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NUMBER 5

REPORT ON THE CRINOIDEA AND ECHINOIDEA

Collected by the Bahama Expedition
from the University of Iowa in 1893

by

HUBERT LYMAN CLARK, PH. D.

Museum of Comparative Zoölogy, Cambridge

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PLATE I.



A Bouquet of "Sea Lilies" (from *Nat. Hist. Bull.* III., 1, 2)

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Report on the Crinoidea and Echinoidea

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By HUBERT LYMAN CLARK, Ph. D.
Museum of Comparative Zoölogy, Cambridge

Early in March, 1916, the collections of crinoids and sea-urchins made by the University of Iowa's Bahama Expedition in 1893 were placed in my hands for study and identification. No collection of holothurians was made by the Expedition, while the sea-stars and brittle-stars have been reported on by Professor A. E. Verrill (Nat. Hist. Bull., V, 1 and VII, 1). To complete the account of the Echinodermata, therefore, it is desirable that a report be made on the collections turned over to me. While there is no close relationship between the crinoids and echinoids (indeed they represent quite different lines of evolution from a presumably Cystid stock), it is most convenient to embody my notes on the two groups in a single report. For the honor done me, in placing this interesting material in my hands, as well as for his help by correspondence, I wish to offer my sincere thanks to the leader of the Bahama Expedition of 1893, Professor C. C. Nutting.

It is to be regretted that the crinoids and echini were not studied soon after they were collected, for during the past twenty years much has been published on these groups as found in the West Indian region. There is not, therefore, any now undescribed species in the series before me though there are probably five crinoids and one sea-urchin which were new to science when taken. The chief value of the collections now lies in the large series of young echini, which throw much light on the growth stages of several little known species, and in the data provided on the distribution of the species represented. The notes on the Echinoderms taken at the various stations, published in Professor Nutting's "Narrative" of the Expedition (1895, Bull. Univ. Iowa, Lab. Nat. Hist., vol. 3, nos. 1 and 2) are not only of great general interest but are of much scientific

value, and have been of real service to me in the preparation of this report. I have quoted from them very freely but they should certainly be consulted by anyone interested in echinoderms.

CRINOIDEA

The collection of crinoids sent to me consists of 1310 specimens, representing 13 species, but unfortunately *Cocometra hagenii* makes up nine lots totalling 1247 specimens, while six of the species are represented by only one specimen each. There are 20 specimens of three species of stalked crinoids, while a fourth species is represented by a photograph of a fine example in the Iowa University Museum, identified by Dr. Charles Wachsmuth, the eminent authority on fossil crinoids. It gives me great pleasure to acknowledge the help I have received from my friend, Mr. Austin H. Clark of the United States National Museum, whose admirable work on the crinoids, has made all workers on echinoderms, his permanent debtors. Mr. Clark was good enough to look over the collection one afternoon when he was in Cambridge and he has also helped me by correspondence. He must not be held responsible however for any errors of identification which may hereafter be found or for any of the statements made herein. I have followed the arrangement of genera and species given in his "Recent Crinoids of the British Museum" (1913, Smith's Misc. Coll., 61, no. 15) so far as possible.

I have ventured to give a key to the 14 species listed here, not because it can be of permanent value but in the hope that since it includes the more common species, it will be of a little help to collectors not acquainted with crinoids in sorting collections made in the West Indies. Of course, the key cannot be relied on to lead to correct identifications since the number of crinoids now known from the West Indies is several times fourteen, but it will at least suggest to a beginner the characters which are of general service in distinguishing genera and species of this difficult group. All lovers of echinoderms are awaiting impatiently Mr. A. H. Clark's systematic monograph, which will be to the crinoids what Mr. Agassiz's Revision has

so long been to the echini, and will make the correct identification of species practicable, if not easy. Identifications made with the following key must be verified by comparison with the original (or with later and fuller) descriptions, or they can have little value.

Key to the Crinoids included in the present report

No stalk.

Basal pinnules (at least the first pair) with a well-marked comb at tip; mouth usually excentric.

Centrodorsal flat and discoidal.

Cirri with dorsal spines on distal segments.

II Br. 2 (i. e. the first division series of each ray consists of only two segments)*Neocomatella alata*

II Br. 4 (3+4) (i. e. the first division series consists of four segments, the third and fourth united by syzygy).

Cirri XV-XXI, with 10-12 segments*Nemaster insolitus*

Cirri XXX-XL, 12-18*Nemaster iowensis*

Cirri smooth without dorsal spines; only

10 arms*Comactinia echinoptera*

Centrodorsal conical, crowded with about 40 cirri, having 14-17 segments of which several proximal ones are very long and slender*Comatonia cristata*

Basal pinnules without terminal combs; mouth central.

Cirrus segments with dorsal, transverse, serrate ridges, contracting to a single spine on the penultimate segment; cirri about XV, 20*Analcidometra armata*

Cirrus segments smooth, or with a single spine, dorsally.

Cirri very long with 40-60 or more segments, of which the distal ones have conspicuous dorsal spines,

Stylometra spinifera

Cirri shorter, with 10-20 segments.

Arms more than 10; cirrus joints stout, even the proximal rarely twice as long as broad.

Cirri XIV-XV, 11-12*Crinometra gracilis*

Cirri XX or more, 15-20.....*Crinometra ornata*
 Arms 10; cirrus joints very slender, many of the
 proximal 2-3 times as long as broad; cirri XXX or
 or more, 18-20.....*Cocometra hagenii*

Stalk present

Cirri present on stalk

Internodes of stalk commonly with 6-9 segments.....
 *Endoxocrinus parrae*

Internodes of stalk commonly with 15-18 segments.....
 *Isocrinus asteria*

Internodes of stalk commonly with 11-14 segments.....
 *Isocrinus decorus*

Cirri wanting *Democrinus rawsonii*

Neocomatella alata

Antedon alata Pourtalès, 1878, Bull. M. C. Z., 5, p. 215.

Neocomatella alata A. H. Clark 1909. Prof. Biol. Soc. Washington, 22,
 p. 177.

Actinometra echinoptera var. *alata* Hartlaub, 1912. Mem. M. C. Z., 27, p.
 444; pl. XVIII, figs. 15 and 16.

This species is represented in the collection by only two specimens. One of these has 15 arms about 50 mm. long. The other has only 13 arms, and all the cirri are lacking. Both are from St. 10 or its vicinity. Station 10. Cuba: off Havana, 200 fms.

Nemaster insolitus

A. H. Clark, 1917. Proc. Biol. Soc. Washington, 30, p. 65.

A single specimen of *Nemaster* answers so well to Clark's description, that I have no doubt it represents this species. It is in only fair condition, however, and unfortunately has no locality label. The centrodorsal is 4 mm. across, flat and discoidal. There seem to have been 21 cirri but only 9 remain. These and the centrodorsal are white, while the arms, of which there were 18 (8 are broken off), are light brown, with the center of the serrate, distal margin of each brachial, darker brown; the pinnules are lighter.

Nemaster iowensis

Actinometra iowensis Springer, 1902, Amer. Geol., 30, p. 98. 1903, Bull. Lab. Nat. Hist., Univ. Iowa, 5, p. 217; pl. 1.
Nemaster iowensis A. H. Clark, 1910. Ann. Mag. Nat. Hist. (8), 5 p. 361.

Certainly, among the echinoderms taken by the Bahama Expedition, no species is so remarkable as this. Collected in shallow water at the Tortugas, the specimens were at once recognized by Professor Nutting as of very unusual interest, and in the "Narrative" (pp. 129-130) he speaks of them as follows: "Perhaps the greatest surprise was when we found a magnificent crinoid with a spread of about twelve inches growing in water less than three feet deep. These specimens were of a rich golden-brown color, which has not faded in alcohol, and belonged to the genus *Actinometra*. The mouth is even more excentric than usual in this genus and the pinnules are long and slender. The arms appear to be more brittle than in other crinoids and the ultimate ramifications are twenty-four in number. This is probably the handsomest species of free crinoid secured during the cruise, and the unexpectedness of the discovery added to its interest."

The structural peculiarities of the species have been fully discussed and figured by Springer, and it is not necessary for me to enter into them. But it may be worth while to add a few words in regard to the subsequent history of this notable comatulid. Professor Nutting says in a footnote (p. 130) that Mr. Agassiz told him he had found large comatulæ in shallow water at the Tortugas. It is greatly to be regretted that no such comatulids are in the M. C. Z. collection. It is possible they were sent to Hartlaub many years ago with most of the M. C. Z. comatulids. If so they are still missing, as that eminent German scientist never returned to the Cambridge Museum any of its collection, save a full series of *Comactinia echinoptera*. All else, he reported, as hopelessly lost!

