Report on the Actiniaria Collected by the Bahama Expedition of the State University of Iowa, 1893.

By Dr. J. PLAYFAIR McMURRICH.

The chief interest of this collection, the examination of which I undertook at the request of Professor Nutting, lies in the number of deep water forms which it contains. Certain of these have been previously described, and I have been able to add to the earlier descriptions of these additional facts which, it is hoped, will render them more complete; but besides these, a number of apparently undescribed forms were found, some of which possessed considerable interest.

The littoral forms were not as abundantly represented as I had expected, but I found especial interest in a species of Adamsia, the study of which seemed to clear up the synonomy of the described American species of that group. My friend, Mr. J. E. Duerden, Curator of the Museum of the Institute of Jamaica has kindly answered many inquiries concerning some of these littoral forms and has sent me specimens for comparison; for these kindnesses I am under great obligations and it gives me much pleasure to make public acknowledgment of my indebtedness.

Order Hexactiniæ.

Sub-order Actininæ.

Family Antheomorphidæ *Hertwig*, 1882.

This family was established by Richard Hertwig ('82) for a form, *Antheomorphe elegans*, obtained by the Challenger

expedition. Two other species, *Porponia elongata* and *P. robusta*, were also doubtfully referred to it, and later, in a supplementary report('88), a third genus *Ilyanthopsis* was added. The distinguishing characteristics of the family as given by Hertwig were the "slightly developed muscular system; long, slightly contractile tentacles, without any circular muscles (tentacles consequently non-retractile); reproductive organs present on all the septa; numerous complete septa; accessory tentacles wanting." It is to be noted, however, that none of the species referred to the family by Hertwig were suitably preserved for an exhaustive study, and some uncertainty exists as to the structure and arrangement of the mesenteries in all of them. Furthermore, if *Porponia elongata* is to be retained in the family it will be necessary to modify the definition as regards the distribution of the reproductive organs on all the mesenteries, since in the species mentioned imperfect non-gonophoric mesenteries occur.

In the collection made by the United States Fish Commission Steamer Albatross, I found a form which in my report ('93) I named *Halcurias pilatus*, referring it, chiefly on account of the arrangement of its mesenteries, to the family Halcampidæ. Carlgren ('93) has, however, shown that in two typical species of the genus Halcampa the sphincter muscle is mesoglœal and this added to the fact that Halcurias possesses an adherent base makes it advisable to remove it from the Halcampidæ. It seems to me that by modifying slightly the definition of the family Antheomorphidæ a place may be found for it in that group, in fact I was inclined at first to associate it with Porponia and was only deterred from doing so by the simplicity of the arrangement of its mesenteries. I would suggest as a definition of the Antheomorphidæ the following:

Actininæ with an adherent base; column smooth; tentacles simple, long or moderately so, conical or digitiform; sphincter muscle and acrorhagi wanting; no cinclides or acontia; no conchula; mesenteries all or nearly all perfect, all (?) the perfect ones gonophoric.

As Hertwig has pointed out the chief difference between

the Antheomorphidæ and the Antheadæ lies in that in the former there is no sphincter muscle while in the latter it is present but feebly developed. Whether this is sufficient to recognize them as distinct families remains to be seen.

Genus HALCURIAS *McMurrich*, 1893.

In my original definition of this genus I laid stress on the fact that four pairs of mesenteries were less developed than the other six; this difference is by no means evident in the specimens I have found in the present collection and is probably due to the stage of development of the individual. It will be necessary accordingly to slightly modify the original definition, so that it may read thus:

Antheomorphidæ with tentacles only moderately long and conical; with ten pairs of mesenteries all of which are perfect and provided with well developed muscle pennons.

1. HALCURIAS PILATUS *McMurrich*, 1893.

Station No. 29. Sand Key light bearing N. about 6 miles; 116 fathoms; 5 specimens.

Station No. 64. American Shoal light bearing N. by W. about 8 miles; 110 fathoms; 1 specimen.

This species I originally described ('93) from specimens collected by the United States Fish Commission in lat. 48° 09′ S.; long. 74° 36′ W., at a depth of 449 fathoms. The external appearance of the specimens in the present collection is somewhat different from that shown by the Fish Commission specimens and it was only when I came to study the anatomy that the identity became evident. The differences are, however, probably due to the methods of preservation; in the present specimens the column is more cylindrical and longer in proportion to its breadth and the color of the specimens is a creamy white, the Fish Commission specimens being of a dirty brownish color with indistinct indications of darker longitudinal bands. This difference in color may be

due to the almost complete loss of the ectoderm in the Iowa University specimens, the white mesoglœa being exposed.

The base in both sets of specimens is slightly less in diameter than the column and appears to have been but feebly adherent. Its diameter in the specimens from Station 29 was 1–1.5 cm., the height of the column in the same specimens varying from 1.5 cm. to 2.5 cm. The single specimen from station 64 had, however, much greater dimensions, its base measuring nearly 2 cm. in diameter while the height of its column was 4 cm. A figure of this specimen of about natural size is given in Pl. 1, Fig. 1.

As a supplement to the original description I give a couple of figures from the present specimens. Pl. 1, Fig. 2 shows the absence of a sphincter muscle and also the sudden cessation of the thickness of the column mesoglœa just at the bases of the tentacles, a distinct parapet being thus formed. The nematocysts found in the ectoderm of the Fish Commission specimens could be seen in the present forms in the few patches of ectoderm which persisted and seemed to be especially abundant at the edge of the parapet. The ectodermal musculature of the column was also visible, though with considerable indistinctness owing to the extensive maceration which all the specimens had suffered. The tentacles in the specimens from Station 29 seemed to be about forty to forty-five in number, but in the large specimen I counted fifty-four and, allowing for a portion of the margin which was injured, the total number must have been over sixty.

