proof of a fusion of the watervascular system of the two specimens which was not to be expected either.

As far as I know, this case has not before been mentioned to occur among Holothurians in nature. Something similar has been noted by Monticelli who, in the aquarium, has seen two pieces of skin from *Cucumaria planci* (Brandt) fuse together.

The fact that the coalesced specimens are in different positions to one another, as seen in the figure, is in good accordance with the way in which the coalescence occurs, the position in which the specimens attach themselves being, of course, quite accidental.

III.

The species *Actinopyga parvula* (Sel.) is stated to have a remarkably wide distribution. Théel („Challenger" Holothurioidea, p. 199) gives only the type locality, Florida, but in later works it is recorded from various places in the Pacific (Fisher, Erwe, Bedford). At the same time the species *Mülleria flavo-castanea* Théel from Madeira is made a synonym of *parvula*. Théel himself is of opinion that perhaps the *flavo-castanea* is the adult *parvula*, and later on all authors have taken this as a fact.

Already from a geographical point of view this distribution seems remarkable enough to arouse suspicion as to the identifications. Of course, such a cosmopolitan distribution cannot beforehand be denied, we have for instance in *Amphipholis squamata* (D. Chiaje) an Echinoderm, which seems to be really cosmopolitan; in other cases, however, — f. i. *Diadema setosum* Gray, — this worldwide distribution has proved to rest on wrong identifications. — I have then undertaken a careful study of the material of *Actinopyga parvula* at my disposal. Through the assistance of Dr. Th. Mortensen I have been able to examine one of the type specimens of Selenka's *A. parvula*, received from Prof. Ehlers, Göttingen, the type of *M. flavo-castanea* Théel, received from Prof. Th. Odhner, Stockholm, together with specimens identified by Théel as *H. captiva* Ludwig, from Prof. Hartmeyer, Berlin; the specimen from Australia, identified by W. Erwe as *A. parvula*, was received from

Prof. Michaelsen, Hamburg, — finally also some specimens of Bedford's *A. parvula*, together with a pair of those, identified by the same author as *H. difficilis* Semper, were received through the kindness of Prof. Stanley Gardiner, Cambridge. — I beg to express my indebtedness to all these gentlemen for their exceedingly valuable assistance which has made it possible for me to reach a definite result in the rather intricate question about the synonomy of *Actinopyga parvula* (Sel.).

As the first result of my researches I must maintain that the specimens from the Pacific are by no means identical with the Floridan type. The pacific form, at least that from Hawaii, is a separate species. According to Erwe, the *M. aegyptiana* of Helfer is identical with the Pacific species. — However, the identification with *M. aegyptiana* is also wrong as I may assert after having had the opportunity of studying this species on the authentic material. Also the examination of the type of *M. flavo-castanea* has convinced me that this species is not a synonym of *parvula* from Florida and still less of the Pacific species.

Further I was very surprised in finding, through the study of the type of *M. parvula* from Florida, that it could not be distinguished from *H. captiva* Ludwig, in spite of the fact that they have been referred to different genera, the former to *Actinopyga* (*Mülleria*) the latter to *Holothuria*. This, however, is due simply to the fact that Ludwig and the following authors who mention this species have overlooked the presence of anal teeth in *captiva*. The examination of Bedford's specimens of *M. parvula* led to the result that they were not the same as the species from the Pacific, identified as *parvula* by Fisher and Erwe. They represent a species which I shall designate as *Actinopyga Bedfordi* n. sp.

I shall here shortly point out the differences between these species, especially between *A. parvula* and the form from the Pacific, hitherto wrongly designated by that name.

Externally these two forms are differing both in colour and size. The Atlantic form grows only to half the size of the Hawaiian, the former being only 4—5 cm, the latter 8—10 cm. That the difference in length is real is confirmed by examination of the generative organs. They are found well developed in the small Atlantic form at the said sizes 4—5 cm, while the Pacific form is

immature at this size, the gonads only being fully developed in specimens c. 8 mm long.