Since the establishment of the Marine Laboratory of the Carnegie Institution at the Tortugas in 1904, Dr. Mayer has made a constant effort to rediscover *Nemaster iowensis*, but without finding a single specimen. The present writer spent the month of June, 1917, at the Tortugas and at every oppor-

tunity searched the reefs and shoals in the effort to find at least one comatulid. Dredging was also carried on continually, but all efforts were vain, for not a trace of a comatulid was found. Either this species formerly occurred and has now died out, or else its normal habitat is in that inaccessible region of the reef where it is too deep to wade and too shallow and rough to work from a boat; and from this habitat it only accidentally or under unusual conditions comes up into more shallow water.

Comactinia echinoptera

Alecto echinoptera J. Müller, 1841. Ber. Verh. Akad. Wiss. Berlin, p. 183.
Comactinia echinoptera A. H. Clark, 1909. Proc. U. S. Nat. Mus., 36, p. 498.

Although Hartlaub devotes two full plates in his account of the "Blake" comatulids, to photographs of *echinoptera* (Mem. M. C. Z., 27 pls. XVI, XVII), he has confused so many different species under that name, that it is not safe to say which of his figures is the true *echinoptera*. One can only wait until Mr. A. H. Clark has completed his work on West Indian crinoids and has brought order out of the chaos in which Hartlaub has left the subject.

The specimens in the Iowa collection agree well with each other and with the description of Müller's type so there is no reason to doubt their identity. They were all taken on the Pentacrinus ground, off Havana, and are for the most part rather badly broken. Most of the specimens are now quite white, but a few are distinctly light brown and one is evidently somewhat purple, especially on the arm-bases. In the "Narrative" (p. 75), Professor Nutting says: "Bright yellow Comatulæ were fairly abundant and white or nearly white Comatulæ were also secured at this place" (i. e. the Pentacrinus ground). Again (p. 75), he says: "Besides the Pentacrini, a number of species of Comatulæ, including several Actinometra, served to enlarge our series of crinoids." There are 5 species of comatulids in the collection sent me, which were taken on the Pentacrinus ground, but *Comactinia echinoptera* is the only one of which more than two specimens occur. It seems likely that this is the species of Actinometra to which he refers and also

that it is the "bright yellow" comatulid which he says was "fairly abundant." The following stations are the places where the 31 specimens at hand were taken:

- Station 2. Cuba: off Havana, 110 fms.
- Station 4. Same as 2.
- Station 5. Cuba: off Havana, 140 fms.
- Station 7. Same as 5.
- Station 9. Cuba: off Havana, 200 fms.
- Station 10. Same as 9.
- Station 11. Same as 9.
- Station 13. Cuba: off Havana, 200 fms.

Comatonia cristata

Actinometra cristata Hartlaub, 1912. Mem. M. C. Z., 27, p. 473; pl. XV, figs 10 and 11.

Comatonia cristata A. H. Clark, 1916. Jour. Washington Acad. Sci., 6, p. 115

There are but three specimens of this comatulid in the collection and they are in only fair condition but they show the prickly crests on the lower brachials much more clearly than they appear in Hartlaub's figures. The species is so much like one of the Antedonidæ superficially that specimens lacking the extraordinary basal pinnules would be very difficult to identify, but the combs on those pinnules are certainly very characteristic.

Station 30. Florida: south of Key West, about 100 fms.
1 specimen.

Station 48. Florida: southeast of Key West, about 80 fms.
2 specimens.

Analcidometra armata

Antedon armata Pourtalès. 1869. Bull. M. C. Z., 1, p. 356. Hartlaub, 1912. Mem. M. C. Z., 27, p. 394; pls. VII, figs. 1-7; XIII, fig. 7.

Mr. A. H. Clark tells me that this species, so long ago described by Pourtalès, is properly a member of the genus *Analcidometra*, instituted by Mr. Clark in 1911 (Mem. Australian Mus., 4, p. 779), but I cannot find that the combination has been published hitherto. The species is easily recognized

among the comatulids of the present collection by its characteristic cirri. There are two specimens before me, each with disk about 3 mm. across and arms 50 mm. long.

Station 74. Bahamas: off Little Cat Island, 3-13 fms.
2 specimens.

Stylometra spinifera

Antedon spinifera P. H. Carpenter, 1881. Bull. M. C. Z., 9, p. 158. Hartlaub, 1912. Mem. M. C. Z., 27, p. 358; pl. II.

Stylometra spinifera A. H. Clark, 1908. Bull. M. C. Z., 51, p. 245.

A single fine specimen of this beautiful species is all that the present collection contains. Unfortunately the cirri are all broken but enough is left of one to reveal the characteristic features.

Station 2. Cuba: off Havana about 2½ miles, 110 fms.

Crinometra gracilis

Antedon brevipinna var. *gracilis* Hartlaub, 1912. Mem. M. C. Z., 27, p. 328; pl. XII, fig. 3.

There are in the Iowa collection two comatulids and fragments of a third which undoubtedly belong to the genus *Crinometra*. In regard to the species of this genus, Mr. A. H. Clark writes me: "Crinometra is in a perfectly hopeless condition. The majority of the new names given by Hartlaub are preoccupied in the genus *Antedon* as understood by him." In spite of this situation, it has seemed desirable to at least place the specimens before me with reference to Hartlaub's many "varieties" of *Antedon brevipinna*. One of these specimens, although fragmentary, seems to answer well to the "variety *gracilis*" and I have therefore labelled it "*Crinometra gracilis* Hartl." The question as to whether *gracilis* in this usage is preoccupied by *Antedon gracilis* may be ignored until Hartlaub's multitudinous varieties are properly identified.

The specimen at hand has a thick, flat or slightly conical centrodorsal, only a little more than 3 mm. in diameter; there are 10 cirri present and sockets of 3 or 4 more; the bare dorsal surface of the centrodorsal is occupied by numerous bluntly pointed granules or thick spinelets. The cirri have 11 or 12

segments and resemble very closely the one shown in Hartlaub's photograph (pl. XII. fig. 3). The two arms remaining are 75-80 mm. long and their ornamentation is very similar to that shown in Hartlaub's figure. There were 18 arms, with syzygies between brachials 1 and 2 and again between 3 and 4, as described by Hartlaub. The pinnules also agree well with his description. The color is uniformly white. While there seems little reason to doubt, therefore, that this specimen is identical with Hartlaub's, what its relation is to the other species of *Crinometra* remains to be determined.

Station 2. Cuba: off Havana about 2½ miles, 110 fms.

Crinometra ornata

Antedon brevipinna var. *ornata* Hartlaub, 1912. Mem. M. C. Z., 27, p. 348; pls. IV, fig. 6; XII, fig. 4.

The specimen and fragments of this *Crinometra* do not correspond in detail with Hartlaub's description and figures, but it is better to refer them to the same *name* than introduce a new name into this already badly confused group.

The individual before me has the centrodorsal so thickly covered with cirri that it is difficult to determine its size and shape. At the dorsal pole are a few high, compressed, irregular granules and ridges. The cirri are about 20 in number, with 17-20 segments, of which the penultimate bears a conspicuous opposing spine, while the 3-6 preceding have a similar but increasingly ill-defined dorsal projection near the distal margin; the distal margins, particularly of the basal segments, are flaring so that they form a conspicuous socket for the next succeeding segment; all the segments are longer than wide, except the basal three, and the fifth (or sixth) is the longest. There are 23 arms, of which two are very small; the longest exceed 100 mm. In their ornamentation, the arms are more like Hartlaub's fig. 9, pl. V, than they are like the figures he gives for *ornata*, but I am not at all clear as to how much weight slight differences of ornamentation properly carry in *Crinometra*. The pinnules of the specimen in hand are remarkable for the very great width of some of the basal segments. Thus P_6 is 6mm. long, and consists of 10 segments of which the third is .75-.80 mm. high and a trifle

more than 1 mm. wide, while the fourth is about as wide and is fully a millimeter high; succeeding segments are much narrower. It will be at once noted that these pinnules are utterly different from Hartlaub's fig. 6, pl. IV, but they are apparently identical with those shown in the photograph, fig. 4, pl. XII. No doubt Hartlaub has at least two distinct species confused under his "variety *ornata!*" The arm-fragments at hand agree perfectly in ornamentation and in pinnules with the whole specimen and there is no doubt of their identity.

Station 9. Cuba: off Havana, 200 fms. Arm-fragments.

Station 16. Cuba: off Havana, 200 fms. 1 good specimen.

Cocometra hagenii

Comatula (Alecto) hagenii Pourtalès, 1868. Bull. M. C. Z., 1, p. 111.

Cocometra hagenii A. H. Clark, 1908. Proc. Biol. Soc. Washington, 21, p. 128.

Antedon hageni Hartlaub, 1912. Mem. M. C. Z., 27, p. 389; pl. VIII, figs. 1-12.

