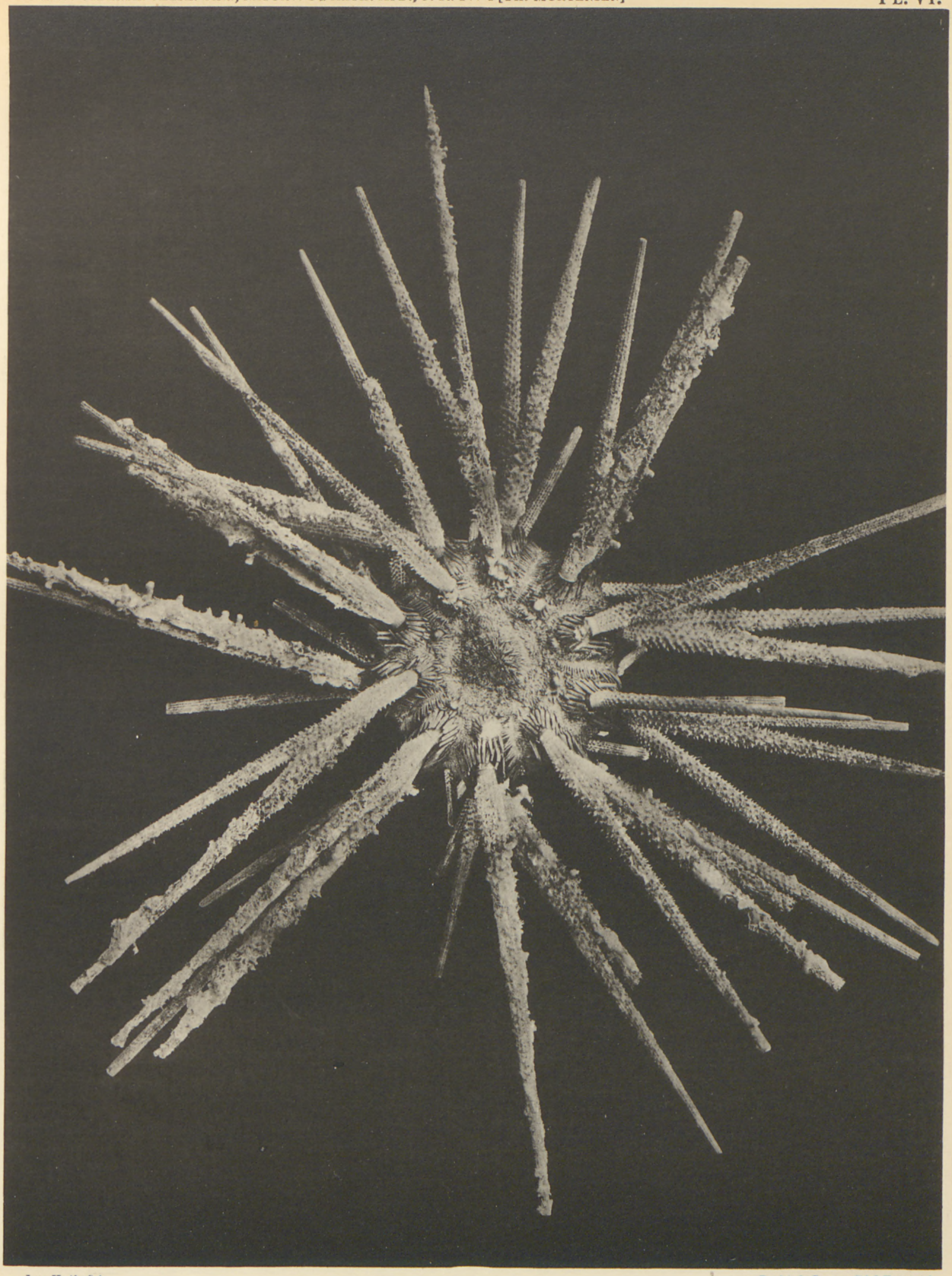


J. v. Huth fot.

Pacht & Crones Eftf. Fototypi.

Plate VI.

