... and Bigelow, C.S. Pelagic Tunicata of the Albatross Pacific expedition. (1905)

Ritter W.E.

Memoirs of the Museum of Comparative Zoology

AT HARVARD COLLEGE.

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REPORTS ON THE SCIENTIFIC RESULTS OF THE EXPEDITION TO THE TROPICAL PACIFIC, IN CHARGE OF ALEXANDER AGASSIZ, IN THE U. S. FISH COMMISSION STEAMER "ALBATROSS," FROM AUGUST, 1899, TO MARCH, 1900, COMMANDER JEFFERSON F. MOSER, U. S. N., COMMANDING.

VIII.

THE PELAGIC TUNICATA.

BY WILLIAM E. RITTER AND EDITH S. BYXBEE.

WITH TWO PLATES.

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The following Publications of the Museum contain Reports on the Dredging Operations in charge of Alexander Agassiz, of the U. S. Fish Commission Steamer "Albatross," during 1899 and 1900, Commander Jefferson F. Moser, U. S. N., Commanding.

I. A. AGASSIZ. Preliminary Report and List of Stations. With Remarks on the Deep-Sea Deposits by Sir John Murray. Mem. M. C. Z., Vol. XXVI. No. 1. January, 1902. 114 pp. 21 Charts.

II. A. G. MAYER. Some Species of Partula from Tahiti. A Study in Variation. Mem. M. C. Z., Vol. XXVI. No. 2. January, 1902. 21 pp. 1 Plate.

III. A. AGASSIZ and A. G. MAYER. Medusæ. Mem. M. C. Z., Vol. XXVI. No. 3. January, 1902. 40 pp. 13 Plates, 1 Chart.

IV. A. AGASSIZ. The Coral Reefs of the Tropical Pacific. Mem. M. C. Z., Vol. XXVIII. February, 1903. 33, 410 pp. 238 Plates.

V. C. R. EASTMAN. Sharks' Teeth and Cetacean Bones from the Red Clay of the Tropical Pacific. Mem. M. C. Z., Vol. XXVI. No. 4. June, 1903. 14 pp. 3 Plates.

VI. W. E. HOYLE. Cephalopoda. Bull. M. C. Z., Vol. XLIII. No. 1. March, 1904. 71 pp. 12 Plates.

VII. H. LUDWIG. Asteroidea. Mem. M. C. Z., Vol. XXXII. July, 1905. 12, 292 pp. 35 Plates, 1 Chart.

VIII. W. E. RITTER and EDITH S. BYXBEE. The Pelagic Tunicata. Mem. M. C. Z., Vol. XXVI. No. 5. August, 1905. 20 pp. 2 Plates.

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The occasion for the present paper was the request of Alexander Agassiz that the authors should examine the pelagic Tunicates secured by the "Albatross" during her cruise in the tropical Pacific from August, 1899, to March, 1900.[1] The material obtained on this voyage is the most interesting of any of the "Albatross" collections yet examined by us. The new Pyrosoma, which we take pleasure in inscribing to Mr. Agassiz, is especially interesting.

The collections upon which report is made have been brought together from many localities in the Pacific Ocean. By far the most important were made by the United States Fish Commission steamer "Albatross" on her many voyages since she first entered the waters of the Great Ocean in January, 1888.

Cyclosalpa bakeri Ritter.

Stn. 7 A.A., Sept. 1, 1899, Lat. N. 10° 19′, Long. W. 134° 57′, surface temp. 76°, surface net, 8 p.m. Two specimens, solitary generation, were taken.

[1] For a list of the Stations and a chart of the route see Memoirs M. C. Z., XXXVI., No. 1, January, 1902.

They were in a very bad state of preservation, in consequence of which the arrangement of the muscle bands, so characteristic of this species, could not be made out; however, the simple hypophysis mouth, and the longitudinal glands, make the identification reasonably certain.

Cyclosalpa affinis Chamisso.

Stn. 31 A.A., Sept. 19, 1899, Lat. S. 12° 20′, Long. W. 144° 15′, surface temp. 80°; taken in deepest part of channel separating the Marquesas from the Paumotu, 7 P. M. Two specimens of the solitary generation.