The vast majority of the crinoids in the Iowa collection belong to this common species. In the "Narrative" (p. 164), Professor Nutting says that "great numbers of crinoids were collected" on the Pourtalès Plateau. On one occasion, "as the bar neared the surface and the tangles themselves could be seen rising through the blue water, we noticed that a stream of brownish objects was trailing after it, as if innumerable mossy bits were floating away from the hemp strands. When the tangles came on board we found them literally covered with a mass of crinoids, all of one kind and quite small. We estimated that at least five hundred specimens came up in that haul and it was evident that hundreds or thousands had washed off during the ascent of the tangles from the sea-bottom. This was probably the greatest number of any one species obtained at a single haul during the entire cruise. The bottom must have been actually packed with them in spots." There is no doubt that the crinoid here referred to is *Cocometra hagenii*. There is little doubt that Hartlaub's figures represent more than a single species and it is difficult to determine which really illustrate *hagenii*.

The Bahama Expedition took this species at the following stations:

Station 27. Florida: south of Key West, 50-60 fms. 5 specimens.

Station 33. Florida: about 6 miles south of Sand Key Light, about 105 fms. 1 specimen.

Station 48. Florida: southwest of Key West, about 80 fms. 6 specimens.

Station 54. Florida: about 10 miles southeast of American Shoal Light, about 130 fms. 185 specimens.

Station 57. Pourtalès Plateau, $24^{\circ} 18' N.$ x $81^{\circ} 18' W.$, 200-225 fms. 365 specimens.

Station 58. Pourtalès Plateau, $24^{\circ} 19' N.$ x $81^{\circ} 19' W.$, about 200-225 fms. 275 specimens.

Station 62. Florida: off American Shoal Light, 70-80 fms. 205 specimens.

Station 64. Florida: about 8 miles southeast of American Shoal Light, about 110 fms. 95 specimens.

Locality unknown. 110 specimens.

Endoxocrinus parræ

Encrinus parræ Gervais, 1835. Dict. d'Hist. Nat., 3, p. 49; pl. 147. fig. 1

Pentacrinus mülleri Oersted, 1856. Forh. Skand, Nartuf. p. 202. P. H. Carpenter, 1884. *Challenger* Crinoids, pt. 1, pl. XIV.

Endoxocrinus parræ A. H. Clark, 1908. Proc. Biol. Soc. Washington, 21, p. 151.

Plates I and II

Here is another of those unfortunate cases where a long familiar name has to give away to an older and less euphonious one. This beautiful crinoid was taken a number of times on the *Pentacrinus* grounds off Havana but it is evidently not nearly so common there as is *Isocrinus decorus*. In the "Narrative" (pp. 73, 74), it is recorded that "when fresh, *P. mülleri* is darker colored than *P. decorus*, and is a handsomer species on account of the greater number of arms." "*Pentacrinus mülleri*. came up with the head erect and the numerous arms very greatly recurved, usually meeting below the calyx," as do the "perianth-segments" of some tiger-lilies.

Station 4. Cuba: off Havana, about 2½ miles, 110 fms. 2 specimens.

Station 5. Cuba: off Havana, about 2½ miles, 140 fms. 1 specimen.

Station 10. Cuba: off Havana, about 2½ miles, 200 fms. 1 specimen.

Station 13. Cuba. off Havana, 200 fms. 1 specimen.

Station 16. Cuba: off Havana, 200 fms. 1 specimen.

Isocrinus asteria

Isis asteria Linné, 1766. Sys. Nat. ed. 12, p. 1288.

Pentacrinus asterius P. H. Carpenter, 1884. *Challenger Crinoids*, pt. 1, p. 300; pl. XI.

Isocrinus asteria A. H. Clark, 1908. Proc. U. S. Nat. Mus., 33, p. 687.

Plate III, Fig. 1

Although there is no specimen of this fine pentacrinid in the collection sent me, two were taken on the *Pentacrinus* ground off Havana and are briefly referred to in the "Narrative" (p. 75) as "beautiful specimens." A photograph of one of these lies before me and shows its beauty admirably.

Isocrinus decorus

Pentacrinus (Neocrinus) decorus Wyville Thompson, 1864. *Intellectual Observer*, 5, p. 7.

Pentacrinus decorus P. H. Carpenter, 1884. *Challenger Crinoids*, pt. 1, pl. XXXIV.

Isocrinus decorus A. H. Clark, 1908. Proc. Biol. Soc. Washington, 21, p. 149.

Plate I and Plate III, Figs. 2, 3

This, the most abundant of the West Indian stalked crinoids, was taken by the Bahama Expedition in great numbers on the *Pentacrinus* grounds off Havana, and 13 specimens were sent to me. The species has been so thoroughly studied, I have nothing to add as regards the morphology. In the "Narrative" (p. 75), Professor Nutting writes: "*P. decorus* when first out of water usually had the head gracefully drooping and the arms not greatly recurved, the outline of the whole being very much like that of a lily." It "is much more fragile than the

other species, both the cirri and arms being more slender and liable to injury. Lieutenant Commander Sigsbee reported that the colors of these pentacrini were light brown, white or yellow. We saw none that were either white or yellow, all being of some shade of light brown, usually with a purplish or violet tinge, and sometimes approaching a flesh color. Bright yellow Comatulæ were fairly abundant, and white or nearly white Comatulæ were also secured at this place. It occurs to me as possible that Lieutenant Commander Sigsbee may have had these in mind when giving the colors of the pentacrini. Several specimens lived some little time after coming on deck. The *P. decorus* would gracefully expand its arms until they assumed a reflexed attitude similar to that of *P. mülleri*. The cirri were also moved about as if seeking support, and there was some motion of the stem. We did not observe any independent motion of the pinnules. A majority of the specimens came on deck in good condition. Some were broken in the operation of disentangling from the hemp strands, and a few, not very many, were ruined by their noted proclivity to 'fly all to pieces' when displeased."

One of the most notable specimens taken on the Pentacrinus grounds was a very small individual, the whole calyx and arms only about 16 mm. high. This specimen was not sent to me but there is little reason to doubt that it is a young *P. decorus*. Although this specimen "is of peculiar interest" as Professor Nutting writes me, nothing has been published in regard to it as far as I know. Professor Nutting adds, in his letter, "Dr. Alexander Agassiz upon seeing it, thought it was at that time the youngest pentacrinus that had been secured. He made some drawings of it and sent it to a German specialist for study. I have seen no results of these studies neither have Agassiz's drawings appeared in print. This specimen we regard as so valuable that I do not like to have it leave our hands."

The list of stations where *Isocrinus decorus* was taken, as shown by the specimens at hand, is as follows:

Station 2. Cuba: off Havana, about 2½ miles, 110 fms. 5 specimens.

Station 5. Cuba: off Havana, about 2½ miles, 140 fms. 1 specimen.

Station 10. Cuba: off Havana, about 2½ miles, 200 fms. 3 specimens.

Station 11. Cuba: off Havana, about 2½ miles, 200 fms. 1 specimen.

Station 13. Cuba: off Havana, 200 fms. 1 specimen.

Station 16. Cuba: off Havana, 200 fms. 1 specimen.

No label, 1 specimen.

Democrinus rawsonii

Rhizocrinus rawsonii Pourtalès, 1874, Illus. Cat. M. C. Z., no. 8, p. 27; pl. V.

Democrinus rawsonii A. H. Clark, 1917. Jour. Washington Acad. Sci., 7, p. 392.

In the "Narrative" (p. 164), speaking of the dredging results on Pourtalès Plateau, Professor Nutting says: "We especially regretted our failure to secure specimens of *Rhizocrinus*, a genus which is represented by abundant individuals in certain definite spots on the Pourtalès Plateau." This disappointment would have been lessened had Professor Nutting known that the genus was represented in the collections he had made off Havana. It was a pleasant surprise to me in examining the specimens of *Isocrinus decorus* to find among them part of the stalk, with calyx attached, of an adult Bourguetocrinid, which proves to be *Democrinus rawsonii*. There is no clue as to the station at which the specimen was taken but there is no doubt of its being from the *Pentacrinus* ground. The stem is about 145 mm. long and consists of 60 segments. The calyx is 4 mm. high and 1.85 mm. in diameter. The sutures are nearly obliterated and were visible only when the calyx was dried and treated for a moment with benzole. The arms are entirely lacking.

ECHINOIDEA

The collection of echini sent to me consists of 381 specimens, representing 21 species. Nearly all are in excellent condition and the many young specimens are very interesting. Besides

these there are five species mentioned in Professor Nutting's "Narrative" which are not in the collection sent to me. One of these (*Dorocidaris blakei*) will be found discussed under *Cidaris abyssicola* and another (*Aspidodiadema sp.?*) under *Centrechinus antillarum*. The others are inserted each in its natural position in the list.

Eucidaris tribuloides

Cidarites tribuloides Lamarck, 1816. Anim. s. Vert., 3, p. 56.

Cidaris tribuloides A. Agassiz, 1872. Rev. Ech., p. 253; pl. Id and pl. II, figs. 1-3.

Eucidaris tribuloides Döderlein, 1887. Jap. Seeigel, p. 42.