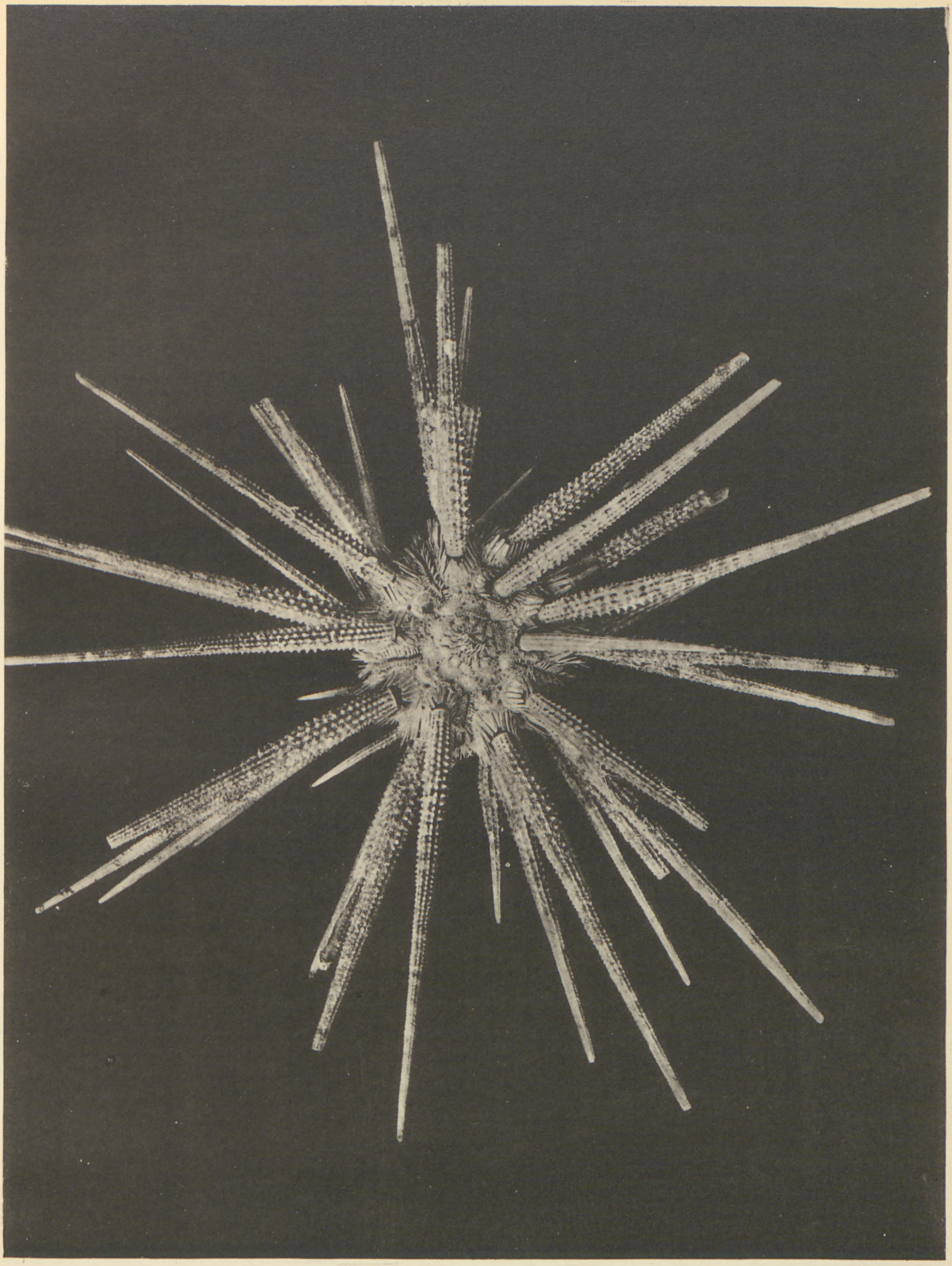
Stylocidaris badia (H. L. Clark).
Old, fullgrown specimen; aboral side. Natural size.



J. v. Huth fot. Pacht & Crones Eftf. Fototypi.

Plate VII.