The preparation from which Fig. 3 was drawn was a transverse section through the upper part of the column of one of the smaller specimens from Station 29, and is given for comparison with Fig. 14, Pl. XXI of my Fish Commission report ('93). The general structure of the mesenteries and their musculature were the same as in the Fish Commission specimens, allowance being made for the difference in size and probably therefore of age of the two examples. Ten pairs of mesenteries were present, but, although some of the mesenteries were smaller than others, I could not make out any definite

arrangement of the large and small mesenteries. I cannot make any statement as to the arrangement of the reproductive organs since only a few scattered ova were to be found in the specimens examined. The mesoglœal ridges of the stomatodæum in the present specimens were much stouter than in the Fish Commission examples, though of the same general form. There were from twelve to fourteen of these ridges in the Station 29 specimens and about twenty in the large specimen from Station 64. Only one siphonoglyph was well marked, although there were two pairs of directives.

The structural differences between the West Indian specimens and those collected by the Fish Commission are but small and do not seem to warrant the establishment of a new species. They are in all probability referable partly to the method of preservation and partly to age.

A word may possibly be in order as to the suggestion of Carlgren ('93) that this form should be referred to his order Protantheæ. I must dissent from such an arrangement, as I do not think that the order can stand, based as it is solely on the occurrence of an ectodermal musculature in the column wall. It is true that this characteristic may be regarded in one sense as primitive, but it is a long journey back from the Hexactiniæ to the Scyphistoma to find the origin of it. It seems to me much more probably a sporadic resurrection of an ancestral characteristic and that it has little phylogenetic significance. The acceptance of it as of classificatory importance will lead to the association of forms which in other respects appear to have widely different affinities, *e. g.*, Gonactinia with Corallimorphus (?) and the form described by Hertwig ('88) as Corynactis sp.? I believe the development of the mesenteries to be a much more reliable phylogenetic character and I see no reason for the obliteration of the order Protactiniæ which is based on this feature. It may be noted that this order is much more comprehensive than Carlgren's Protantheæ, and in view of our present more complete knowledge of the forms in the past associated in the family Halcampidæ, I would even suggest the propriety of increasing its comprehensiveness by

including many of these within it. This is an idea which, however, will require considerable discussion hardly appropriate to this report, and I must defer a consideration of it to a future occasion.

FAMILY ANTHEADÆ *Hertwig*, 1888.

2. CONDYLACTIS PASSIFLORA *Duch. & Mich.*, 1866.

The Dry Tortugas; 1 specimen.

There was no room for doubt as to the identification of this specimen and as the species had already been studied (McMurrich, '89) I did not think it necessary to mutilate the single example of it in the collection.

FAMILY BOLOCERIDÆ *McMurrich*, 1893.

3. BOLOCERA POLLENS sp. nov.

Station No. 64. American Shoal light bearing N. by W. about 8 miles; 110 fathoms; 1 specimen.

The single specimen which I regard as the type of a new species of Bolocera was obtained at the same station as the large specimen of Halcurias. It was badly distorted and rather poorly preserved and I contented myself with cutting out a small portion of the margin for an examination of the sphincter and with removing some of the tentacles for a study of their sphincters. The results of this partial examination were, however, so decisive that I think there can be no doubt but that we have to do with an undescribed species.

In its general appearance the specimen resembled greatly *B. pannosa* which I described for the Albatross collection (McMurrich, '93), having the same flaccid tentacles and being approximately of the same size. On account of the distortion which the specimen had suffered it was difficult to obtain exact dimensions, but the base measured about 2.8 cm. in diameter and the column about 1.2 cm. in height. The lower portion of the column was smooth or shows only fine longitudinal lines due to contraction, but the upper part for a dis-

tance of about 0.5 cm. from the margin had a very irregular surface, appearing as if verrucose, though it is impossible on account of the poor preservation to say that verrucæ were actually present. The sphincter was remarkably strong, more so than in any of the hitherto described species of Bolocera, and consisted of a median axis provided with very numerous lateral lamellæ arranged pinnately (Fig. 4).

The tentacles were about 1.6 cm. in length and, as is usual in the Boloceridæ, were attached to the disk by a narrow neck, beyond which they suddenly enlarged to a somewhat bulbous form, tapering off distally to a more slender portion. The longitudinal ridges with which they were provided were very numerous and low, so that they were evident only on close scrutiny. The only trace of color persisting in the specimen was found in the tentacles, which, especially in the bulbous portion, were of a brownish purple color. The sphincter of the tentacles, which occurs just distal to the narrow neck, was thickened at its free edge, where it bore muscle processes, one of which, with lateral secondary processes, was especially long and projected into the lumen of the tentacle towards its apex. This process, however, did not seem to be equally developed all around the sphincter fold, sections which passed through the axis of the tentacle showing it in some cases only on one side (Fig. 5).

In most of the species of Bolocera which have been studied anatomically the sphincter is of the diffuse endodermal type. This is the case with *B brevicornis* and *B. longicornis* where it is typically diffuse; and in *B. occidua* and *B. kerguelensis*, in which, however, there is an indication of circumscription in that in the upper portion of the muscle there is a strong mesoglœal process which bears secondary pinnately arranged processes, the whole not projecting, however, much beyond the general mass of the sphincter.[1] In *B. pannosa* this upper pro-

[1] Practically the same arrangement I have found in forms from the east coast of North America identified by Verrill ('73, '83, etc.) with *B. tuediæ* (Johnston) Gosse. This identification is, however, open to question until the anatomical characteristics of the European and American forms have been compared.

cess of the sphincter becomes of greater importance compared with the remaining processes, forming a condition which leads, through *Liponema multiporum* (Hertwig, '82 and '88), which I have elsewhere ('93) shown to be almost certainly a Bolocera, to the typically circumscribed sphincter of *B. pollens*.

The occurrence of such a sphincter is of importance in determining the family affinities of Bolocera. As is well known, Gosse in establishing the genus, assigned it to the family Bunodidæ and succeeding authors followed his example until 1891 when Carlgren, relying on the nature of the sphincter of *B. longicornis*, transferred the genus to the Antheadæ. In 1893 I proposed the establishment of the family Boloceridæ, a step which received the approbation of Carlgren ('93). Recently, however, objections have been made to this family by Kwietniewski ('96), who prefers to retain the genus among the Antheadæ. The occurence of the remarkably circumscribed sphincter of *B. pollens* renders this position untenable, and the diffuse sphincter of *B. brevicornis* and *B. longicornis* excluding the genus from the Bunodidæ, the recognition of a special family for it seems to be necessary.

FAMILY PHYLLACTIDÆ.