There is only a single specimen of this common West Indian cidarid in the collection before me, but in the "Narrative," the species is reported from the Tortugas (p. 132), where it "was found principally on the mud-flats just inside the reef," and from Pourtalès Plateau (p. 173). The specimen sent me is labelled "Bahama Islands." It is a fine adult, 44 mm. in diameter of test.

Cidaris abyssicola

Dorocidaris abyssicola A. Agassiz, 1869. Bull. M. C. Z., 1, p. 253.

Dorocidaris papillata A. Agassiz, 1872. Rev. Ech., p. 254 (*in part*); pl. I, figs. 1-4.

Cidaris abyssicola H. L. Clark, 1909, Ann. Mag. Nat. Hist. (8), 3, p. 88

An excellent series of this cidarid is in the collection, but most of the specimens are very young. They range in test-diameter from 5.5 to 37 mm. Some of the smaller specimens throw some light on the color of this species in life. The primary spines are pure white, except the very young ones near the apical disk which, while still covered with the epidermis, are brownish-red. The epidermis, while retained over the whole spine, gives it a dull, smooth, opaque appearance, very different from the mature spine. When the epidermis is first shed the spines are quite rough with longitudinal series of minute sharp teeth, but with the passage of time these wear down until in fully adult individuals the primary spines are nearly or quite smooth. In one young specimen, the test and second-

ary spines are still quite bright brownish-red but in all the other specimens this color is nearly or quite faded out and they are yellowish or white.

Mortensen (1910, Bull. 74 U. S. Nat. Mus., p. 13) has suggested a distinct variety of *abyssicola*, which he calls *teretispina*, and of which he says (p. 15) "I am inclined to think it will ultimately prove to be a distinct species." In deference to this opinion of my honored friend and colleague, I have carefully examined more than 150 specimens of *abyssicola* from ten different localities to see if I could distinguish this variety consistently. While many specimens answer perfectly to the description and figures of *teretispina*, and others are with equal certainty typical *abyssicola*, I cannot find any combination of characters by which they can be separated consistently from each other. Even the shape of the primary spines is unreliable and indeed shows great diversity. Relatively few specimens have the radioles "somewhat fusiform and attain their greatest diameter at about one-fifth the length of the spine from the base," and it is very unusual to have more than a few spines on one specimen show this character clearly. Many specimens have most of their spines cylindrical with a more or less indistinct constriction at the base, or very slightly fusiform with the largest diameter at or near the middle. Sometimes the greatest diameter of the spine is near the tip, but this is quite unusual. In one specimen a primary spine on one interambulacrum is notably stout and slightly thicker distally than proximally, while the others are slender and nearly cylindrical. Perfectly terete mature spines are very uncommon but immature spines are usually terete. Cylindrical spines, terete distally, such as characterize Mortensen's proposed variety (see his plates 9 and 10) are very common and are often found on specimens which have most of the spines more perfectly cylindrical. So far as the tuberculation of the ambulacra and the shape of the test is concerned, they are simply matters of slight individual diversity, and instead of considering *teretispina* as a potential species, I cannot even accept it as a variety worthy of recognition.

In the "Narrative" (p. 173) *Dorocidaris blakei* A. Ag. is re-

ferred to as though many specimens were secured on the Pourtalès Plateau, but Professor Nutting particularly states that the specimens "were without the peculiar fan-shaped spines or radioles which constitute the most striking peculiarity of the species." He adds: "The characters of the test were well marked however." There can be little doubt I think that these specimens were *C. abyssicola* and Professor Nutting's misidentification was most natural. It is due to the fact that Mr. Agassiz in the "Revision of the Echini," united under the name *Dorocidaris papillata* several species which we now consider quite distinct. Two of the most distinct of these are *Stylocidaris affinis* and *Cidaris abyssicola*. These were both dredged by the Iowa party on Pourtalès Plateau and as they were obviously different, the former were called *D papillata* and the latter were naturally called *blakei*, as the bare test of that species can only be distinguished with difficulty from that of *abyssicola*.

The specimens in the Iowa collection were taken as follows:

- Station 39. Florida: off Key West, 20 fms. 3 specimens.
 Station 54. Florida: about 15 miles off American Shoal Light, about 130 fms. Primary spines only.
 Station 56. Pourtalès Plateau, 24° 16' N. x 81° 22' W., about 200 fms. 1 specimen.
 Station 57. Pourtalès Plateau, 24° 18' N. x 81° 18' W., 200-225 fms. 10 specimens.
 Station 58. Pourtalès Plateau, 24° 19' N. x 81° 19' W., about 200-225 fms. 10 specimens.
 Station 62. Florida: about 8 miles off American Shoal Light, 70-80 fms. Primary spines only.
 Station 64. Florida: about 8 miles off American Shoal Light, about 110 fms. 1 specimen.

Stylocidaris affinis

Cidaris affinis Philippi, 1845. Arch. Naturg. 11, jhg. 1, p. 351. See Mortensen, 1903, *Ingolf Ech.*, pt. 1, pl. I, fig. 1.

Dorocidaris papillata A. Agassiz, 1872. Rev. Ech., p. 254 (*in part*); pl. I, fig. 5.

Stylocidaris affinis Mortensen, 1909. Ech. Deutsch. Südpolar-Exp., p. 52.

This species, notable as one of the very few echinoderms common to the Mediterranean and the West Indian region, is repre-

sented in the present collection by 14 specimens, most of which are however quite young. I am satisfied that Mortensen's institution of a new genus, *Stylocidaris*, for this species and its near allies is advisable and I am inclined to think that his suggestion that *affinis* hybridizes with *Tretocidaris bartletti* is worthy of serious examination. Several of the specimens in the series before me have distinctly banded spines as in *T. bartletti* but their pedicellariæ are those of *affinis*. They are however quite small and the banded spines may be merely a revelation of an ancestral character or they may indicate only individual diversity. The large specimen figured by me as *T. bartletti* (1907, Bull. M. C. Z. 51, pls. 8 and 9) which showed pedicellariæ in part like *bartletti* and in part like *affinis* is much more probably a hybrid, as Mortensen suggests.

As regards Dr. Mortensen's proposed species *Stylocidaris lineata* (1910, Bull. 74 U. S. Nat. Mus., p. 10), I have examined not only the series before me now, but the large series in the M. C. Z. collection, in the hope of confirming my Danish friend's judgment. I am obliged to say however that I do not find the characters given at all constant. The color is the best of these, and uniformly white specimens might perhaps bear the varietal name *lineata*, if the color in life is similar to that shown by the preserved specimens. If, however, there is more or less of a reddish tinge in life, the variety would be difficult to maintain. As regards the tuberculation of the ambulacra and the length of the radioles and tridentate pedicellariæ the light and dark colored forms are not separable.

In the "Narrative" (p. 173) this species is reported naturally as *Dorocidaris papillata* A. Ag. and is said to occur on the Pourtalès Plateau "in definite spots where there were innumerable individuals." These "repeatedly came up on the tangles by the hundred and became a sore trial to our patience, the serrated spines being especially difficult to disengage from the tangles. Indeed, this labor became one of our main occupations while on the Pourtalès Plateau." The specimens sent to me are from the following stations:

Station 4. Cuba: off Havana, 110 fms. 1 small specimen with banded spines.

Station 5. Cuba: off Havana, 140 fms. 3 specimens.

Station 27. Florida: off Key West, 50-60 fms. 2 small specimens with banded spines.

Station 39. Florida: off Key West, 20 fms. 2 specimens.

Station 57. Pourtalès Plateau, 24° 18' N. x 81° 18' W., 200-225 fms. 2 small, nearly white specimens.

Locality unknown. 4 specimens.

Tretocidaris bartletti

Dorocidaris bartletti A. Agassiz, 1880. Bull. M. C. Z., 8, p. 69.

Tretocidaris bartletti Mortensen, 1903. *Ingolf* Ech. p. 16. 1910, Bull. 74 U. S. Nat. Mus., pls. 2 and 3.

In the "Narrative," this handsome species is referred to as occurring both on the Pentacrinus ground, off Havana (p. 82) and on the Pourtalès Plateau (p. 173). It has been fully described and beautifully figured by Mortensen (*op. cit.*, 1910). Only two young specimens are in the collection sent to me.

Station 7. Cuba: off Havana, 140 fms. 2 specimens.

Histocidaris sharreri

Porocidaris sharreri A. Agassiz, 1880. Bull. M. C. Z., 8, p. 71. 1883, Blake Ech., pl. III.

Histocidaris sharreri Mortensen, 1909. Ech. Deutsch. Südpolar-Exp., p. 55.