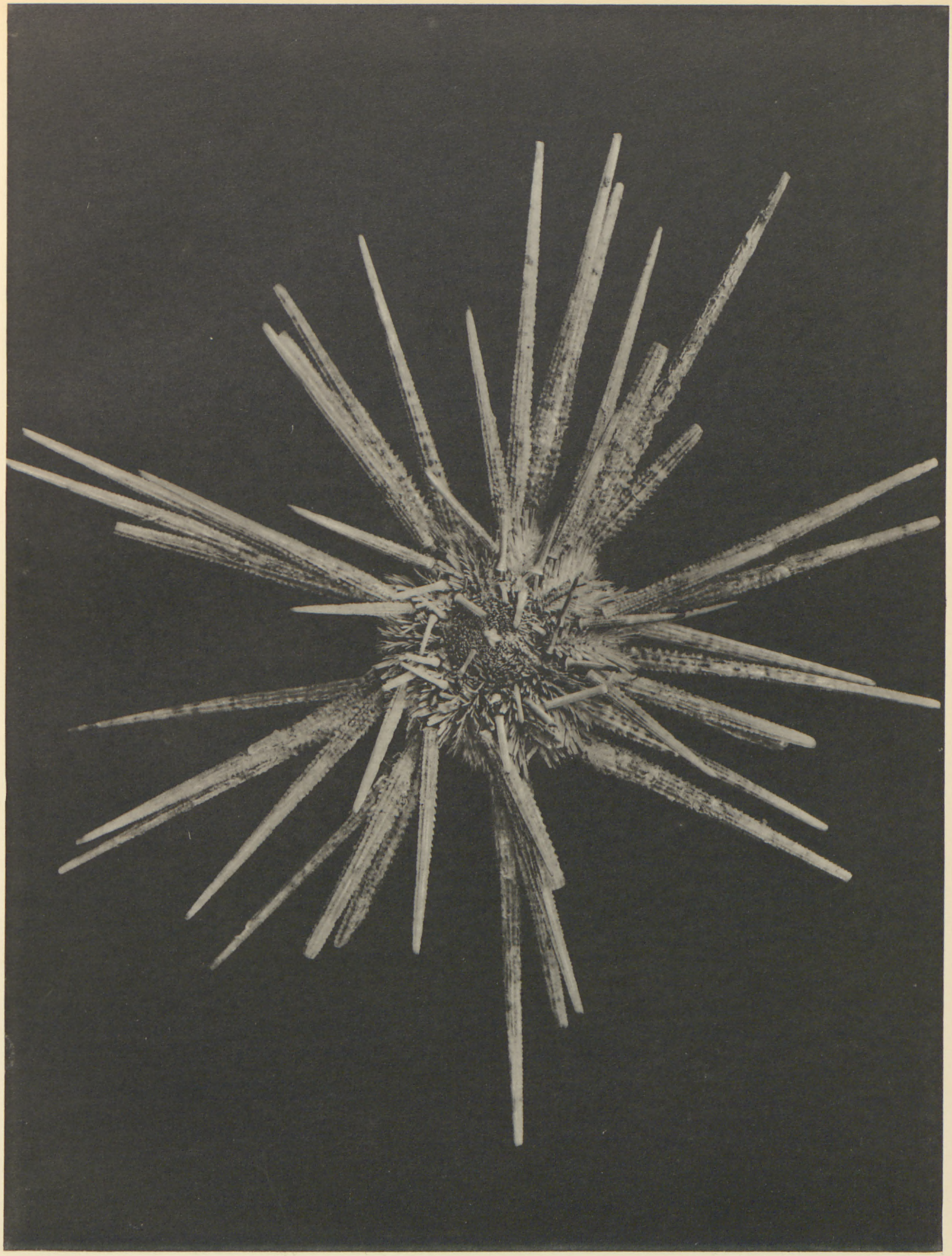
Stylocidaris bracteata, var. *mauritiana* Mrtsn.
Adult specimen; aboral side. Natural size.



J. v. Huth fot. Pacht & Crones Eftf. Fototypi.

Plate VIII.