4. ASTERACTIS EXPANSA *Duerden*

Bahia Honda, Cuba; 26 specimens.

A description of this species has been written by my friend, Mr. Duerden, and will shortly be published with the necessary figures. Mr. Duerden has kindly allowed me to see his manuscript and has also sent me specimens for comparision with those in this collection; there can be no question as to the identity of the forms I have examined with those from Jamaica.

Mr. Duerden considers the species a new one and refers it to the genus Asteractis established by Verrill ('68). According to Verrill's definition the absence of verrucæ is one of the characteristics of this genus, and if this portion of the definition is to be retained the present species cannot be considered an Asteractis, even though the fronds, as in *A. bradleyi*, are

arranged in cycles of different orders, those corresponding to the primary tentacles being the largest. Whether this arrangement of the fronds is a matter for generic distinction seems to me, however, exceedingly doubtful; in an earlier paper ('89) I accepted it as such, but the opportunities I have since had for studying members of the family Phyllactidæ have led me to modify my opinion in this respect. It seems to me that the shape and structure of the fronds is a more substantial feature for generic distinction than mere differences in the development of the primary, secondary and other cycles, and I cannot see that the structure of the fronds of the present species differs sufficiently from what occurs in Oulactis to warrant its separation from that genus. Whether the fronds of *A. bradleyi* differ sufficiently from those of Oulactis to warrant a new genus must remain a question until opportunity is afforded for a renewed study of this form; judging from Verrill's description they may be.

I am also in doubt as to the propriety of considering this a new species. Mr. Duerden has had opportunities for studying living specimens, and his judgment is accordingly worthy of great consideration, and I would merely suggest a possibility which occurred to me when studying the Cuban specimens. It is noticeable that the species seems to be fairly common on the Cuban coast judging by the number collected by the Iowa University expedition, and Mr. Duerden also finds it common in Jamaica; this makes me suspect that it may be identical with one of the forms described by earlier authors. With none, however, does it seem to agree very closely, though it seems to come nearest to *O. flosculifera* of Duchassaing and Michelotti ('60). In my original description of *O. flosculifera* ('89) I took it for granted that Duchassaing and Michelotti's identification was correct. Andres ('83) thinks otherwise and has separated the form described by these authors from Lesueur's *O. flosculifera* and named it *O. foliosa*. Perhaps after all Andres may have been right; the form which I described from the Bahamas agrees fairly well as to coloration with Lesueur's form, while the present form seems to agree

more closely with that of Duchassaing and Michelotti. However the earlier descriptions are all too indefinite to make the identification certain and it will perhaps lessen the chances of confusion in the future to accept Mr. Duerden's separation of the present species under the specific name he has chosen.

FAMILY SAGARTIDÆ.

SUB-FAMILY SAGARTINÆ.

5. ADAMSIA TRICOLOR (*Lesueur*) *McMurrich.*

Synonyms:—*Actinia tricolor* Lesueur, 1817.
Actinia bicolor Lesueur, 1817.
Adamsia egletes Duchassaing & Michelotti, 1864.
Cereus sol Agassiz Ms. Verrill, 1864 (p.p.)
Adamsia sol McMurrich, 1883.

Bahia Honda, Cuba; 1 specimen.

The base was evidently adherent, but though its ectoderm was preserved no signs of a horny secretion were present. The column was practically cylindrical, tapering slightly above and measured 2.7 cm. in height, the diameter near the base being about 2 cm., or rather since the column was flattened slightly the diameter in one direction was 2.5 cm. and in the other 1.5 cm.; near the margin it was 1.6 cm. and 0.9 cm.

The column wall was of a firm coriaceous texture and was marked by fine longitudinal and transverse lines probably due to contraction. The ectoderm was almost completely macerated away, the few fragments of it which persisted being of a dirty cream white color. A short distance above the base there were a number of purple brown spots or tubercles arranged in two horizontal rows; both rows were somewhat incomplete, some of the tubercles probably not being evident on account of the loss of the ectoderm. In the upper row I counted only four tubercles and in the lower only 6 (7?), the lower tubercles being considerably smaller than the upper ones.

The tentacles were marginal and were small and numerous, being too crowded to count accurately. Those of the inner-

most cycle were decidedly longer than those situated more peripherally and measured about 0.4 cm. in length. A faint rose-purple color persisted in the tentacles, but it was faint, the color of the entire specimen having been almost entirely extracted by the alcohol in which it was preserved. The disk and peristome could not be examined owing to the manner of contraction.

Sections through the column showed that the mesenteries were arranged in five cycles, of which only one cycle, consisting of six pairs, was perfect. Two pairs of directives were present. The fifth cycle was not quite complete in its development, some of the interspaces being destitute of representatives of it, and, throughout, its mesenteries were small and possessed no mesenterial filaments. Acontia were present but were few in number. The longitudinal musculature was only moderately developed, the mesoglœal processes covering a considerable portion of the surfaces of the mesenteries at the level of the lower part of the stomatodæum, but not being very high (Pl. 1, Fig. 7). No parieto-basilar or basilar muscles were observed. The reproductive organs were borne upon the mesenteries of the second, third and fourth cycles, the specimen being a male.

The stomatodæum possessed two well developed siphonoglyphs and also was furnished with a number of longitudinal ridges, each of which was supported by an elevation of the mesoglœa.

The sphincter muscle was mesoglœal and well developed. It has a general triangular shape, occupying almost the entire thickness of the mesoglœa above but tapering off somewhat below, where it lies nearer the endodermal than the ectodermal surface (Pl. 1, Fig. 6). Above it is finely reticular, bands of mesoglœa extending transversely from the inner to the outer surface of the muscle area, finer longitudinal strands breaking the intervals between successive bands into smaller compartments which are lined by the muscle cells supported on processes which project into the compartments (Pl. 11, Fig. 1). About the middle of the muscle some of the longitudinal strands become thicker, and, being placed as it were

end to end in successive intervals, produce the appearance of two or three longitudinal bands of mesoglœa. Below the partitions between the muscle-containing compartments thicken, so that the compartments become distinctly separated from one another, some even at the lower end of the muscle, being separated by considerable intervals from their fellows (Pl. II, Fig. 2).