Plate IV, Fig. 1

On p. 82 of the "Narrative," Professor Nutting says, in speaking of the Echini taken on the Pentaerinus ground, off Havanna: "Perhaps the handsomest species was *Porocidaris sharreri*, one specimen being a truly magnificent one, with spines about seven inches in length, and the peculiar serrated radioles resembling some of the ivory spear-heads used in Africa." On my writing Professor Nutting that two species have been confused under the name *Porocidaris sharreri* and inquiring about this specimen from the Pentacrinus grounds, he replied: "I am practically certain it is the true *P. sharreri*. We have the specimen here. It is one of those about which I wrote, saying that there were certain specimens in our exhibit series that it would be inconvenient to send and that I would have them photographed. This I have done and a very good

photograph was included in those recently sent you. You will see that the prominent primary spines are not smooth but jagged, with thorn-like processes. I remember very well the color of this specimen when fresh and it was that of the true *P. sharreri*. Had it exhibited the 'exquisitely tinted pink and apple-green' that you speak of*, I am sure I would have noted it." The photograph sent me shows that this specimen has much more slender spines than the individual figured in the *Blake* report but many of them flare and are fluted at the tip in characteristic fashion. The measurements of the specimen are approximately 60 mm. in test diameter, nearly 50 mm. in height, and 155 mm. in length of longest spine.

There can be no doubt then of the occurrence of this fine species off Havana, as well as off Georgia and off Barbados. There is no specimen in the series sent to me.

Salenia pattersoni

A. Agassiz, 1878. Bull. M. C. Z., 5, p. 187. 1883, *Blake Ech.*, pl. V.

Plate V

There are 12 specimens of this lovely sea-urchin taken on the Pentacrinus grounds, off Havana, but there is no label showing the exact station or depth. In the "Narrative" (p. 82) Professor Nutting says this "species, with spines banded with vermilion and white, is rendered still more attractive by bands of deep violet following the ambulacral furrows and outlining the plates of the apical system, the ground color being a dove or cream color."

Arbacia punctulata

Echinus punctulatus Lamareck, 1816. Anim. s. Vert., III, p. 47.

Arbacia punctulata Gray, 1835. Proc. Zool. Soc. London, p. 38. A
Agassiz, 1872. Rev. Ech., pl. II, fig. 4.

In the "Narrative" (p. 98), in speaking of the sea-urchins found at Bahia Honda, Cuba, Professor Nutting says: "*Arbacia punctulata* was the only other echinoid found here in abundance." This is remarkably interesting for the genus was not

*The colors in part of *Calocidaris micans*.

known from the southern or eastern side of the Gulf Stream, north of Tobago. It has long been supposed that *punctulata* does not occur in the West Indies, but that it ranges from Yucatan and the Tortugas, northward to Massachusetts. It is true that in the Revision, Mr. Agassiz refers to specimens from Hayti in the M. C. Z. collection but such specimens are not now to be found and it is quite possible that there is some mistake. In March and April, 1916, I was surprised to find *punctulata* at Buccoo Bay, Tobago; and later, I saw in the collection of Mr. R. J. L. Guppy, of Port-of-Spain, Trinidad, specimens which he had taken in the Gulf of Paria many years before. Mr. Guppy called my attention to the fact that the species was listed by him (as *Echinocidaris punctulata*) in 1895 in an article on the Echinoderms of the Gulf of Paria (Proc. Victoria Inst. Trinidad, pt. 2, p. 115).

Unfortunately the specimens of *Arbacia* sent me in the Bahaman collection are either from the Pourtalès Plateau of Florida, or have no locality label, and I have not yet seen therefore any authentic West Indian specimens from north of Tobago. The specimens with simply the label "West Indies" are probably from Bahia Honda but there is no direct evidence of the fact. They are notable for their very slender spines. The smallest is 16 mm. in diameter and has spines 20 mm. long and .80 mm. thick, while the largest is 25 mm. in diameter and has spines 22 mm. long and 1 mm. in diameter. In none of the five *Arbacias* before me is there an ocular plate insert.

Station 27. Florida: off Key West, 50-60 fms. 1 very young specimen.

Florida: The Tortugas, Sand Key. 1 specimen.

West Indies. 3 specimens.

Cœlopleurus floridanus

A. Agassiz, 1872. Rev. Ech., p. 102. 1883, *Blake Ech.*, pl. VII.

This very remarkable and very characteristic West Indian sea-urchin was met with by the Bahama Expedition on both sides of the Gulf Stream. Most of the specimens before me are quite small (under 20 mm. in test diameter) but one is fully grown and measures 44 mm. through the test; all of the pri-

mary radioles are broken but the longest piece remaining measures 57 mm. The smallest specimen is only 9 mm. in diameter but the radioles are 29 mm. long. Of the 13 specimens, 11 have 4 anal plates, 1 has 3 and 1 has 5. Both of these latter specimens are referred to by Professor Nutting in the "Narrative" (p. 83), where he speaks of this "beautifully colored species" which "made a pleasing display with its brilliant crimson and white spines." These individuals were taken on the Pentacrinus ground off Havana but the same species was found on the Pourtalès Plateau and of these, it is said (p. 173) they were "probably the most beautiful of the true sea-urchins collected at this time, some specimens being considerably larger than those secured off Havana. Not only are the long, slender spines brilliantly colored with carmine and white or orange, but the test itself is equally striking with its alternate chocolate and orange zones, making it resemble, the gorgeously colored balls in which children delight."

Station 5. Cuba: off Havana, 140 fms. 1 specimen.

Station 26. Florida: off Key West, 60 fms. 1 large specimen.

No label, but apparently Cuba: off Havana, Pentacrinus grounds, 110-200 fms. 11 specimens.

Centrechinus antillarum

Cidaris (Diadema) antillarum Philippi, 1845. Arch., Naturg., jhg. 11, 1, p. 355.

Diadema setosum A. Agassiz, 1872. Rev. Ech., p. 274. (*in part*).

It is of course to be regretted that the name *Diadema*, which has been in use for many years for this most common and easily recognized, and unfortunately most to-be-dreaded West Indian sea-urchin, must be abandoned, but there can be no doubt that Jackson (1912, *Phylogeny Ech.*, p. 27) was absolutely right in rejecting that preoccupied name and proposing the highly appropriate and euphonious name, *Centrechinus*, in its stead. Dr. Mortensen, whose opinion is entitled to more weight perhaps than that of any other student of echini, disagrees with me very decidedly on this point and refuses positively to give up *Diadema*. He holds strongly to the view that *Diadema* is one of those long-used names which should be arbitrarily maintained

by means of a list of *nomina conservanda*, adopted by international agreement. To this I should make no objection whatever and if it ever is done, I will cheerfully take up *Diadema* again. Meanwhile it seems to me that *Centrechinus* is the only correct name for this genus of long-spined, poisonous black sea-urchins.

Mr. Agassiz did not distinguish between the species of the East and West Indies, in the Revision, but later (1908, Mem. M. C. Z., 34 p. 112) he came to agree with Mortensen in recognizing half a dozen species, and in restoring Philippi's name to that of the West Indies.

This is unquestionably the most conspicuous and generally known of the West Indian sea-urchins but oddly enough it has never been adequately figured. The photographs of *Diadema setosum* given in the Revision are not taken from West Indian specimens. The little drawing (fig. 1) on the plate opposite p. 224 in the "Narrative", and labelled "*Aspidodiadema sp.*" gives as good an idea of the appearance of this sea-urchin in life as any figure I can find. This figure is a life-size drawing of a young *Centrechinus*; and except for the banded spines would, if magnified three or four times, represent the adult equally well. It is an interesting fact that the young of this species always have the spines prettily banded with purplish-violet and white. They thus look very unlike the adults and it is not strange that they are often mistaken for a different species. In the "Narrative" (pp. 83, 223) these pretty little long-spined urchins are referred to as *Aspidodiadema* of uncertain species. The specimens in the collection sent me are also labelled *Aspidodiadema*. These young specimens of *Centrechinus* are referred to in the "Narrative" as occurring at the *Pentacrinus* ground off Havana (p. 83) and near Little Cat Island, Bahamas (p. 223). Adult examples were found at Egg Island, Bahamas (p. 45), the Tortugas, Florida (p. 132) and at Spanish Wells, Eleuthera Island, Bahamas (pp. 202, 213). Professor Nutting's field notes on the very painful stinging powers of the spines (p. 132) and of the possible use of the jaws in rock-boring (p. 213) are of great interest and value but are too extended to warrant repetition here. The specimens of *Centrechinus* in the Iowa collection are as follows:

Bahamas: Little Cat Island. 4 small specimens, 16-25 mm. in diameter, with banded spines 50 mm. long.

Bahamas: Eleuthera Island, Spanish Wells, 2 adults.

Bahamas: no definite locality, 1 adult.

No locality label. 5 small specimens, 10-18 mm. in diameter, with banded spines, 22-30 mm. long.

Aræosoma fenestratum

Calveria fenestrata Wyville Thomson, 1872. Proc. Roy. Soc. London, 20, p. 494.

Asthenosoma hystrix A. Agassiz, 1883. Blake Ech., pls. XIII and XIV.