The Atlantic form is pale yellow in colour, the Hawaiian is dark chocolate-brown. — From an anatomical point of view these two species are not differing in many points. This was not likely either as the Holothurians belonging to these genera are of a very uniform type. — I have compared specimens of nearly equal size and have found the tentacleampullae to be larger and darker pigmented in the Hawaiian form than in the Atlantic. The number of Polian vesicles is in most cases 2 for the Hawaiian, 3 for the Atlantic species, but this is not quite constant, as I have found specimens of the latter species with only one, and a specimen from Hawaii with 3 vesicles, the third being very small.

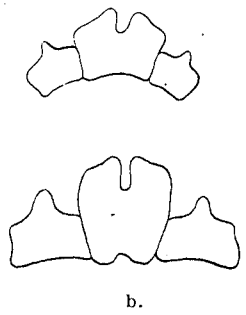
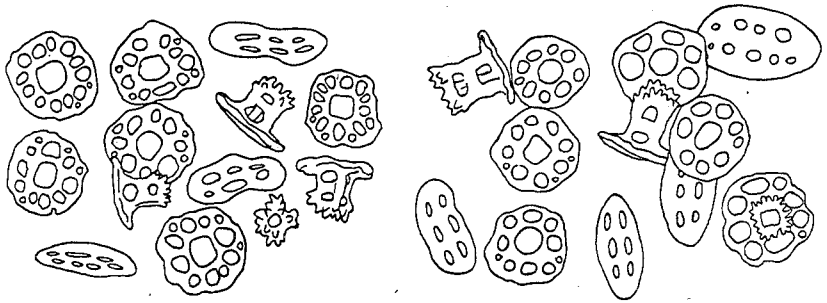


Fig. 5. Part of the calcareous ring of *Actinopyga parvula* (Sel.) (a) and *A. difficilis* (Semper) (b). $^{8}/_{1}$.

A very distinct difference is afforded by the Cuvierian organs, which are in the Atlantic form discharged in the form of long thread-fine bands, as noted by Crozier; in the Hawaiian form Dr. Mortensen has observed that when the animals are irritated they discharge the Cuvierian organs in small bits, recalling „vermicelli soup". The calcareous ring affords the best distinguishing character of the two species; in the works of Fisher and Ludwig pieces of the calcareous ring are figured, the differences between the two species thus being clearly shown. I have figured pieces of the calcareous ring from the present material. The ring of the Atlantic form (Fig. 5 a) is very thin and low. When treated with hypochlorite of sodium the ring is easily isolated without losing its characteristic form. The ring of the Hawaiian form (Fig. 5 b) is thick, high and robust. After very short treatment with hypochlorite of sodium the losely united spicules of the ring are set free and the ring is destroyed, long before the organic substance has been dissolved. Also by ordinary preparation with a scalpel the little thin ring of the Atlantic species is far more resistent than the thick, robust ring of the Hawaiian form.

The deposits in the skin show a well marked difference (Figs. 6—7). Most of the buttons in the Atlantic form are, as Théel has pointed out, obviously curved, while they are very regular in the Pacific species and not so slender of shape. The tables in the first mentioned form are perforated by many small holes, while in the Hawaiian form there are generally eight holes. — It is quite evident from this comparison of the Atlantic and the Pacific „*Actinopyga parvula*" that they cannot be identical, but are really two well separated species.



Figs. 6—7. Calcareous spicules of *Actinopyga parvula* (Sel.) (Fig. 6) and *A. difficilis* (Semper) (Fig. 7). $^{170}/_{1}$.

A comparison of the type of *Actinopyga parvula* (Sel.) with the *Holothuria captiva* of Ludwig gives the result that there is not a single character by which they can be distinguished, and there is not the slightest doubt that *H. captiva* is only a synonym of *A. parvula*. Unfortunately the type specimen of *H. captiva* appears to have been lost. At least I am informed that it is no more in the collection of the Würzburg Institute from which it was described; but still the description given by Ludwig is sufficient to identify it with certainty as the common, small Westindian species, the multiplication by fission of which was mentioned above.