Three species of Adamsia have been described from the West Indies; Lesueur ('17) has described two forms which he named *Actinia tricolor* and *Actinia bicolor*, the one from Barbadoes and the other from St. Vincent, while Duchassaing and Michelotti ('64) have described *Adamsia egletes* from St. Thomas. Of these three the one which seems to resemble most closely the form here described is *A. egletes* and I think there can be little doubt as to the identity of the two. The relationships of Lesueur's forms are more uncertain on account of the incompleteness of the descriptions, but I am inclined to consider them identical with *A. egletes*, so that but a single species of Adamsia is at present to be recognized in the West Indian region. My reasons for this belief are by no means conclusive, resting as they do upon circumstantial evidence, but I think they are sufficiently strong and my conclusion has received confirmation from my colleague, Mr. Duerden, who has had much experience with West Indian forms.

The habits of the genus Adamsia are such as to render probable the wide distribution throughout any region of a species occurring in it, and furthermore, so far as our present information extends, the distribution of the various species of Actinians throughout the West Indian islands is pretty uniform. One should hardly expect, I think, to find three species of Adamsia in different islands, especially since a form, *A. sol*, identical with the one here described, occurs on the coasts of North and South Carolina. I have examined carefully and compared *A. sol* with the Cuban specimen described above and I find such complete similarity in structural peculiarities that the identity of the two seems indubitable. With such an extensive distribution, the coasts of the Carolinas, Cuba, and

St. Thomas, one may well expect the same species to occur elsewhere throughout the West Indies.

As regards *A. bicolor*, it is unquestionably an Adamsia but the size given for it, "height and diameter about six or seven lines," indicates that it was a young individual and the differences between it and *A. tricolor* may well be accounted for on this supposition.

The first point in Lesueur's description of *A. tricolor* that may be noticed is the statement that the mouth is surrounded by "a circle of blue and another of orange." Here we have a very characteristic marking and turning to the description of *A. egletes* we find that it has a circle of red around the mouth. In both cases there is a distinct band of color around the mouth, and the discrepancy in the color of the band may, I think, be explained by a reference to *A. sol*, in which the lips are of a canary-yellow color (Lesueur's orange circle) and around this is a vivid circle of crimson lake, a color which may readily shade off into bluish on the one hand or red on the other. This marking seems to me very characteristic, and occurs, so far as is known, in no other species of Adamsia.

A seemingly important difference between *A. tricolor* and *A. egletes*, and one which led Duchassaing and Michelotti to regard the latter as a distinct species, is the statement that in *A. tricolor* there are several rows of cinclides. I think this difference is also capable of explanation, even leaving out of consideration the indefiniteness of the word "several," since in *A. sol* the lower row of cinclides is sometimes irregular and might suggest the occurrence of more than two rows, and I may further add that Mr. Duerden informs me by letter that from an examination of the species of Adamsia occurring in Jamaica and which he considers identical with *A. egletes* and *tricolor*, he believes that "little importance can be attached the arrangement of the cinclides." The tubercles which Lesueur describes as occurring around the mouth in *A. tricolor* are, I believe, merely the crenulations of the lips so frequently noticeable in Actinians and due to the longitudinal ridges of the stomatodæum; while the tubercles of the ten-

tacle which are mentioned are probably merely an appearance produced by the coloration of the tentacles, such an appearance being thus produced in *A. sol.*

To sum up then it seems probable that *A. bicolor* is merely a young specimen of *A. tricolor*. The similarity of the locality and the characteristic color mark around the mouth indicate the identity of *A. tricolor* and *A. egletes;* the Cuban form here described is almost certainly identical with *A. egletes;* and finally the *A. sol* of the Carolinas is undoubtedly identical with the Cuban specimen. If this series of identities be accepted the name which has the priority is Lesueur's *A. tricolor* and the species should be known as *Adamsia tricolor* (Les.).

6. Sagartia spongicola *Verrill*, 1883.

Station No. 29. Sand Key light bearing N. about 6 miles; 116 fathoms; numerous specimens.

Station No. 51. American Shoal light bearing N. by W. 10 miles; about 100 fathoms; 3 specimens.

These specimens I have been able to compare with specimens from the collection of the United States Fish Commission identified by Professor Verrill and can accordingly vouch for the correctness of their identification. The base is of the adherent type and the column is nearly cylindrical, broadening slightly above and measuring from 2.3–2.5 cm. in height by about 1 cm. in diameter. In several specimens the dimensions fell considerably below these figures. The contraction of the column was incomplete in all the specimens, the tentacles being more or less exposed and the disk and peristome visible in some cases. The ectoderm had for the most most part macerated away in all the specimens, the patches of it which persisted having the dirty white color frequently seen in alcoholic material. The outer surface of the mesoglœa was raised into ridges, irregular in size and distribution and probably due to contraction. Small depressions were visible here and there on the column wall but I found no structures which I could positively regard as cinclides, nor any traces of verrucæ, such as Verrill ('83) describes on the upper part of the column.

The absence of ectoderm, however, probably accounts for my failure to find these structures.

The tentacles are marginal in position and are rather short, tapering gradually to a rather blunt extremity. They are arranged apparently in about three cycles and seem to be somewhat irregular in number, the two specimens in which I counted them possessing respectively 51 and 49; this irregularity is probably related to the peculiar arrangement of the mesenteries described below. The longitudinal musculature of the tentacles, which is ectodermal, was moderately developed, the mesoglœal processes being higher towards the base, and the radial musculature of the disk was considerably higher at the bases of the tentacles than elsewhere. The disk was smooth and the peristome somewhat elevated in those specimens in which it was visible.

The mouth was more or less circular in shape, the lips being crenated and the gonidial grooves not very well marked. Sections showed that the stomatodæum possessed several longitudinal ridges, due to thickening of the mesoglœa and producing the crenations of the lips. Two siphonoglyphs were present in all the specimens examined, and others, one or even two, were found in several cases; they were always, however, rather feebly developed and sometimes hardly distinguishable from the grooves of the general surface of the stomatodæum.

