NOTES ON BERMUDA ECHINODERMS.

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THE collection of echinoderms made in Bermuda in the summer of 1897 by the New York University party, has been very kindly placed in my hands by Professor Bristol, for examination. Although the collection is in itself a small one, it is of no little interest, as our present knowledge of the echinoderms of Bermuda is very incomplete. So far as I can discover, no attempt has hitherto been made to prepare a complete list of them, so that it has seemed worth while to add to the species in the New York University collection, others which have previously been recorded from the islands, thus making as far as possible a catalogue of the littoral echinoderms of Bermuda. In 1888, Professor Heilprin, of the Philadelphia Academy of Sciences, published in the *Proceedings* of that Academy, a list of the echinoderms, which he and a party of students had collected in Bermuda that summer. The list contains twenty species, six holothurians, six echinoids, six ophiurids and two asteroids. Of the six holothurians, four are described as new to science. The New York University collection contains only eleven species, but of these at least three are additions to Professor Heilprin's list. The principal interest of the collection, however, lies in the light which it throws on Professor Heilprin's "new" species of holothurians, and on one of Professor Verrill's species of starfish.

There are only two species of ASTEROIDS in the collection, but both are of interest. One of them, of which ten specimens lie before me, is the common starfish of the Bermudas. One of its peculiar features is the great variation in the number of arms, one specimen having nine, five having seven and the other four

six, while Professor Heilprin reports having found one or two specimens with only five. The specimens I have agree in every particular with the most careful descriptions of *Asterias tenuispina* Lamk., from the Mediterranean and eastern Atlantic, and, I have no doubt, belong to that species. Verrill has separated the *Asterias* of Bermuda from *A. tenuispina* as *A. atlantica*, on the ground that the proportions of the arms are slightly different and that there are no large single pedicellariæ. Sladen, in his report on the starfishes of the "Challenger" collections, identifies the only *Asterias* from Bermuda as *A. tenuispina* and questions the authenticity of Verrill's species. In the specimens before me the proportions of the arms vary considerably and large single pedicellariæ occur in the ambulacral furrow as in *A. tenuispina*. Accordingly it would appear that *A. atlantica* must be regarded as a synonym of that species. In several of the New York University specimens the prominent spines on the upper surface are rather unusually colored, being strongly tinged with violet. The other starfish, of which there are five specimens in the collection, is *Asterina folium* Ltk., a small pentagonal species found closely adhering to the under side of broken pieces of rock. They are very light colored, almost white, but one is strongly tinged with blue. They agree in all particulars with specimens of the same species from Jamaica.

The two OPHIURIDS are of no especial interest, though one of them has not previously been taken in Bermuda. This is *Ophiura appressa* Say, of which there are three specimens in the collection. They were kindly identified for me and compared with Jamaica specimens by my friend, Mr. Caswell Grave, of the Johns Hopkins University. Of the other species, *Ophiomeris reticulata* Ltk., there is a large number of specimens. It seems to be the common brittle-star of the islands.

The four ECHINOIDS are all reasonably common in suitable places, Professor Bristol tells me, and have all been recorded from Bermuda before. They are *Diadema setosum* Gray, *Echinometra subangularis* Leske, *Hipponoë esculenta* Leske and *Toxopneustes variegatus* Lamk. Anyone familiar with the latter urchin as it appears in Jamaica or along our southern coast would never recog-

nize it in these handsome specimens from Bermuda. A close examination, however, shows that the great difference in color is only one of degree. Specimens from Jamaica are green with white markings and with whitish or greenish spines, the latter being often tipped with violet. Now in the Bermuda *Toxopneustes*, violet has become the predominant color, so that all trace of green and white variegation has disappeared. The test has become very dark and the spines are a bright purple violet. This tendency towards violet coloration of spines has already been mentioned in connection with the starfish, *Asterias*, and it is also quite marked in one of the other sea-urchins, *Echinometra*. Specimens of this form from Jamaica are usually reddish-brown of some shade but the spines are often greenish, tipped with violet. Bermuda specimens show this violet coloration of the spines much more plainly. It would be interesting to know what may be the cause of this tendency toward violet among the Bermuda echinoderms; but I have no explanation to offer.