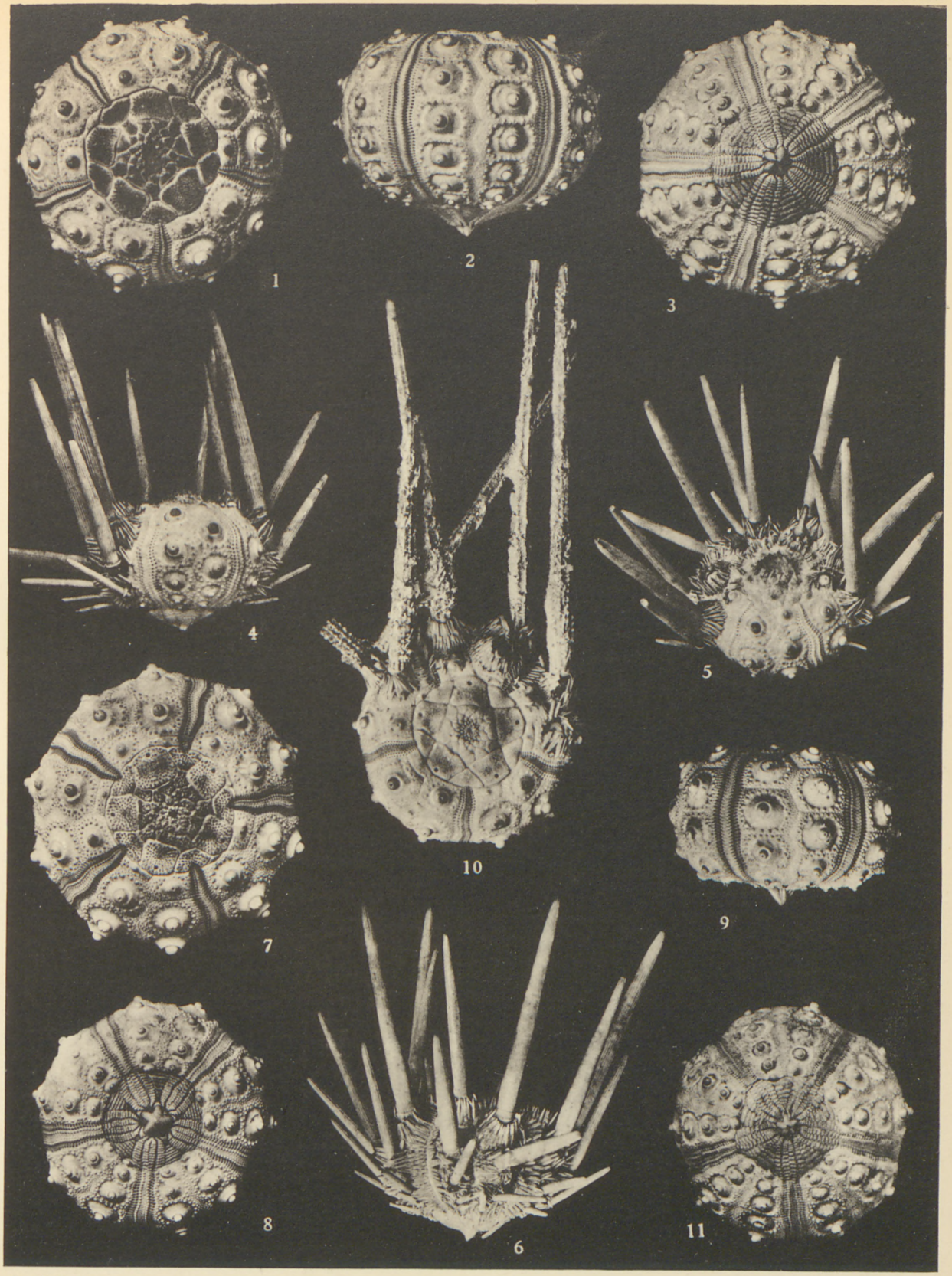
Stylocidaris bracteata, var. *mauritiana* Mrtsn.
Adult specimen; oral side. Natural size.



J. v. Huth fot. Pacht & Crones Eftf. Fototypi.

Plate IX.

Figs. 1— 3. *Stylocidaris badia* (H. L. Clark). Denuded tests.
Aboral side (1); side view (2); oral side (3).
- 4— 6. *Kionocidaris striata* Mrtsn. Type specimen; half denuded.
Side view (4); aboral side (5); side view (6).
- 7— 9. *Prionocidaris pistillaris* (Lamk.); denuded tests.
Aboral side (7); oral side (8); side view (9).
- 10—11. *Stylocidaris bracteata*, var. *mauritiana* Mrtsn. Denuded tests.
Aboral side (10); oral side (11).
All figures natural size.