The arrangement of the mesenteries was very interesting, so much so as to induce me to give a special description of it elsewhere ('97); I may therefore, confine my remarks here to a general statement of the peculiarities which were found. The mesenteries were arranged in three cycles, only those of the first cycle being perfect. In different specimens, however, the first cycle consisted of either six, seven, or eight pairs, a hexamerous, heptamerous, or octamerous symmetry being thus produced, since the mesenteries of the second and third cycles were arranged in the intervals between those of the first cycle. Furthermore the directives were liable to considerable variety both in number and position, specimens having

been found with two, three, or four pairs, and when only two pairs were present they were not opposite each other, but were separated on one side by one pair of the first cycle and on the other side by three pairs. These irregularities seem to be characteristic of the species, since out of seven specimens examined not one showed what is usually regarded as a typical arrangement. The condition described by G. Y. and A. F. Dixon ('89) for *Bunodes thallia* is thus recalled.

The longitudinal muscles of the perfect mesenteries were well developed, the long mesoglœal processes radiating out in a somewhat fan-like manner from a thickened portion of the mesentery (Pl. II, Fig. 3). The parieto-basilar muscle was also well developed on these mesenteries, but on those of the second and third cycles, which lack mesenterial filaments, the musculature was borne by a number of short processes arranged equally on both sides of the mesenteries, those on one side representing the longitudinal muscle processes and those on the other the parieto-basilar processes. Acontia were present but were few in number. I found reproductive organs in only two of the specimens examined and in these they occurred on the mesenteries of the first cycle, the directives included. In both cases, however, they were immature, though it seems probable that even when mature they are limited to the mesenteries of the first cycle, since those of the second and third cycles lack that portion of the mesentery which corresponds to the reproductive region of the first cycle mesenteries and possess only the muscular region.

A well developed sphincter of the mesoglœal type occurred in the upper part of the column wall. It was of an elongated oval form in section (Pl. II, Fig. 4) and the area which it occupied was traversed by numerous strands of mesoglœa, running in the direction of the thickness of the column wall and anastomosing somewhat so that the spaces occupied by the muscle fibres were somewhat spindle-shaped. The area occupied by the muscle was sharply marked off as a rule, though occasionally a few detached and scattered muscle cavities were observed.

Haddon ('89) has suggested the possible identity of this form with *Gephyra dohrnii*. Undoubtedly there is considerable external similarity between the two forms, but until a more thorough anatomical description is given of Gephyra their identity must be left an open question. Haddon states that anatomically Gephyra "belongs to the series of typical Sagartians," and from this statement, as well as from the fact that in all the specimens he examined the tentacles were arranged on a typically hexamerous plan, I should be inclined to doubt its identity with *S. spongicola*, which can hardly be called a "typical sagartian." Von Koch's description ('78) of the anatomy of Gephyra is too incomplete to throw any light upon the subject.

Sub-family PHELLINÆ.

7. Actinauge longicornis *Verrill*, 1883.

Station No. 64. American Shoal light bearing N. by W. about 8 miles; about 40 fathoms; 1 specimen.

The single specimen which I refer to this species I was unwilling to injure, but I was able to compare it with a specimen from the United States Fish Commission and can state that so far as their external appearance was concerned the two specimens were practically identical. It is probable that the specimen belongs to Verrill's variety *caribæa*, though it seems questionable if there be good grounds for recognizing this as a distinct variety.

Sub-order STICHODACTYLINÆ.

Family DISCOSOMIDÆ.

8. Discosoma anemone (*Ellis*) *Duch.*

Spanish Wells; 13 specimens.

I have nothing to add to the description of this form which I have already published ('89).

ORDER ZOANTHEÆ.

FAMILY ZOANTHIDÆ.

9. ZOANTHUS SOCIATUS *Ellis.*

Dry Tortugas; 2 colonies.

Spanish Wells; 3 colonies.

I have compared these specimens wlth *Z. sociatus* from the Bahama Islands and can find no differences sufficient for their separation. All the colonies were adherent to blocks of coral rock somewhat uneven in shape, and, as a result, there is some difference in the size of the various individuals, since there seems to be a tendency for the disks of the expanded polyps to lie at approximately the same level. Those individuals which are situated in the depressions, or on the sides of a block, consequently grow to a greater height than those situated on elevations or on the general level. Thus in one of the colonies examined many of the individuals measured only 0.5 cm. in height, while others measured as much as 2 cm., these measurements being in both cases of individuals whose diameter slightly below the apex of the contracted column was about 0.5 cm. There were of course numerous small polyps recently budded off from the stolons, whose height was less than that given for the small adults, but these could be readily recognized by their small diameter.

I can add nothing to the description of *Z. sociatus* I have already published ('89), especially since the internal parts of the specimens examined were rather badly macerated. I give, however, in Pl. III, Fig. 1, a view of a transverse section of the sphincter, having omitted such a figure in my earlier paper.

10. PALYTHOA NIGRICANS sp. nov.

Station No. 24. Off Key West; Sand Key light bearing N. N.W., Key West light bearing N.; about 60 fathoms; 3 colonies on coral rock.

I have adopted for the Zoantheæ the generic definitions as

given by Haddon and Shackleton ('91 and '91 *bis*), and consequently refer this form, which according to Erdmann's classification ('85) would be regarded as a Corticifera, to the genus Palythoa.

The colonies form compact masses, with a thickness of about 1–1.5 cm., the individual polyps measuring on an average about 0.7 cm. in diameter. As in other members of the genus they are imbedded in cœnenchyme throughout the greater portion of their length, only the upper part of each individual being free, though it is to be noted that even the most contracted individuals project somewhat above the general level of the cœnenchyme. Many of the individuals were, however, only partially contracted, the mouth and a portion of the disk being frequently visible, but in all cases the tentacles were curled in beneath the margin so that they could not be counted. The general color of the preserved colonies was yellowish sandy, the color deepening towards the bases of the tentacles to what is almost orange. The disk is apparently of a lighter shade than the column and a considerable quantity of black pigment, in the form of granules, occurs in the endoderm of the mesenteries especially towards their inner ends below the level of the stomatodæum, and also in the lacunar spaces of the lower portion of the column wall and in the basal lacunæ of the mesenteries. As a result of the presence of this pigment the lower portions of the colonies have a greyish black color, very distinctly seen when a portion of a colony is cut away or when the base of the colony is examined.