There are only three species of HOLOTHURIANS in the collection but all of these are of considerable interest because of the light which they throw on the "new" species described by Professor Heilprin. Professor Bristol's students report that there are two large species of *Stichopus* common at the Bermudas, and that they are readily distinguishable from each other. This statement agrees with Professor Heilprin's, who has described and figured each of them as a new species. One of them is black and was called *S. diaboli*, but I am sorry to say that of this species there is not a specimen in the collection before me. The other one is less common, is markedly different in color, and was given the name *S. xanthomela* Heilprin. Of this species, I have two specimens in hand, one of which agrees perfectly in color with Professor Heilprin's description, while the other is much darker. It needed but a glance to see that they are the common West Indian form of *Stichopus*, though what that form is to be called it is not easy to decide. A more careful examination of the Bermuda specimens has shown that they agree in all particulars with specimens from Jamaica. After a careful examination of hundreds of specimens of *Stichopus* from Jamaica, both living

and alcoholic, I am convinced that specific differences cannot be distinguished in this genus with any accuracy except in living specimens, and furthermore that coloration is so variable that it is almost useless as a standard in classification. Four species of *Stichopus* have been described from the West Indian area, all of them from alcoholic material, by men who have never visited the West Indies, and they are separated from each other by characters which are seen in a large series of specimens to intergrade in inextricable confusion. For the present however, the commonest West Indian species may bear the name *S. möbii*, bestowed by Semper, and Heilprin's *S. xanthomela* is doubtless the same. According to the latter the Bermuda form has eighteen tentacles, but both of the specimens before me have twenty, while one Jamaica specimen has nineteen and another twenty-one. The normal number of tentacles in *Stichopus* is however twenty, and any other number is merely an individual peculiarity.

The second species of holothurian from Bermuda in my hands is a small one, occurring under broken slabs of rock, and of this there are six specimens. I have compared them with more than a dozen species of small holothurians collected in Jamaica in similar situations, but they do not agree with any of them satisfactorily. After some hesitation, I have decided to refer them provisionally to Ludwig's *Holothuria surinamensis*, as they approach nearest to that species, though the differences are pretty clearly marked. I think it probable that a larger series of specimens will show the Bermuda form to be a new species. Professor Heilprin collected five specimens of a small holothurian, which he refers to *H. floridana* Pourt., but neither in his description nor his plate does he refer to the small rosette-like calcareous bodies, so characteristic of that species and its allies. If they are not present in his specimens, I should think it at least possible that these are the same species as the ones before me. The last of the three species in the New York University collection is obviously either a *Thyrne* or a representative of that section of *Cucumaria* to which Lampert gave the name *Semperia*. There are two specimens about 6 cm. long and agreeing in all particulars with each other. After a careful

examination I refer them without hesitation to Ludwig's *Cucumaria punctata*, described from a specimen collected in Barbadoes. In a few details they differ from that species: the color being apparently different, the stone canal free, only one polian vessel, and the anus armed with five small calcareous teeth. The calcareous buttons are so numerous in some places that the skin is very hard, the layer of buttons being .4 mm. thick. Professor Heilprin describes from a single specimen a new species of *Cucumaria* which he calls *Semperia bermudiensis*. While I have no way of proving that this is the same species as the specimens before me, the differences which he points out between it and Ludwig's *C. punctata* do not seem to me important, and I strongly suspect that *S. bermudiensis* Heilp. ought to be put down as a synonym of *C. punctata* Ludw. I am at a loss to understand what Professor Heilprin means by the "long back processes" of the calcareous ring "for the attachment of the powerful retractor muscles." So far as I know the retractor muscles of *Cucumaria* and *Thyrne* are never attached to the *posterior* prolongations of the radial pieces of the calcareous ring but always to *anterior* prolongations. The latter are quite long in *Cucumaria punctata*.