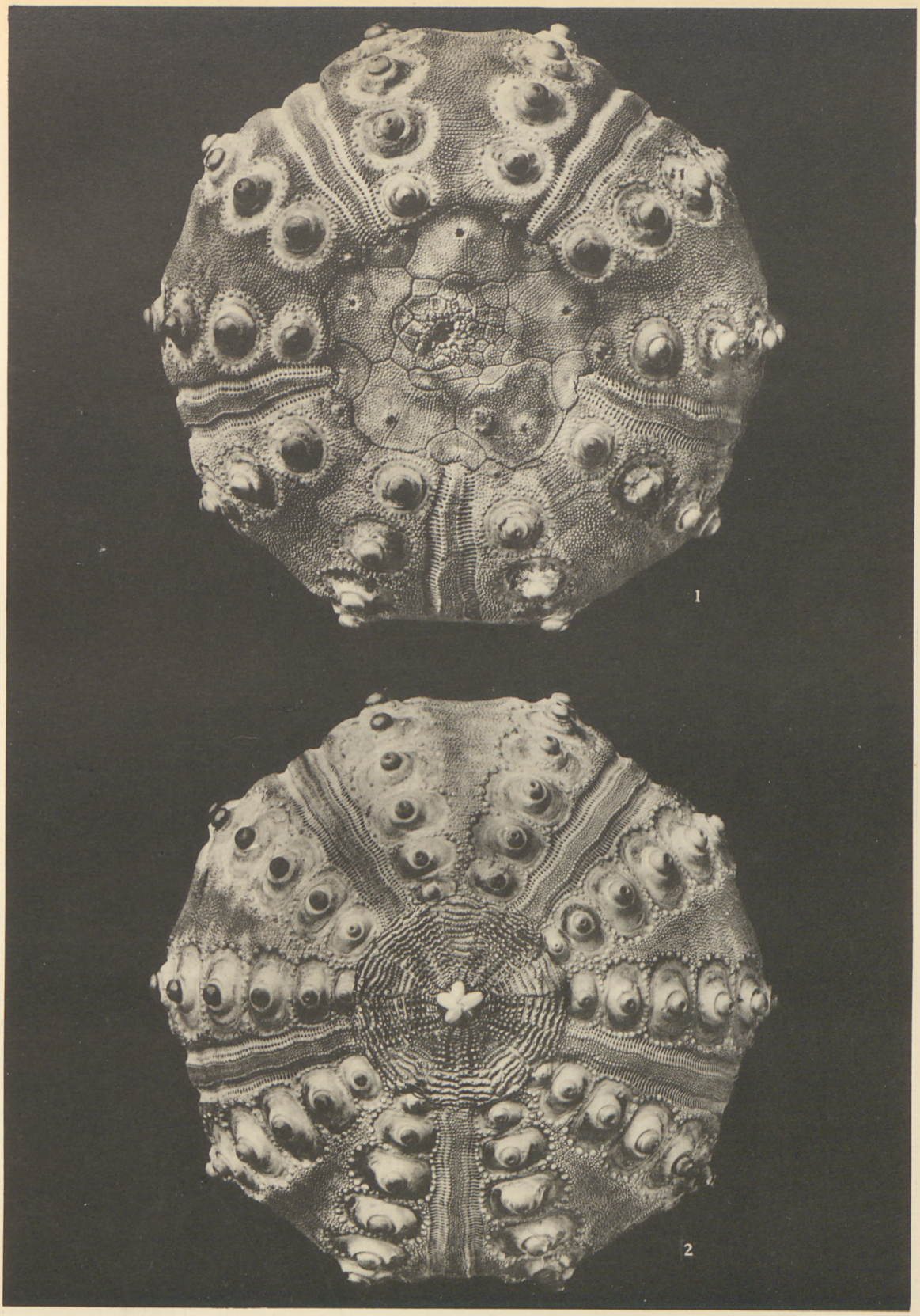


J. v. Huth fot.

Pacht & Crones Eftf. Fototypi.

Plate X.

Figs. 1—2. *Chondrocidaris gigantea* A. Agass. Denuded test. Aboral side (1); oral side (2). Reduced 1/6.



J. v. Huth fot. Pacht & Crones Eftf. Fototypi.

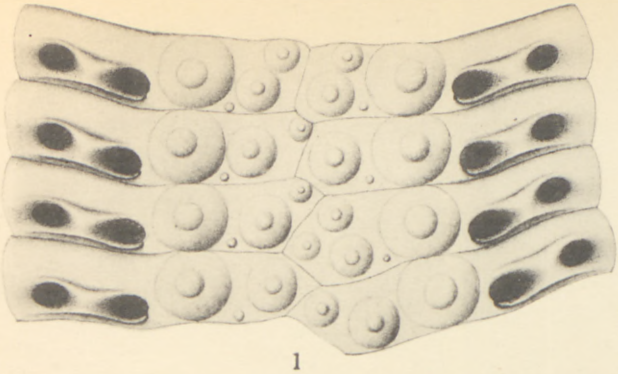
Plate XI.

Figs. 1—2. *Stereocidaris excavata* Mrtsn. Part of ambulacra of a smaller (1) and a larger specimen (2).

Fig. 3. *Kionocidaris striata* Mrtsn. Part of ambulacrum of type-specimen.

- 4. *Acanthocidaris curvatispinis* (Bell). Part of ambulacrum.
- 5. — *maculicollis* (de Meijere). Part of ambulacrum.
- 6. *Stylocidaris cingulata* Mrtsn. Part of ambulacrum of type-specimen.
- 7. *Goniocidaris balinensis* Mrtsn. Part of ambulacrum. Paratype.
- 8. *Prionocidaris pistillaris* (Lamk.). Part of ambulacrum.
- 9. *Kionocidaris striata* Mrtsn. Part of primary spine.

Figs. 1—6, 8 × 12. Fig. 7 × 50. Fig. 9 × 30.