It is very noticeable that the type specimen of *A. parvula* is regenerating its anterior end which fact has escaped the attention of Selenka. —

The *Mülleria flavo-castanea* Théel is in colour and size quite different from both the Floridan and the Pacific type. The type specimen is 10 cm in length, the dorsal side is white, spotted with brown around the papillæ, the ventral side is brown. The tentacle

ampullae are short and pale. The calcareous ring thick and robust and in structure very like that of the Hawaiian form. One long Polian vesicle and one madreporic canal. — A tuft of gonads on the left side and well developed Cuvierian organs. All internal organs are of a very pale colour. The deposits in skin are never to be mistaken as they are quite different from the above mentioned species. The tables have many holes in the disk and the margin is smooth; the buttons are 3—4 times larger than in the other species (Fig. 8). In his „Notes on the Holothurioidea of the Indian Ocean". II. (Spolia Zeylanica IX. 1914. p. 176) I. Pearson mentions a specimen of *M. (Argiodia) flavo-castanea* from the Red Sea. In a letter to Dr. Mortensen he gives the information that on further examination he has found the specimen to be not an *Actinopyga (Argiodia) flavo-castanea,* but an *Argiodia maculata* (Brandt).

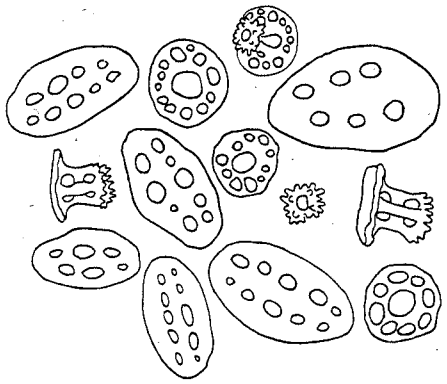


Fig. 8. Calcareous spicules of *A. flavo-castanea* Théel. 170/1.

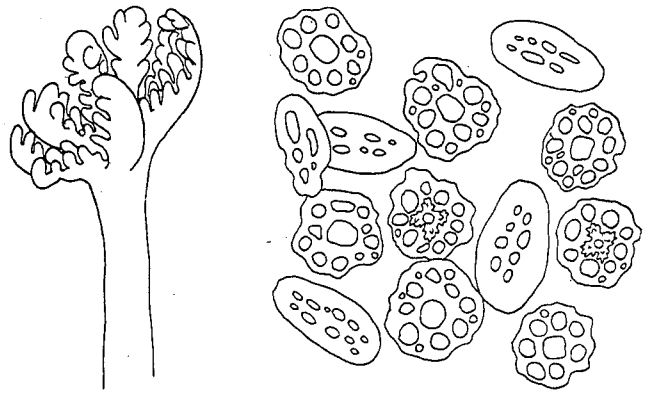
Actinopyga aegyptiana Helfer is especially characterized by its tentacles which are very slender (Fig. 9), quite pale and nearly without disk, while the Hawaiian form has broad, robust, dark-coloured disks. The specimen I have had the occasion to examine is 4 cm in length, with well developed genital organs of a peculiar green colour on the left side of the mesentery. The ring is low and fine and the single pieces are hard. The ampullae are short, pale in colour. 2 Polian vesicles and 1 madreporic canal are present. Also Cuvierian organs. The colour of the animal is pale whitish with brown spots on the dorsal side. A very prominent, white tentacle collar is present.

The buttons are very similar to those in the Hawaiian form, but the tables are much more uneven in the margin (Fig. 10).

I have not succeeded in finding buttons of the form which Helfer figures, but I have happened to see similar buttons with toothed margin in a preparation where the isolated spicules were

not sufficiently washed and released from crystals of sodium. I hardly have any doubt that the spicules with serrated edge, figured by Helfer, really are some such that have not been sufficiently cleaned.