Araeosoma fenestratum Mortensen, 1903. Ingolf Ech., pt. 1, p. 52.

Plate IV, Fig. 2

In the "Narrative" (p. 173), there is an interesting account of the capture of an adult specimen of this remarkable sea-urchin on the Pourtalès Plateau in 105 fms., which is referred to as "the largest sea-urchin secured during the entire cruise." "This specimen was seven inches across the test and was swollen out, when it came on deck, to the regulation out-line of a sea-urchin." It was soon discovered "that it was not an animal to be handled with impunity, as its spines, although small, were exceedingly sharp and inflicted a wound so painful as to suggest some poisonous properties. The specimen was of a dull vinaceous color."

A photograph of this specimen, now 6 inches in diameter and 2 inches high, has been sent me but I have not seen the specimen. I have no doubts however of the identification.

There is, in the collection before me, a very young echinothurid, labelled "*Phormosoma placenta*" but with no locality indicated, which I think is the young of this species. It is only 22 mm. across and is somewhat damaged but there is little doubt it is an *Aræosoma*. The spines of the upper surface are notably long and relatively more numerous than in larger specimens and the color is rusty-red. This color, however, may have been artificially produced, after preservation.

Cænopedina cubensis

A. Agassiz, 1869. Bull. M. C. Z., 1, p. 256. 1872, Rev Ech., pl. III, figs. 1-7 (as *Hemipedina cubensis*).

The Bahama Expedition was so fortunate as to secure two specimens of this very rare sea-urchin. One of these (St. 58) is an unusually fine specimen, 22 mm. in diameter; the primary spines are 27 mm. long but all are broken at the tip; they are of a yellow-green color while all the smaller ones are white. This is the largest specimen I have seen but Koehler (1909, *Princesse-Alice* Ech., pl. 1, fig. 1) gives a fine colored figure of a specimen about 35 mm. in diameter, with primary spines 66 mm. long. The second specimen secured by the Bahama Expedition is only 13 mm. in diameter and has lost all of its spines.

This species is not referred to in the "Narrative" of the expedition, and there are few references to it elsewhere in literature. It is not included in the *Blake* report among the echini taken by the *Blake* but there is a small specimen in the M. C. Z. taken at *Blake* St. 320, off Georgia, in 257 fms. According to Verrill (1885, *Albatross* Expl., p. 49) the *Fish-Hawk* took a specimen in 1882 off the eastern coast of the United States in 194 fms. The only station occupied by the *Fish-Hawk* in 1882, with a depth of 194 fms. was near Nantucket. The *Princess-Alice* took one specimen in 1901 near the Canary Islands in 610 fms. and two specimens in 1902 near the Azores Islands in 659 fms. Evidently the species is widespread in the North Atlantic but in much deeper water on the eastern side than near the American coast.

In my key to the species of *Cænopedina* (1912, Mem. M. C. Z., 34, p. 217) there is a very unfortunate *lapsus calami* which vitiates one of the distinctions between *C. cubensis* and *C. indica*. The comparison made between "actinostome" and "periproct" should be between actinostome and the *entire abactinal system*. In *cubensis*, the actinostome is distinctly smaller than the abactinal system, while in *indica* they are of about equal size.

The Bahama Expedition took *cubensis* at the following places:

Station 58. Florida: on the Pourtalès Plateau, $24^{\circ} 19' N.$ x $81^{\circ} 19' W.$, about 200-225 fms. 1 fine specimen.

Locality unknown, 1 bare test.

Echinus gracilis

A. Agassiz, 1869. Bull. M. C. Z., 1, p. 269. 1872, Rev. Ech., pl. VIa, fig. 6.

This is one of the characteristic species of the Pourtalès Plateau, where, Professor Nutting says (p. 174) it is, next to *Stylocidaris affinis*, the most abundant species of sea-urchin. He also says it is the largest species from the region, except *Araeosoma fenestratum*. All the specimens sent to me however are small, ranging from 6 to only 24 mm. in diameter. They are of great interest, nevertheless, as showing the changes which take place during growth in this very handsome species. The changes in color are of course the most obvious. The smallest specimen is nearly all white but the genital plates and the three or four uppermost interambulacral plates show sufficient green (dull olive in dried specimens) to form a more or less distinct star on the center of the abactinal surface. In slightly larger specimens the *inner* ends of the uppermost ambulacral plates are green and in specimens 10 mm. in diameter the green has extended to the ambitus; in the interambulacra, the upper part and both ends of each plate are more or less fully and deeply green, while in the ambulacra, the green occupies all the inner half of each plate, leaving the primary tubercle and poriferous area white. The ocular and genital plates are more or less variegated with green but the periproctal plates as a rule remain white; occasionally they too are greenish however. This is essentially the coloration of the adult, though the green may in large specimens extend well down onto the actinal surface.

There is little change in the ambulacra during growth, the adult plates remaining remarkably primitive, and the plating of the peristome remains about the same in the larger specimens as it is in the smallest. But the relative size of the peristome decreases rapidly as is usual in the genus *Echinus*. Thus the specimen 6 mm. in diameter has a peristome 3.5 mm. across or nearly .60 of the test; one 10 mm. in diameter has the peristome 5 mm. or .50; one 17 mm. has the peristome 7 mm. or only a

little over .40; and the largest, 24 mm. has a peristome only 8 mm. or .33. Large specimens have the peristome often under .30 of their horizontal diameter.

Another interesting growth change is in the plating of the periproct. In the smallest specimen, the suranal plate covers the periproct almost completely, just as it does in adult *Genocidaris maculata*. In specimens a little larger, there are three other periproctal plates; the four plates have the relative size and position of those in adult *Trigonocidaris albida*, though the suranal may be relatively larger. In a specimen 8 mm. in diameter, there are eight periproctal plates, but the suranal is much the largest. The number of plates then increases and the relative size of the suranal decreases until, in a specimen 17 mm. in diameter, there are 14 plates and the suranal covers only about one-fourth of the periproct. In the adult (43 mm. in diameter), there are about twenty plates and except for its position the suranal is scarcely distinguishable.

The specimens in the Iowa collection were taken at the following places:

Station 57. Pourtalès Plateau, 24° 18' N. x 81° 18' W., 200-225 fms. 29 specimens.

Station 58. Pourtalès Plateau, 24° 19' N. x 81° 19' W., about 200-225 fms. 1 specimen.

Station 64. Florida: off American Shoal Light, 110 fms. 1 specimen.

Locality unknown. 11 specimens.

Lytechinus euerces

H. L. Clark, 1912. Mem. M. C. Z., 34, p. 247; pl. 107, figs. 4-6.

It is interesting to find half a dozen specimens of this species in the Iowa collection but it is most unfortunate that there is no locality label, so there is no clue to the depth at which they were taken. As they were mixed with *Trigonocidaris albida*, *Echinus gracilis* and *Genocidaris maculata*, it is fairly certain that they were collected with those three species on Pourtalès Plateau. They are all young, the test-diameter being only 10-15 mm. For the differences between this species and those with which it occurs see below (p. 33) under *Genocidaris*.

Lytechinus variegatus

Cidaris variegata Leske, 1778. Add. ad Klein, p. 85.

Lytechinus variegatus A. Agassiz, 1863. Bull. M. C. Z., 1, p. 24.

Toxopneustes variegatus A. Agassiz, 1872. Rev. Ech., pt. 1, p. 298; pl. IVa, figs. 5, 6.

This, the most abundant of West Indian echini, except perhaps *Centrechinus*, is represented in the collection before me by only 7 specimens, 3 small adults from Bahia Honda, Cuba, and 4 young without locality but evidently from the Cuban coast also.

Lytechinus variegatus carolinus

Lytechinus carolinus A. Agassiz, 1863. Bull. M. C. Z., 1, p. 24. 1872, Rev. Ech., pl. II, figs. 5, 6 (as *Toxopneustes variegatus*).

Lytechinus variegatus carolinus H. L. Clark, 1912. Mem. M. C. Z., 34, p. 245.

It is rare indeed that trinomials, indicating geographical subspecies, can, in the present state of our knowledge, be used among echinoderms, but *Lytechinus variegatus* is a remarkably clear case. Specimens from the northern and western sides of the Gulf usually have the spines so much stouter and shorter, relatively, than those of the specimens from Cuba, Jamaica and eastward, and their color is so pink that they look very different. But intergradations are so common and indubitable that the relation is best shown by trinomials. A third form (*atlanticus*) is well differentiated in the Bermudas.

The Iowa collection contains five small, poor specimens of this subspecies, ranging in disk diameter from 6 to 10 mm. The locality is not indicated, except that two are labelled "West Indies." They are all probably from the Tortugas.

Tripneustes esculentus

Cidaris esculenta Leske, 1778. Add. ad Klein, p. XVII.

Hipponoë esculenta A. Agassiz, 1872. Rev. Ech., p. 301; pl. VIa, figs. 1-3.