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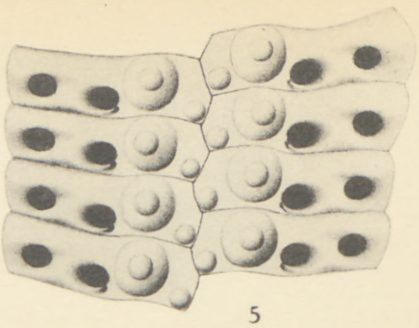

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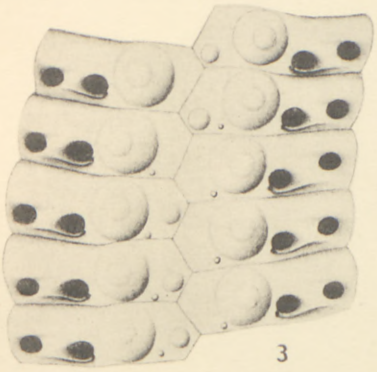

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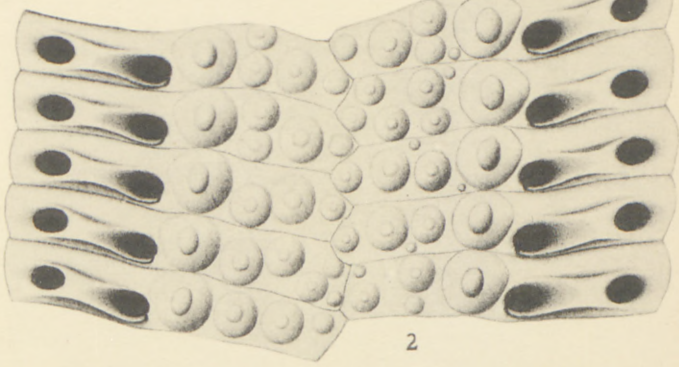

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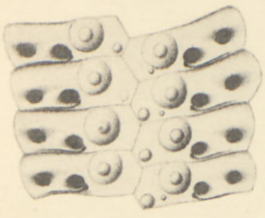

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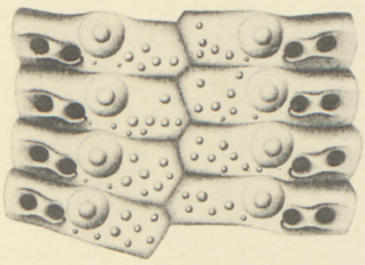

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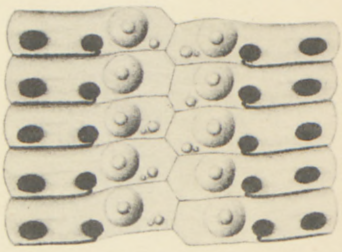

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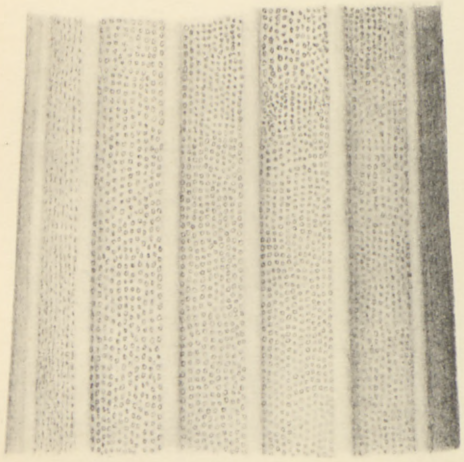

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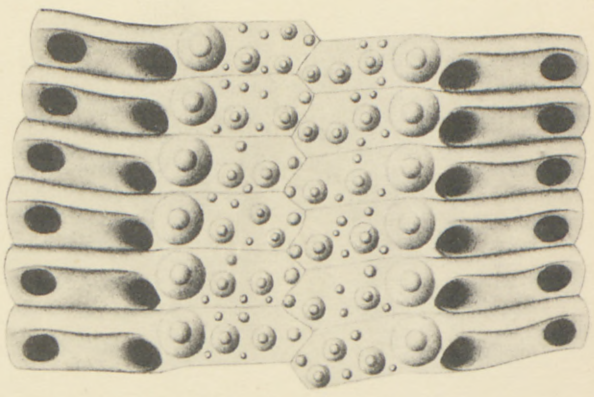

8

Plate XII.

Figs. 1— 2. *Kionocidaris striata* Mrtsn. Tridentate pedicellaria, large (1) and small form (2). × 50.
- 3— 5 and 7. *Stylocidaris bracteata* var. *mauritiana* Mrtsn. Tridentate pedicellariæ. × 50.
- 6. *Stylocidaris bracteata* (A. Agass.). Small tridentate pedicellaria. × 105.
- 8. *Acanthocidaris curvatispinis* (Bell). Tridentate pedicellaria. × 50.
(The underlying third valve indicated only at the point, otherwise not indicated, in order not to make the figure less clear). × 50.
- 9—10. *Stylocidaris badia* (H. L. Clark). Two types of tridentate pedicellariæ. × 50.