The mesoglœa is throughout thickly studded with foreign particles, mostly irregular fragments of carbonate of lime, though foraminiferous shells and sponge spicules also occur. In sections through decalcified specimens the column wall has a fenestrated appearance owing to the imbedded particles having been dissolved out (Pl. III, Fig. 6). Of the ectoderm little can be said, as the preservation of the material was by no means what was to be desired, but apparently it was not divided into compartments by lamellæ of mesoglœa as in

Zoanthus, nor did it seem to be covered by a sub-epidermal layer of mesoglœa.

The upper part of each polyp showed a number of ridges radiating, in the completely contracted specimens, from the center of the upper surface of the column; they were not, however, very distinctly marked. The mouth is small and oval or slit-like in form and the stomatodæum presents the usual single siphonoglyph, whose mesoglœa is thickened and has the truncate form noted for other species of Palythoa.

Sections show that the mesenteries are arranged on the brachycnemic plan; I counted in one specimen eighteen pairs and in another twenty. The individual mesenteries are very thin, and each is provided with elongated basal lacuna, which in the lower part of the column becomes almost circular. I can say nothing regarding the musculature of the mesenteries, the internal parts being in a very imperfect state of preservation; I should judge, however, that the longitudinal musculature was very weak as I could find no traces of mesoglœal processes for its support. Reproductive organs, spermatozoa, occurred very abundantly in the lower portions of the mesenteries and the species seems to be unisexual; in fact all the individuals of a colony seem to be of the same sex, since specimens taken from various parts of one colony all possess only spermatozoa.

The sphincter muscle is moderately long but narrow, consisting practically of but a single row of cavities (Pl. III, Fig. 7). It is, of course, mesoglœal.

In its general appearance this species resembles the *P. mammillosa* of Duchassaing and Michelotti as represented in their Pl. VI, Fig. 10 ('64), but it must be observed that they include *P. ocellata* and *P. flava* under this title, an alliance which may possibly be correct for *P. flava*, but not, I believe, for *P. ocellata*. The present species differs from the figure of *P. mammillosa* given by Ellis and Solander ("86) in that the polyps at the edge of the colony are not at all, or but slightly, separated by longitudinal grooves, a fact which may or may not be of importance, and apparently *P. mammillosa*

Explanation of Plate I.

Fig. 1. *Halcurias pilatus* from Station No. 64. About natural size.

Fig. 2. Longitudinal section through the upper part of the column of *Halcurias pilatus*, showing the absence of a sphincter muscle.

Fig. 3. Transverse section through a portion of the column of *Halcurias pilatus* in the stomatodæal region. D=directive mesenteries; si=siphonoglyphs.

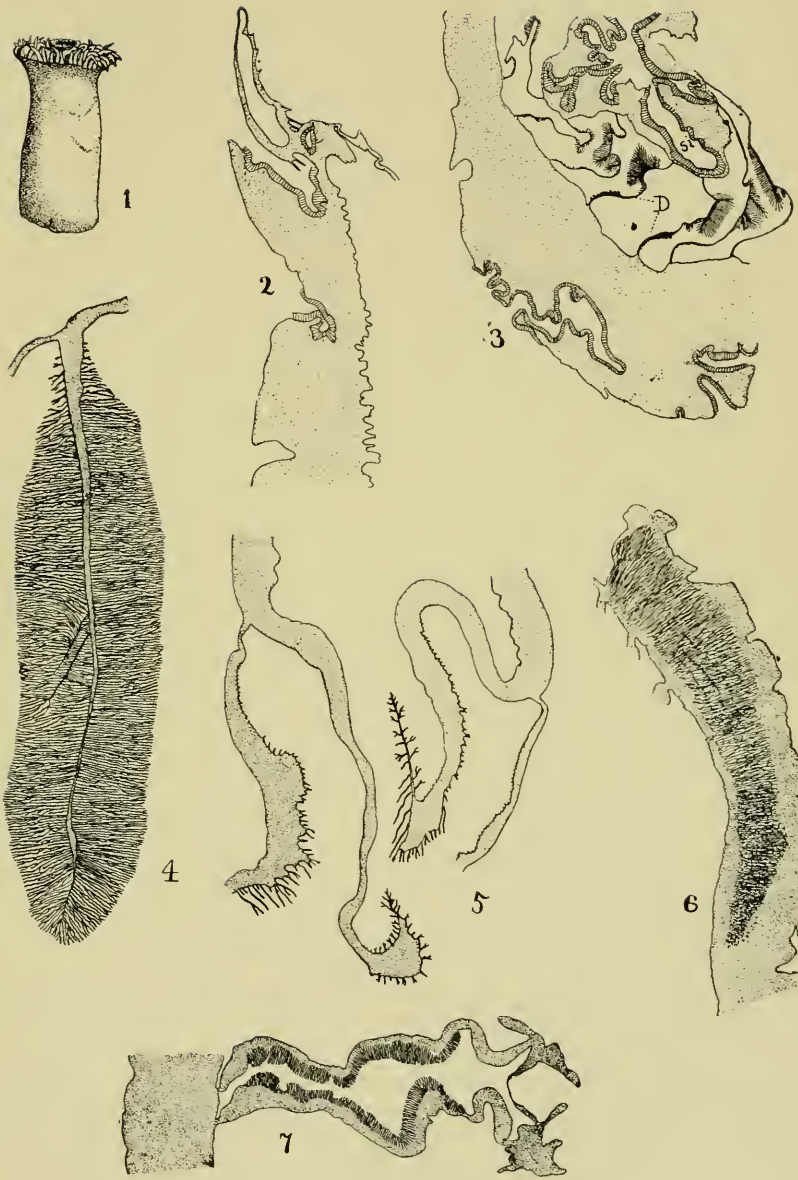
Fig. 4. Transverse section of the sphincter muscle of *Bolocera pollens*.

Fig. 5. Longitudinal section through the basal portion of a tentacle of *Bolocera pollens*, to show the tentacular sphincter.

Fig. 6. Transverse section through the sphincter of *Adamsia tricolor*, to show its general form.

Fig. 7. Transverse section through a pair of mesenteries of the first cycle of *Adamsia tricolor* in the stomatodæal region.

PLATE I.



Explanation of Plate II.