In the light of these facts, I append the following revised list of the littoral echinoderms of Bermuda, as complete as I have been able to make it. It does not pretend to include the deeper water species collected in the vicinity of the islands by the "Challenger."

CATALOGUE OF THE LITTORAL ECHINODERMS OF BERMUDA.

ASTEROIDS.

1. **Asterias tenuispina** LAMK. = *A. atlantica* Verrill. Common. Collected by all parties.
2. **Asterina folium** LTK. Not very common. One specimen collected by the "Challenger" and five by the New York University party.

3. *Linckia guildingii* GRAY. Apparently not common. Recorded by Sladen in the "Challenger" report and by Professor Heilprin.

OPHIURIDS.

4. *Ophiactis mulleri* LTK. Two specimens collected by the Philadelphia party.

5. *Ophiocoma crassispina* SAY. One specimen taken by the Philadelphia party.

6. *Ophiocoma pumila* LTK. Collected by the "Challenger" and by the Philadelphia party.

7. *Ophiomyxa flaccida* LTK. One specimen taken by the Philadelphia party.

8. *Ophionereis reticulata* LTK. Abundant. Recorded by all parties.

9. *Ophiostigma isacantha* SAY. Two specimens taken by the Philadelphia party,

10. *Ophiura appressa* SAY. Three specimens taken by the New York University party.

ECHINOIDS.

11. *Cidaris tribuloides* BL. Reported common by the Philadelphia party.

12. *Diadema setosum* GRAY. Common. Collected by all parties.

13. *Hipponoe esculenta* LESKE. Not uncommon. Collected by all.

14. *Echinometra subangularis* LESKE. Common. Collected by all.

15. *Toxopneustes variegatus* LAMK. Common. Collected by all.

16. *Mellita sexforis* AG. Said to be common, but not actually collected by either the Philadelphia or New York parties. Recorded from Bermuda by Agassiz.

17. *Echinoneus semilunaris* LAMK. Reported from Bermuda by Agassiz in his "Revision of the Echini" and in the "Challenger" report.

18. *Brissus unicolor* KL. Reported from Bermuda by Agassiz.

HOLOTHURIANS.

19. *Cucumaria punctata* LUDW. Two specimens collected by the New York University party.

20. *Cucumaria* (*Semperia*) *bermudiensis* HEILP. A very doubtful species described from a single specimen taken by the Philadelphia party.

21. *Holothuria floridana* POURT. Five specimens collected by the Philadelphia party.

22. *Holothuria captiva* LUDW. Two specimens collected by the Philadelphia party.

23. *Holothuria abbreviata* HEILP. A very doubtful species described from a single specimen, probably an abnormal individual of the preceding species, collected by the Philadelphia party.

24. *Holothuria surinamensis* (?) LUDW. Six specimens, collected by the New York University party, are referred to this species with much hesitation.

25. *Stichopus diaboli* HEILP. Reported as very common.

26. *Stichopus möbii* SEMPER. = *S. xanthomela* HEILP. Reported as quite common.

27. *Stichopus haytiensis* SEMPER. Reported from Bermuda by Dr. Theél from a single specimen collected by the "Challenger." I am inclined to think it may be the same species as the preceding.

28. *Synapta vivipara* OERST. Recorded from Bermuda by Dr. Theél in the "Challenger" report under the name *S. picta*. Dr. Theél also has numerous other specimens from the Bermudas.

Of the above twenty-eight species, four or five of the holothurians are in doubt, so that the need of larger and more complete collections is very obvious. Of the remaining twenty-two or three species, all but one or two are distinctly West Indian, so that it is only fair to expect the discovery of many more, by more careful and systematic collecting.