The specimen of *„Mülleria parvula"*, recorded by Erwe from Western Australia appears to be identical with the Hawaiian form,



9. 10.

Fig. 9. Tentacle of *A. aegyptiana* Helfer. 15/1. — Fig. 10. Calcareous spicules of *A. aegyptiana* Helfer. 170/1.

at least I have been unable to find any noteworthy difference between them.

Whether the *Argiodia parvula* (Sel.) mentioned by Pearson (Notes on the Holoth. of the Indian Ocean. II. Spol. Zeylanica. IX. p. 177) from the Maldives and the Seychelles is also identical with the Hawaiian form I cannot decide; I have not seen any of the specimens and the information given by Pearson in the said paper and in a letter to Dr. Mortensen does not seem to me sufficient for deciding which species it really is. But it appears certain at least, that it is not identical with the West Indian species; probably it is *Actinopyga difficilis* (Semper).

That the *Mülleria parvula* of Bedford from Funafuti could hardly be the same as either the true Westindian *A. parvula* or as the Pacific form thus designated by Fisher, was fairly evident already from description and figures, given by Bedford. — An examination of the specimens received from Cambridge gave the

expected result that this is a separate species, quite distinct from any of those mentioned above, as also from any other species hitherto known. Even the size forms a very conspicuous character, the animal being apparently fullgrown at a length of 2,5 cm.

I shall now give a description of this species naming it *Actinopyga Bedfordi.* Length 2,5 cm. Colour brown. Integument weak. The animal is nearly transparent. Pedicels ventral, long and few, in three rows, the median double. Papillæ in the dorsal side few and small, hardly perceivable. Tentacles 15—16. Anal opening surrounded by 5 small, plateformed teeth.

Calcareous ring of ordinary type, very soon destroyed by hypochlorite of sodium. Short tentacle ampullae. 2 Polian vesicles, 1 dorsally embedded madreporic canal. Muscular bands slender. Rete mirabile present. Respiratory tree short, in length exceeding the very short Cuvierian organs and the right and left branches are of equal length.

Deposits in the skin are absent, in most of the specimens only some small, ellipsoid grains are present. In one specimen deposits, in all respects exactly like those figured by Bedford, were present.

While thus the „*Actinopyga parvula*" of Bedford has nothing with that species to do, — nor with the false Pacific *A. parvula,* as is evident from the facts here given, the species named *Holothuria difficilis* Semper by Bedford appears to be identical with the Hawaiian species. Bedford gives only a figure of the animal; about the calcareous bodies he says: they agree with Semper's short description and figures". Unfortunately nearly all the spicules in the specimens at my disposal have been quite dissolved, — perhaps on account of acidity of the alcohol in which they were preserved (it does not appear from Bedford's paper that they were preserved in formalin) — but the pieces left seem to be identical with those in the Hawaiian form. Also the other characters are perfectly identical with those of the Hawaiian form. Both specimens possessed well developed anal teeth which could be seen without hand lens, and one of the specimens was regenerating the forepart, which only had 15 tentacles, — so I have no doubt that they are really identical.

The description, given by Semper of his *Holothuria difficilis,*

is very short, and figures are given of the calcareous bodies alone. (Holothurien. p. 92. Taf. XXX, Fig. 21). Excepting the number of Polian vesicles (1), there is nothing either in the description or in the figures of the deposits which does not agree with the present species, and as the type appears to have been lost, (I am informed that it is not found in the Würzburg collection) it seems reasonable to adopt the name *Actinopyga difficilis* (Semper) for this species.

The present studies thus have led to the result that among the forms hitherto confused with *Actinopyga parvula* (Sel.) the following species are to be distinguished.

1. *Actinopyga parvula* (Selenka).