Tripneustes esculentus Bell, 1879. Proc. Zool. Soc. London, p. 657.

Of the 7 specimens of this common species, only one deserves any comment. It is one of the smallest specimens of this big "sea-egg" (the West Indian native name) which I have ever

seen. It is about 7 mm. in diameter and 4 mm. high and is denuded of all its spines. The peristome is relatively very large as it is about 3.75 mm. across; except for the primordial ambulacrals it is almost completely free from plates. The abactinal system is less than 3 mm. across but ocular I is broadly insert. The ambulacra are very simple and quite echinoid with the pores in regular arcs of 3; the only peculiarity is that, above the ambitus, every other primary ambulacral tubercle on each side is distinctly smaller or may even be suppressed.

In the "Narrative", this species is referred to as occurring at the Tortugas (p. 133) where it is said to be "much larger" than in the Bahamas. In the latter region, it is referred to as occurring at a flat bar near the mainland of Eleuthera (p. 202) and at Spanish Wells (p. 213). On pp. 213 and 214, Professor Nutting records some very interesting and important observations which go to show that this sea-urchin exercises "choice" and has at least a rudimentary "memory."

Bahamas: Eleuthera Island, Spanish Wells. 4 adult specimens.

Bahamas: Eleuthera Island, Harbor Island. 2 adult specimens

Locality unknown. 1 very small specimen.

Trigonocidaris albida

A. Agassiz, 1869. Bull. M. C. Z., I, p. 263. 1872, Rev. Ech., pl. IV, figs. 1-7.

In the "Narrative" (p. 174) Professor Nutting speaks of this pretty little sea-urchin being abundant on the Pourtalès Plateau. There are nearly a hundred specimens in the collection but the great majority lack a locality label. There is no doubt however that they are from the Pourtalès Plateau. They range in diameter from 6 to 13 mm., the latter being about the maximum size for the species. The growth changes after the diameter is 6 mm. seem to be very slight. Even the peristome shows only a small relative decrease; it is 3 mm. across (50%) in the smallest specimen and 5.5 mm. (42%) in the largest. The amount of sculpturing on the test does not seem to vary

with age or size, but is subject to very great individual diversity.

As this little echinoid is known not only from the West Indian region but from the Hawaiian Islands and Dutch East Indies as well as from the eastern Atlantic, it seems to have a world wide distribution in the tropics.

Station 54. Florida: 15 miles off American Shoal Light, about 130 fms. 2 specimens.

Station 57. Pourtalès Plateau, $24^{\circ} 18' N.$ x $81^{\circ} 18' W.$, 200-225 fms. 7 specimens.

Station 64. Florida: about 8 miles off American Shoal Light, about 110 fms. 1 specimen

Locality unknown. 84 specimens.

Genocidaris maculata

A. Agassiz, 1869. Bull. M. C. Z., I, p. 262. 1872, Rev. Ech., pl. VIII, figs. 1-18.

This species occurs in abundance on Pourtalès Plateau ("Narrative" p. 174) and was also found on the Pentacrinus ground near Havana (p. 83). The range of this little urchin is remarkable, extending across the Atlantic and far into the Mediterranean, and southward on the African coast to the region of the Congo. The specimens in the Iowa collection are nearly all from an unknown locality, presumably some station or stations on the Pourtalès Plateau. They range in size from 3 to 12 mm. diameter. The growth changes between these two extremes are not remarkable, the peristome decreasing only from 50 per cent to about 45 per cent. Even in the largest the periproct is practically all covered by the single suranal plate. The general coloration is more or less light greenish abactinally, becoming nearly pure white below. In some individuals, there is a more or less elongated blotch of light purplish-brown, in each interambulacrum near the abactinal system; this may extend to the ambitus or there may be a second blotch at the ambitus. In many individuals these, and other scattered blotches, are distinctly green in tint. These blotches, from which the specific name, *maculata*, arises are rarely absent even in very young specimens. In the larger specimens, the basal part of all the

primary spines above the ambitus is distinctly pink and most of the larger primaries have one or two bands of brownish-pink at the middle or distally; these bands are however very faint and might easily pass unnoticed.

This species and the preceding are so easily confused with the young of *Echinus*, *Lytechinus* and even *Tripneustes* that the following key will be useful to those who have occasion to sort small West Indian echini. It is based largely upon the material before me in the Iowa collection.

Buccal membrane thin and perfectly naked or at most with widely scattered calcareous granules, in addition to the five pairs of buccal plates.

Periproct covered almost wholly by the huge suranal plate; ocular plates all exsert; general tint of coloration greenish *Genocidaris maculata*

Periproct with many small plates and no conspicuous suranal; ocular I insert; general tint pinkish or pure white..... *Tripneustes esculentus*

Buccal membrane usually heavily plated or at least with numerous plates in addition to the buccal plates

Abactinal system large (about .40 test diameter), flat, smooth and shining; ocular plates equally exsert; periproct covered by 4 plates, the suranal distinctly largest; test depressed and usually more or less sculptured *Trigonocidaris albida*

Abactinal system smaller (.30-.35 test diameter), not flat, smooth and shining; ocular I often nearly or quite insert; periproct with 6 or more plates; test not depressed and never sculptured.

Buccal membrane not heavily plated but with numerous small thin plates; green color in ambulacra abactinally, confined to inner side of the series of primary tubercles, the whole inner end of each plate being more or less green; ocular I never insert..... *Echinus gracilis*

Buccal membrane heavily plated; ocular I often insert or more nearly so than the others.

Test white and light yellow-green, the green color in ambulacra abactinally, confined to outer side of the series of primary tubercles *Lytechinus euerces*

Test white and green, but the color in ambulacra occupies more or less nearly all the plates *Lytechinus variegatus*

Test pinkish or pale brown, with no indications of green *Lytechinus variegatus carolinus*

Some of the differences in the above key may seem trivial but they are surprisingly constant. Of course there are additional and often much more important differences than those here given; these are selected because they are so easily seen. The most common confusion is between *Trigonocidaris* and *Lytechinus euerces* and specimens of equal size, especially if under 10 mm. in diameter are often hard to distinguish. But the flattened and sculptured test of *Trigonocidaris*, with its large shiny abactinal system and 4 periproctal plates are generally distinctive. There may be added however, as additional features, the lack of any distinct green in the coloration and the fact that the white actinal spines are commonly encircled with a broad red band. Very small specimens of *euerces* have no green in the coloration but there is little or no red on the actinal spines. The pretty coloration of *Echinus gracilis* is very distinctive even in young specimens. Probably *Genocidaris* is the most easily recognized of the small echini; the huge suranal plate, together with the distinctive coloration, the test-sculpture and the naked buccal membrane, make it a well-marked form. The specimens of *Genocidaris* in the Iowa collection are from the following places:

Station 27. Florida: southeast of Sand Key Light, 50-60 fms.
1 specimen.

Station 48. Florida: southeast of Key West Light, about
80 fms. 1 specimen.

Locality unknown. 112 specimens.

Echinometra lucunter

Echinus lucunter Linnè, 1758. Sys. Nat. ed. 10, p. 665.

Echinometra subangularis A. Agassiz, 1872. Rev. Ech., p. 283, pl. Xa, figs. 2-4.

Echinometra lucunter Lovén, 1887. Ech. Linnæus, p. 157.

This very common sea-urchin is only mentioned twice in the "Narrative", where it is spoken of as being found at the Tortugas (p. 133) and on Pourtalès Plateau (p. 174) in shallow water. The specimens before me are from the following places:

Bahamas: Eleuthera, Harbor Island, 1 specimen.

Bahamas: Little Cat Island. 1 specimen.

Florida: The Tortugas, Sand Key. 5 specimens.

"West Indies." 7 specimens.

Echinometra viridis

A. Agassiz, 1863. Bull. M. C. Z., I, p. 22. 1872. Rev. Ech., pl. Xa, fig. 1,

It is unfortunate that Mr. Agassiz's figure represents the less common thick-spined variety of this rather uncommon species. On the reefs at the Tortugas, the differences between *viridis* and *lucunter* are very marked and no collector familiar with sea-urchins would confuse them. But after the colors have become dull and faded, the differences are less marked and in photographs the two species might easily be mixed. In the number of pore-pairs in an arc however, the two are constantly different and in photographs as good as those on plate X a of the Revision this difference is easily seen with a lens. In life, *viridis* is light brown, usually with a yellowish tinge but not uncommonly reddish; the primary spines are pale brownish at base, rapidly becoming greenish and quite evidently green distally, but tipped rather abruptly with bright purple; the very tip of the spine is sometimes whitish in marked contrast to the purple; the milled ring at the base of the spine is conspicuously white. The largest specimen of *viridis* I have seen is 42 mm. long and 36 mm. wide; it is the stout-spined form, the primaries being only 18 mm. long and fully 2 mm. thick while in the usual form, spines 18-20 mm. long are only about 1 mm. thick. At the ambitus, there are 5 pore-pairs in an arc, but below, there are only 4; abactinally, clear to the ocular plate, there are but 5 pairs in each arc. This arrangement of pore-pairs is characteristic of the species and is well shown in much smaller specimens. In *E. lucunter*, on the contrary, the full number of pore-pairs is 6 and if (in a small individual) there are only 5 pairs at the ambitus, some of those above the midzone will show the characteristic 6. There is only one specimen of *viridis* in the Iowa collection and it was taken at the Tortugas. The species is known only from Florida, Jamaica and Hayti. I did not find it at Tobago in 1916, although particular search was made for it.