Stn. 2928, Jan. 23, 1889, off Southern California, Lat. N. 32° 47′, Long. W. 118° 10′, surface temp. 59°. Six specimens of the aggregate generation.

Salpa confoederata-scutigera Forsk. Cuv.

This species seems to be common off the coast of California and very variable. It is rare in the south seas. It was collected at four stations on these voyages.

Stn. 2928, Jan. 23, 1889, off Southern California, Lat. N. 32° 47′ 30″, Long. W. 118° 10′, surface temp. 59°. One specimen of the aggregate generation.

The test over the posterior part is much thickened and ridged, the ridges covered with papillae.

Stn. 2937, Feb. 4, 1889, off the coast of Southern California, Lat. N. 33° 04′ 30″, Long. W. 117° 42′, surface temp. 62°. A number of the aggregate generation of various sizes was collected.

All have the test much thickened over the viscera. The larger specimens have short processes scattered over this thickened portion, and a few over the soft anterior part.

Stn. 2946, Feb. 6, 1889, off Southern California, Lat. N. 33° 58′, Long. W. 119° 30′ 45″, surface temp. 56.5°. A number of large chains.

The specimens are in such poor condition that no internal characteristics can be made out, but they seem to belong to this species.

Stn. 15 A.A., Sept. 8, 1899. Lat. N. 4° 35′, Long. W. 136° 54′, surface temp. 79°. A single young specimen of the solitary generation was collected on the surface.

Salpa democratica-mucronata Forsk.

This species was taken at two stations, both off the coast of Southern California.

Stn. 2928, Jan. 23, 1889, Lat. N. 32° 47′ 30″, Long. W. 118° 10′, surface temp. 59°. A number of both generations was collected. The solitary generation has very long, slender processes at the posterior end. In some cases these processes are almost as long as the body. In this particular they approach Traustedt's var. *flagellifera*, but there is no other resemblance between the two.

Stn. 2937, Feb. 4, 1889, Lat. N. 33° 04′ 30″, Long. W. 117° 42′, surface temp. 62°. Both generations were collected, exactly similar to those taken at station 2928.

Salpa fusiformis-runcinata Cuv.-Cham.

This is the most common species in the collections. Large numbers of both generations were taken at different stations from the coast of Alaska to the South Pacific.

Stn. 2869, Sept. 21, 1888, Lat. N. 47° 38′, Long. W. 124° 39′, surface temp. 60°. Between Sitka and the Columbia River. Specimens in a very poor state of preservation.

July 12, 1887–88, Beaver Harbor (no such date given in printed records), British Columbia. There are a number of both generations bearing this label.

The test is somewhat thickened over the posterior part and provided with ridges.

Stn. "Sur. 35," 1887–88.

Stn. "Sur. 36,"[1] 1887–88.

[1] Mr. C. H. Townsend writes us as follows concerning these stations: "I think surface tow-net station No. 36 must certainly have been made immediately north of the Galapagos Islands. The surface tow-net records of that voyage were not printed in the 'Albatross' report for that year."

No record of these two tow-net stations can be found. From the nearest record it would seem that the "Albatross" was in the vicinity of the Galapagos Islands.[1] There are a large number of the aggregate generation in this collection.

Stn. 7 A.A., Sept. 1, 1899, Lat. N. 18° 19′, Long. W. 134° 57′, surface temp. 76°. A number of specimens of the solitary generation were taken at the surface. 8 P. M.

Stn. 12 A.A., Sept. 4, '99, Lat. N. 12° 07′, Long. W. 137° 18′. Surface temp. 81°. Four large specimens of the aggregate generation were collected between a depth of 150 fathoms and the surface. Two of them measure 6.5 cen. in extreme length and the smallest measures 4.5 cen. The test over the nucleus is much thickened and ridged, and the posterior processes show a tendency to become prismatic. Variations of this kind are mentioned by Herdmann as occurring in large specimens collected in the South Pacific by the "Challenger."

Stn. 14 A.A., Sept. 7, 1899, Lat. N. 6° 41′, Long. W. 137°, surface temp. 82°. One specimen of the solitary and three of the aggregate generation were taken on the surface at 8 P. M.

All of the aggregate generation have the anterior and posterior processes very short and bifurcated. Two of them have a short process at the level of the branchial orifice on the left side.