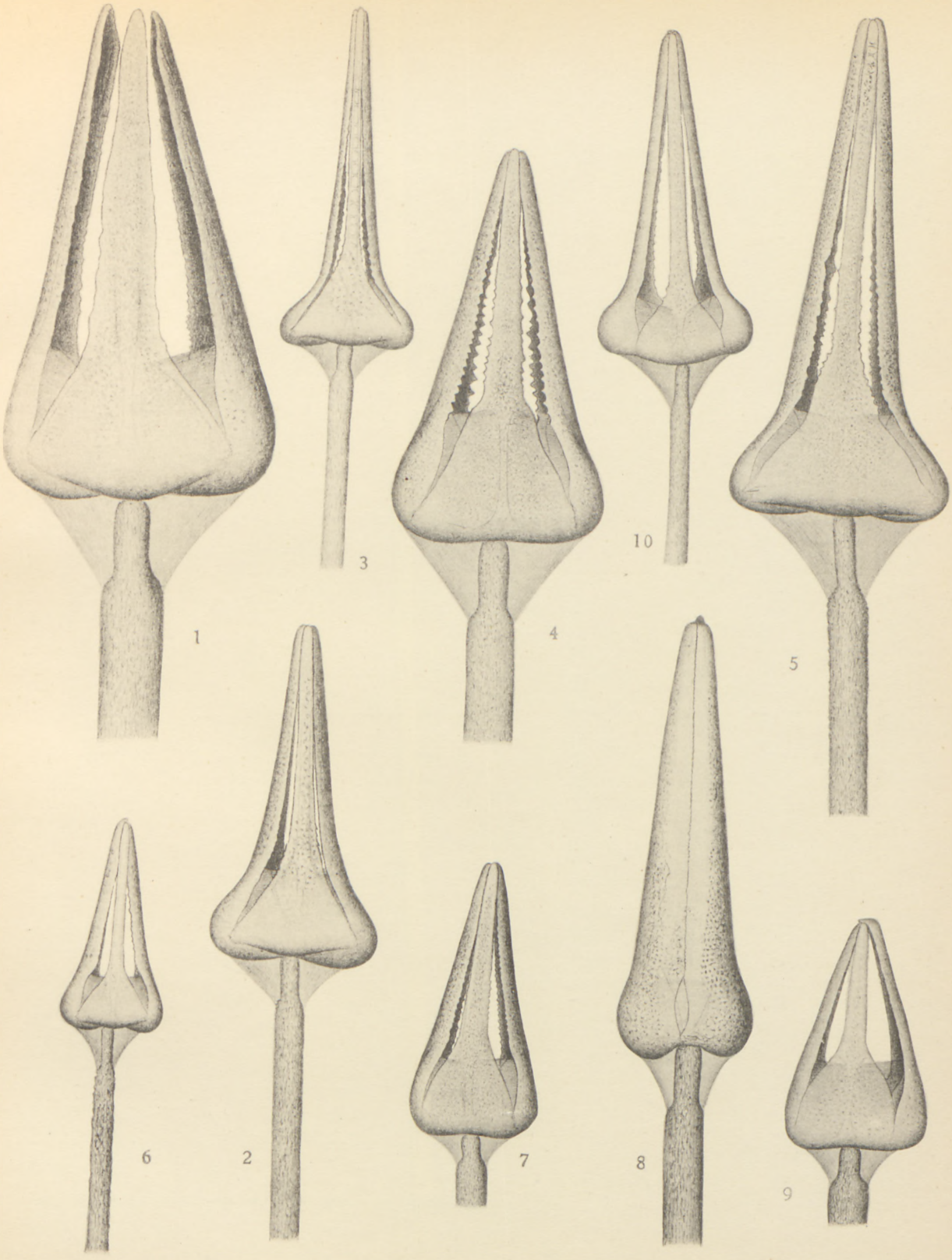

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Plate XIII.

Figs. 1—2. *Stylocidaris badia* (H. L. Clark). Valves of two forms of tridentate pedicellariæ; side view. × 100.