Mülleria parvula. E. Selenka. Beiträge z. Anat. u. Syst. d. Holothurien. Z. wiss. Zool. XVII. 1867. p. 314. Taf. XVII, Fig. 17—18.

Holothuria captiva. H. Ludwig. Beiträge z. Kenntniss d. Holothurien. Arb. zool. Inst. Würzburg. II. 1874. p. 32.

Mülleria parvula. Hj. Théel. „Challenger" Holothurioidea. II. 1885. p. 220.

" " C. Ph. Sluiter. Westindische Holothurien. Zool. Jahrbücher Suppl. XI. 1910. p. 333. (In Kükenthal & Hartmeyer. Ergebnisse einer zool. Forschungsreise nach Westindien.)

Holothuria captiva. W. I. Crozier. Multiplication by fission in Holothurians II. Amer. Naturalist. 1917. p. 560.
Distribution. West Indies. (Florida, Jamaica, St. Barthélemy, Barbados, Tobago; Bermuda).

2. *Actinopyga flavo-castanea* Théel.

Mülleria flavo-castanea. Hj. Théel. „Challenger" Holothurioidea. II. 1885. p. 198.

Non: *Argiodia flavo-castanea* (Théel). I. Pearsson. Notes on the Holoth. of the Indian Ocean. II. The subgenera Argiodia and Actinopyga. Spolia Zeylanica. IX. 1914. p 176.

3. *Actinopyga difficilis* (Semper).

Holothuria difficilis. Semper. Reisen im Archipel d. Philippinen. I. Holothurien. 1868. p. 92. Taf. XXX, Fig. 21.

— — Théel. „Challenger" Holothurioidea. II. 1885. p. 219.

Holothuria difficilis. F. P. Bedford. Holothurians coll. by Stanley Gardiner at Funafuti & Rotuma. Proc. Zool. Soc. 1898. p. 838. Pl. LII. Fig. 3.

Actinopyga parvula. W. K. Fisher. The Holothurians of the Hawaiian Islands. Proc. U. S. Nat. Mus. 1907. p. 645. Pl. LXVII; Figs. 2—2g.

— — W. B. Benham. Report on Sundry Invertebrates from the Kermadec Islands. Trans. New Zealand Inst. 1912. p. 136.

Mülleria — H. Helfer. Über einige von Dr. R. Hartmeyer im Golf v. Suez ges. Holothurien. Mitt. Zool. Mus. Berlin. VI. 1912. p. 330.

— — W. Erwe. Holothurien. Die Fauna Südwest-Australiens, herausgeg. v. Michaelsen & Hartmeyer. Bd. IV. Lief. 9. 1913. p. 366.

Holothuria difficilis. W. Erwe. Ibid. p. 381. Taf. VII. Fig. 17.

? *Argiodia parvula.* I. Pearson. Notes on the Holothurioidea of the Indian Ocean. II. The subgenera Argiodia and Actinopyga. Spolia Zeylanica. IX. 1914. p. 177. Pl. XXVIII. Fig. 4. Distribution. The Indo-Pacific, from the Red Sea and Mauritius to Hawaii and the Kermadec Islands; West Australia.

4. *Actinopyga Bedfordi* n. sp.

Actinopyga parvula. F. P. Bedford. Holothurians .... Funafuti & Rotuma. Proc. Zool. Soc. 1898. p. 836. Pl. LII. Figs. 1a—d.
Distribution. Funafuti and Rotuma.

5. *Actinopyga aegyptiana* (Helfer).

Mülleria aegyptiana. H. Helfer. Über einige ..... im Golf v. Suez ges. Holoth. Mitt. zool. Mus. Berlin. VI. 1912. p. 330.
Distribution: Gulf of Suez.

In conclusion I wish to express my best thanks to Dr. Th. Mortensen for giving me the opportunity to study this excellent material from his Pacific expedition 1914—16, for his valuable help, and the interest with which he has alway favoured my studies.

19—11—1921.