Stn. 15 A.A., Sept. 8, 1899, Lat. N. 4° 35′, Long. W. 136° 54′, surface temp. 79°. Two of the solitary and four of the aggregate generation were collected on the surface at 8 P. M.

All are more or less angular. Those of the aggregate generation have the serrate ridges strongly developed, and the test much thickened over the nucleus.

Stn. 31 A.A., Sept. 19, 1899, Lat. S. 12° 20′, Long. W. 144° 15′, surface temp. 80°. Two specimens of the solitary generation were taken on the surface, 7 P. M.

Stn. 89 A.A., Oct. 14, 1899, Lat. S. 16° 03.5′, Long. W. 145° 43′, surface temp. 80°. About one mile N. 28° W. of north entrance to Fakarava. Two specimens of the aggregate generation were taken between 350 fathoms and the surface.

[1] See note on page 197.

Salpa fusiformis-runcinata form echinata.

Two specimens of this form were taken on successive days not far from the equator.

Stn. 14 A.A., Sept. 7, 1899, Lat. N. 6° 41′. Long. W. 137°, surface temp. 82°. One specimen of the solitary generation was taken at the surface at 8 P.M. It is 6 cen. in length, 15 mm. in breadth near the posterior end and about 10 mm. at the anterior end. The chain of blastozooids is well developed.

Stn. 15 A.A., Sept. 8, 1899, Lat. N. 4° 35′. Long. W. 136° 54′, surface temp. 79°. One specimen of the solitary generation.

Salpa cylindrica Cuv.

Stn. 2928, Jan. 23, 1889. Off the coast of Southern California. Lat. N. 32° 47′ 30″. Long. W. 118° 10′, surface temp. 59°. A number of the solitary generation were taken.

Salpa tilesii-costata Cuv.-Quoy et Gaim.

Stn. 2928, Jan. 23. 1889. Off Southern California. Lat. N. 32° 47′ 30″, Long. W. 118° 10′, surface temp. 59°. A number of specimens apparently belonging to this species were collected. They are in very bad condition and only the general shape serves to identify them.

Stn. 236 A.A., Jan. 28, 1900. About forty-six miles southwest of south point of Arhno. Lat. N. 6° 34′, Long. E. 170° 59′, surface temp. 81°. Four specimens were taken on the surface by electric light. They are in very good condition. There are numerous sharp-pointed papillae scattered over the test of the dorsal side.

Salpa zonaria-cordiformis Pall.-Quoy et Gaim.

Specimens of this species were collected at four localities:

Stn. 2 A.A., Aug. 27, 1899, Lat. N. 28° 23′, Long. W. 126° 57′. surface temp. 66°. Four specimens of the aggregate generation were collected on the surface at night.

Three are about 1 cen. in length and have rather narrow muscle bands. One of these has the posterior extremity prolonged into a prominent process about 1 mm. in length. The fourth specimen is 2 cen. long and has much broader muscle bands than the other three.

Stn. 12 A.A., Sept. 4, 1899, Lat. N. 12° 07′, Long. W. 137° 18′, surface temp. 81°. One specimen of the aggregate generation was collected. It is 1.5 cen. in length, with a process at the posterior end measuring 5 mm.

Stn. 15 A.A., Sept. 8, 1899, Lat. N. 4° 35′, Long. W. 136° 54′, surface temp. 79°. One specimen of the solitary generation was taken at 8 P. M.

Stn. 31 A.A., Sept. 19, 1899, Lat. S. 12° 20′, Long. W. 144° 15′, surface temp. 80°.

One specimen of the solitary generation and four of the others have a short bifid process.

Salpa hexagona Quoy et Gaim.

This species was collected at three stations in the tropical Pacific.

Stn. 8 A.A., Sept. 2, 1899, Lat. N. 17° 13′, Long. W. 136° 09′. A single young specimen of the solitary generation was taken in the trawl, which had been down to a depth of 3088 fathoms. It measures 11 cen. in length, exclusive of the two posterior processes which are 1 cen. long, and is 3 cen. in breadth. This makes it almost exactly twice the size given by Traustedt in his description of the species. The processes, however, in Traustedt's figures are about $\frac{1}{5}$ the length of the body and are serrate. In this specimen the processes are only $\frac{1}{11}$ of the length of the body and are smooth. In all other respects the specimen agrees perfectly with Traustedt's figures.