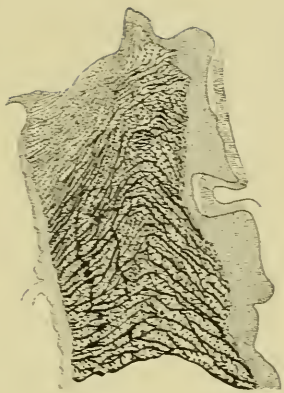
Fig. 1. Transverse section through the upper part of the sphincter of *Adamsia tricolor*.

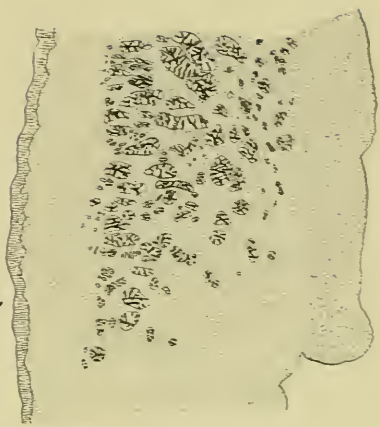
Fig. 2. Transverse section through the lower part of the sphincter of *Adamsia tricolor*. This figure was drawn under higher magnification than the preceding one.

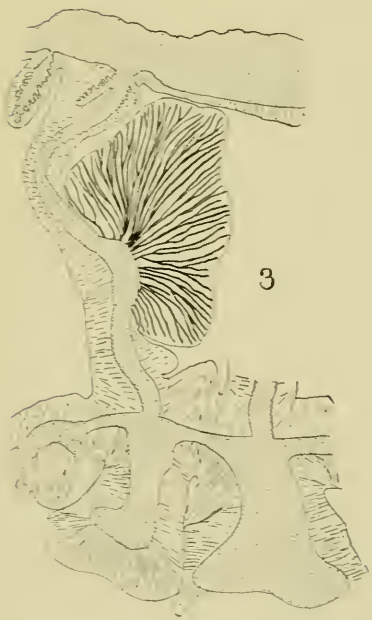
Fig. 3. Transverse section through mesenteries of the first and third cycles of *Sagartia spongicola*.

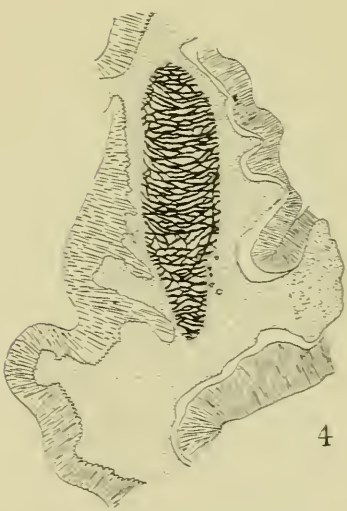
Fig. 4. Transverse section through the sphincter muscle of *Sagartia spongicola*.

PLATE II.









Explanation of Plate III.

Fig. 1. Transverse section through the sphincter muscle of *Zoanthus sociatus*.

Fig. 2. *Epizoanthus hians* on worm tube. About natural size.

Fig. 3 Longitudinal section through the upper part of the column of *Epizoanthus hians*. st=stomatodæum; sp=sphincter; t=tentacle.

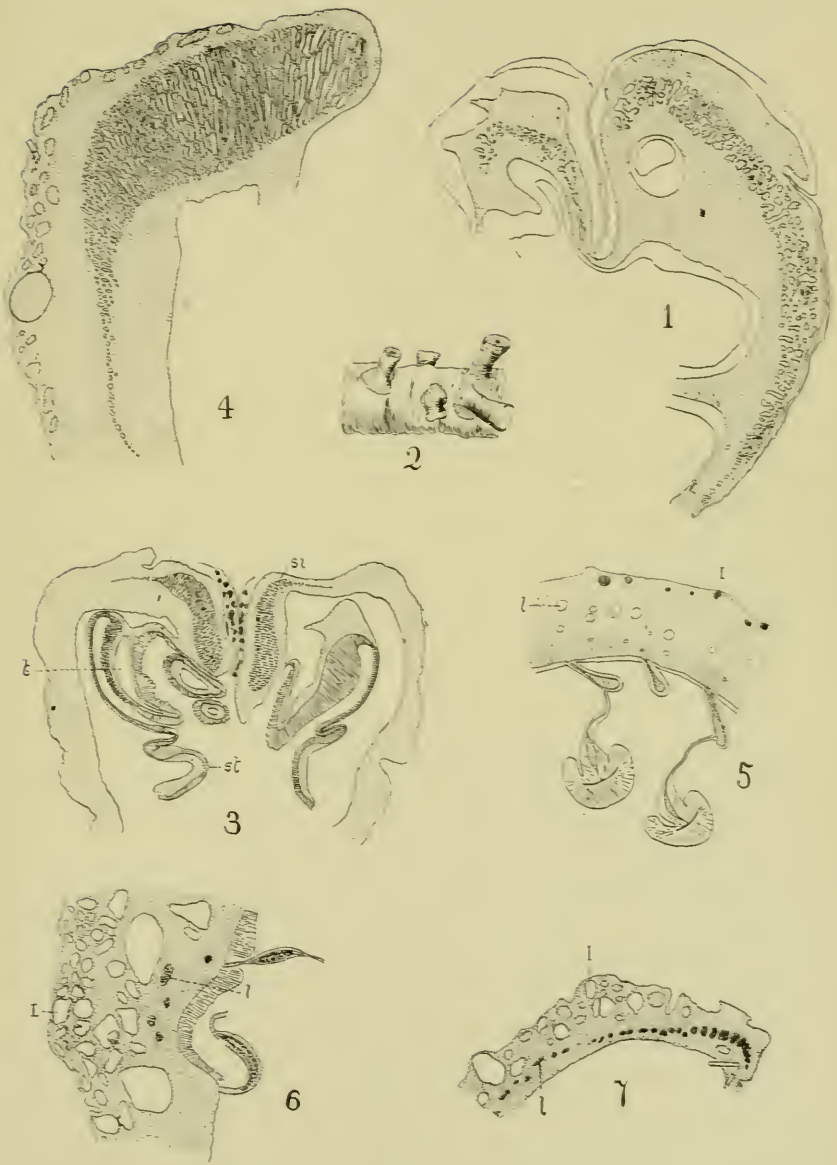
Fig. 4. Transverse section through the sphincter muscle of *Epizoanthus hians*.