Clypeaster rosaceus

Echinus rosaceus Linné, 1758. Syst. Nat. ed. 10, p. 665.

Clypeaster rosaceus Lamarck, 1801. Syst. Anim. s. Vert., p. 349.

Echinanthus rosaceus A. Agassiz, 1872. Rev. Ech., p. 311; pl. XI *d*, figs. 1 and 2.

In the "Narrative", this species is referred to as abundant on the Great Bahama (p. 53) and as "found in limited numbers" near Bird Key, Tortugas (p. 133). There are two large specimens in the collection labelled Bahama Banks, May 17, 1893.

Clypeaster subdepressus

Echinanthus subdepressa Gray, 1825. Ann. Phil., 26, p. 427.

Clypeaster subdepressus Agassiz, 1836. Mem. Soc. Sci. Nat. Neuchatel, 1, p. 187. A. Agassiz, 1872. Rev. Ech., pl. XI *b*.

No specimen of this large clypeaster is in the collection, but in the "Narrative" (p. 174), Professor Nutting says that it was dredged on Pourtalès Plateau in 60 fms. It may be well to note here that while *C. rosaceus* and *C. subdepressus* are the common West Indian clypeasters, there are now recognized at least *four* other species in the West Indian region. Little however is known of either their distribution or growth changes and specimens of all are much to be desired. An artificial key to the Recent species of *Clypeaster* is to be found in Mem. M. C. Z., 46, pp. 22-25.

Palæotropus josephinæ

Loven, 1872. Oefv. Vet. Akad. Förh. f. 1871, no. 8, p. 21. A. Agassiz, 1883. Mem. M. C. Z., 10, p. 53; pl. XXIII, figs. 5-14; also pl. XXIV, figs. 6-15 (as *Palæobrissus hilgardi*).

Although the collection contains but a single specimen of this uncommon spatangoid, the "Narrative" (p. 174) refers to its occurrence on Pourtalès Plateau in 110-220 fms. as though it were met with more than once. The specimen at hand is nearly bare, 20 mm. long, and has a distinct subanal fasciole and only 2 genital pores. It is thus still immature, as the adult, originally described as *Palæobrissus hilgardi*, has 4 genital pores, no subanal fasciole and is over 45 mm. long. The growth changes

in this species are most interesting and a large series of specimens is greatly to be desired.

Station 52. Florida: about 10 miles off American Shoal Light, 105-110 fms. 1 specimen.

Meoma ventricosa

Spatangus ventricosus Lamarck, 1816. Anim. s. Vert., 3, p. 29.

Meoma ventricosa Lütken, 1864. Vid. Med. f. 1863, p. 120 A. Agassiz. 1872, Rev. Ech., pl. XXII, figs. 3 and 4.

This conspicuous West Indian spatangoid is not mentioned in the "Narrative" but there is a large, bare test in the collection, from Eleuthera Island, Bahamas. It measures 160 mm. long, 125 mm. wide and 77 mm. high. This is an unusually large size but by no means the maximum. The largest specimen I have seen (M. C. Z. no. 3159) is 175 mm. long, 152 mm. broad and 90 mm. high.

Plagiobrissus grandis

Echinus grandis Gmelin, 1788. Sys. Nat. ed. 13, 1, pt. 6, p. 3200.

Metalia pectoralis A. Agassiz, 1872. Rev. Ech., p. 361; pl. XXI, figs. 4 and 5.

Plagiobrissus grandis H. L. Clark, 1917. Mem. M. C. Z., 46, p. 207.

There is no specimen of this truly magnificent spatangoid, common in some parts of the Bahamas, in the Iowa collection, but in the "Narrative" (p. 134) it is stated that "a portion of the test of a *Metalia* was picked up near Bird Key." The species is not otherwise known from the Tortugas but as it is known from the west coast of Florida (Tampa Bay), it will probably be found there some day.



Endoxocrinus parræ (x $\frac{1}{2}$)

PLATE III.



Fig. 1 *Isocrinus asteria* ($\times\frac{1}{2}$)

Fig. 2 Very young specimen of *Isocrinus decorus* ($\times\frac{3}{2}$)

Fig. 3 Same specimen ($\times 1$)

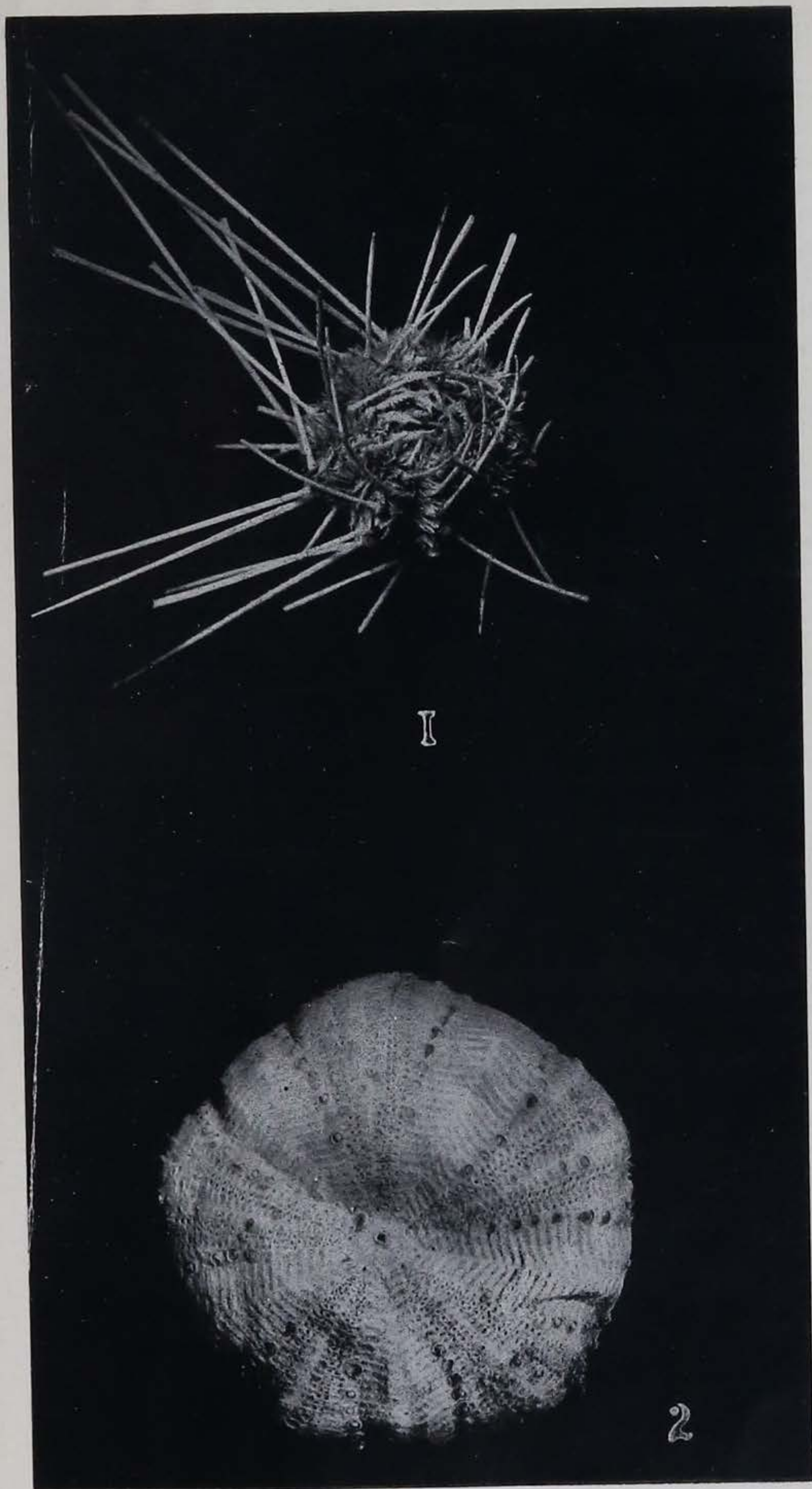


Fig. 1 *Histocidaris sharreri*, oral view (x2/5)

Fig. 2. *Aræosoma fenestratum*, aboral view, without spines (x1/3)

PLATE V.



Salenia pattersoni, oral view (x2)

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