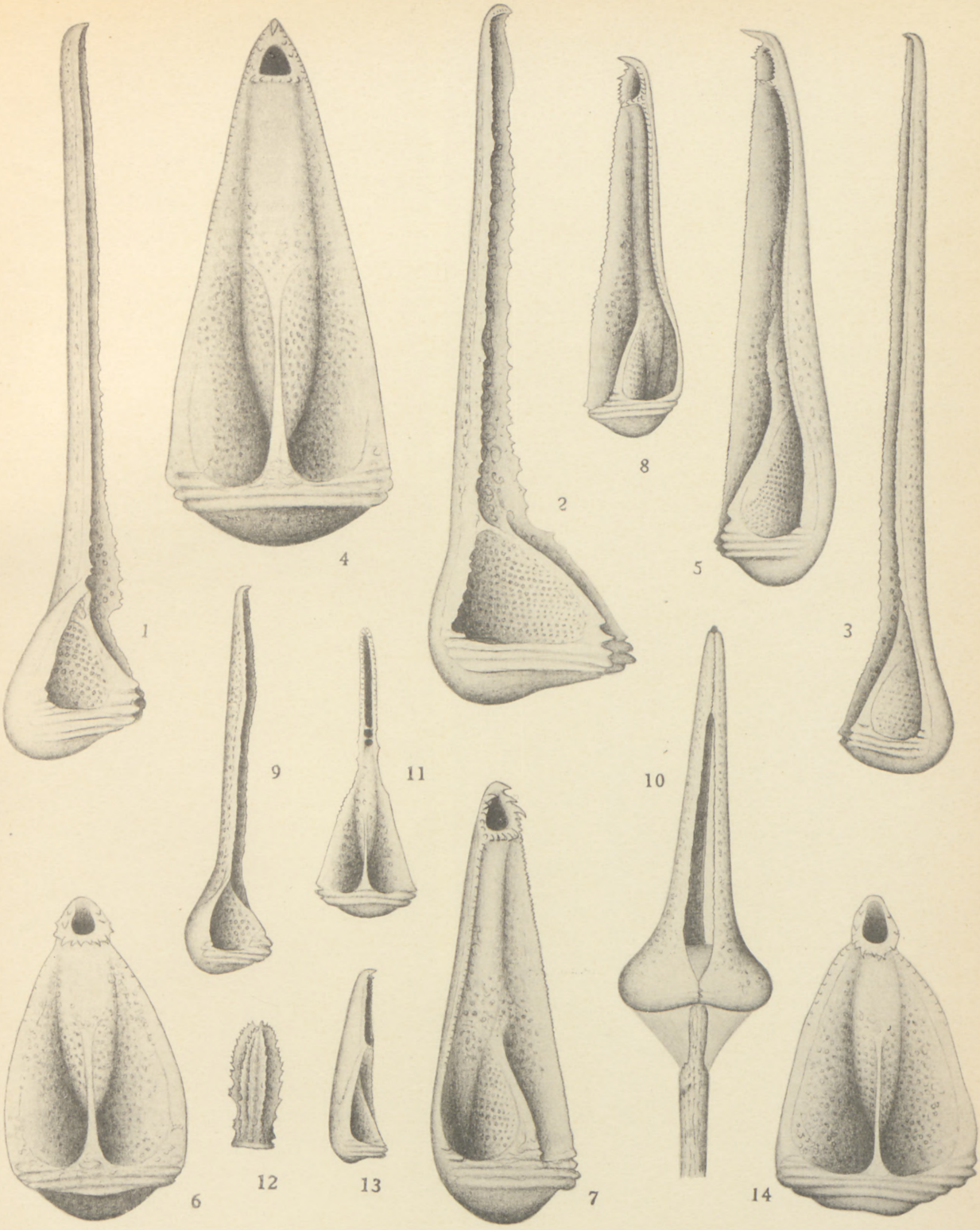
Fig. 3. *Tretocidaris spinosa* Mrtsn. Valve of tridentate pedicellaria; side view. × 95.

Figs. 4, 6—7. *Kionocidaris striata* Mrtsn. Valve of small globiferous pedicellaria, from the inside (4) and in half side view (7). Valve of large globiferous pedicellaria, from the inside (6). × 120.

Fig. 5. *Kionocidaris striata*, var. *teretispina* Mrtsn. Valve of small globiferous pedicellaria; side view. × 95.

Figs. 8—10. *Stylocidaris cingulata* Mrtsn. Valve of small globiferous pedicellaria, side view (8). × 100. Valve of tridentate pedicellaria, side view (9). × 100. Tridentate pedicellaria (10). × 68.

Figs. 11—14. *Goniocidaris balinensis* Mrtsn. Valve of small globiferous pedicellaria, elongate form, from the inside (11). Miliary spine (12). Valve of small globiferous pedicellaria, side view (13). Valve of large globiferous pedicellaria, from the inside (14). × 105.



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