Fig. 5. Transverse section through a portion of the column wall and mesenteries of *Epizoanthus hians*, below the level of the stomatodæum. I=inclusions in mesoglœa; l=lacunæ.

Fig. 6. Transverse section through part of the column wall of *Palythoa nigricans*. I=inclusions in mesoglœa; l=lacunæ.

Fig. 7. Longitudinal section through the upper part of the column wall of *Palythoa nigricans*. sp=sphincter muscle; I=inclusions in mesoglœa; l=lacunæ.

PLATE III.



did not posses black pigment in its endoderm, as no mention is made of it, although individuals of a colony were dissected. In fact the occurrence of this black pigment in the present species seems to separate it from all hitherto described species from the West Indies, except the *P. lutea* of Hertwig and Erdmann from the Bermudas, in which "Das ganze entodermale Epithel is mit dunkeln Körnchen pigmentiert" (Erdmann '85). This form is, however, very different from the present one, judging from the figure of a colony given by Erdmann and Hertwig ('88).

In addition to the occurrence of the pigment the shape of the sphincter also serves to separate the form now under discussion from *P. ocellata* and *P. flava*, it being much shorter and weaker, and a distinguishing feature is also found in the greater amount of foreign matter contained in its mesoglœa, sections of its column wall appearing when decalcified much more fenestrated than in either of the species just mentioned. From *P. cinerea* Duch. and Mich. it seems to be distinguished by the lesser size of its polyps, and from *P. glutinosa* Duch. and Mich., *P. caribœa* Duch. and Mich., *P. glareola* Lesueur, and *P. lutea* Hertwig it differs in the marked projection of the contracted polyps above the general surface of the cœnenchyme.

With none of the West Indian species of Palythoa then does it appear to agree, nor do I see any reason for identifying it with any of the species described from other localities. The depth from which it was taken does not seem to be sufficient to preclude its identity with one of the littoral forms, and yet it seems to be decidedly different from any at present known. How far the occurrence of the black pigment is a specific characteristic remains to be seen, but it seems improbable that it is merely a local or a seasonal peculiarity.

11. EPIZOANTHUS HIANS sp. nov.

Station No. 51. American Shoal light bearing N. by W. 10 miles; about 100 fathoms.

Station No. 52. American Shoal light bearing N. by W. ½ W.; about 10 miles; 105–110 fathoms.

Station No. 28. Sand Key light bearing N. about 6 miles; 116 fathoms.

Tank 8.

This form, which appears to be a new species, was abundantly represented in the collection. The individuals occur singly or in groups of from two to four, arising from a low flat plate of cœnenchyme, and are free throughout their entire length (Pl. III, Fig. 2). The colonies occur principally on sponges, though also on tubes of Hyalinœcia (?) and, in case of the specimens from Station 52 on a branching, dense, calcareous substratum which seems to be a millepore, and on the serpulid tubes which twined around the base of this.

All the specimens are completely contracted, the extremity of the column in the majority being flattened and marked by a number of ridges radiating out from the central depression. The various individuals vary somewhat in size, the largest having a height of about 1.4 cm., and a diameter at the top of the column of 0.5 cm., but many individuals were only 0.2–0.3 cm. in height with a diameter of about the same; gradations between these two extremes occur in abundance. The wall is firm and on a superficial view shows no trace of foreign incrustation, though sections reveal foreign matter such as sand and sponge spicules imbedded in the outer part of the mesoglœa fairly abundantly on the upper part of the column, but more scantily below. The introverted portion of the column has the inclusions most abundant. No trace of color persists in any of the specimens.

The tentacles are arranged in two cycles. Their musculature is fairly well developed, and in their mesoglœa sponge spicules and foraminferous shells are imbedded, especially towards their bases, but also less abundantly throughout almost their entire length.

The mouth is large and in all the specimens examined was widely open, the tips of the tentacles projecting into it (Pl. III, Fig. 3). The stomatodæum is short and is furnished as usual with a single siphonoglyph, moderately deep and with the mesoglœa of its walls considerably thickened.

The mesenteries are arranged on the macrocnemic plan. In two specimens I counted in each twenty mesenteries on one side and twenty-one on the other. The shape of the perfect mesenteries is somewhat peculiar. The basal portion of each is thickened and distinctly club-shaped, the longitudinal musculature being situated on one surface of this portion, and from a little below the tip of the club a very thin lamella begins, which terminates at its free edge in the mesenterial filament and bears the reproductive organs when these are developed (Pl. III, Fig. 5). In one specimen examined, ova were found in this thin portion of the perfect mesenteries and there were no signs of spermatozoa, so that it may be presumed that the species is unisexual. The imperfect mesenteries resemble the muscular portion of the perfect ones, the gonophoric lamella and the mesenterial filaments being wanting. No basal lacunæ occurred in any of the mesenteries. Owing to the width of the stomatodæum and the consequent small space between it and the inner surface of the column wall the mesenteries are narrow, a feature especially noticeable in sections below the level of the stomatodæum since the mesenteries project only a relatively short distance into the cœlenteron and thus leave a large empty space in the center of the column.

The sphincter muscle (Pl. III, Fig. 4) is imbedded in the mesoglœa and is strong, especially that portion which is contained in the wall of the introverted portion of the column. At its upper end it is composed of numerous elongated cavities, whose long axes are at right angles to the column axis; further down the cavities become smaller and oval, though still occupying a considerable portion of the thickness of the column wall, but below the introvert it becomes rapidly reduced to a single row of small oval cavities which approach the endodermal surface of the mesoglœa as they are traced downwards.

The form which approaches this most nearly is that described by Erdmann ('85) as species 4, and named by Hertwig ('88) *E. stellaris*. It was obtained by the "Challenger" off one of the Philippine Islands. In the general form of the

column this form differs greatly, however, from *E. hians*, and taking this into consideration with the localities from which the two forms were obtained it seems proper to regard the West Indian species as new.

University of Michigan,
July 28th, 1897.

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