Stn. 12 A.A., Sept. 4, 1899, Lat. N. 10° 57′, Long. W. 137° 35′, surface temp. 81°. Fifteen specimens of solitary generation were collected.

They are all young with a large part of the eleoblast still present. Their average length is 3 cen. and the processes at the posterior end are $\frac{1}{3}$ of the length of the body.

Sta. 12 A.A., Sept. 4, 1899, Lat. N. 10° 54′, Long. W. 137° 35′. Fifteen specimens of the aggregate generation were collected on the surface.

Their ridges are only slightly serrate.

Stn. 14 A.A., Sept. 7, 1899, Lat. N. 6° 41′, Long. W. 137°, surface temp. 82°. A single specimen of the solitary generation was taken on the surface at 8 P. M.

Pyrosoma giganteum Les.

Stn. 3474, Dec. 6, 1891, Lat. N. 21° 12′, Long. W. 157° 38′ 30″, Hawaiian Islands. Surface temp. 77°. Two specimens measuring respectively 8 cen. long and 5 cen. broad at closed end and 2 cen. broad at open end; and 6 cen. long and 2.5 cen. broad at open end; .9 cen. broad at closed end; colony narrowing abruptly toward closed end.

Pyrosoma atlanticum.

Stn. 14 A.A., Sept. 7, 1899, Lat. N. 6° 41′, Long. W. 137°, surface temp. 82°. Fourteen specimens were taken in the surface tow-net at 8 P. M. The largest measures 11.8 cen. in length, 2.7 cen. in greatest breadth, 2.4 cen. at the open, and 1.3 cen. at the closed end. The smallest measures 5.5 cen. in length, 1.3 cen. greatest breadth, .9 cen. at open, and .6 at closed end. All are of a beautiful clear shining white color.

Pyrosoma agassizi, sp. nov.

External Characters. Colony cylindrical, flaccid, 12 cen. long, 1 cen. broad in the middle, tapering very slightly toward both extremities. Surface covered with small quadrangular processes, 1 to 5 mm. in length, tapering abruptly from a broad base to an acute point; all curving toward the open end of the colony. Common atrial opening 6 mm. wide, guarded by four large processes of the test. These processes 6 mm. long, non-muscular, quadrangular, tapering to a blunt point; placed in pairs on opposite sides of the opening over which they curve. Test between processes thin. Vessels carrying muscles running down into this thin test. Pl. I, fig. 1.

Test 3 mm. thick, gelatinous, transparent.

Zooids visible through the test, numerous, much flattened laterally, all placed with the dorsal edge toward the common opening of the colony, the larger zooids averaging 2 mm. long by 3 mm. broad. Young zooids and buds thickly scattered among the older zooids, Pl. I, figs. 2 and 3.

Mantle delicate. Muscles of the prebranchial zone well developed, especially one immediately above the peripharyngeal band. Atrial sphincter strong.

Branchial Apparatus. Branchial orifice at the base of a process of the test which curves over it, on the side toward the open end of the colony. Ventral tentacle present, also about twelve others; these slender and irregularly placed, varying in number and size in zooids of different ages. Branchial sac, with usually 20–26 stigmata on each side; 16 longitudinal bars on each side. Endostyle large, strongly curved. Dorsal languets, about six in number, very slender. Peripharyngeal band delicate, limbs not meeting on the dorsal side, but the two turning back and forming a broad angle, within which the dorsal tubercle is situated.

Ganglion large. Gland conspicuous; its duct long and bent near the middle; opening circular. Phosphorescent bodies large and prominent in the young zooids, becoming less conspicuous in the older ones, the cells composing them apparently decreasing in number and becoming somewhat scattered.

Digestive tract compact. Oesophagus short, funnel-shaped, entering the stomach near its middle. Stomach nearly globular. Rectum bent sharply back immediately on leaving the stomach and remaining parallel to it, Pl. I, fig. 4.

Atrial chamber small. Atrial orifice large, circular, furnished with a single tentacle on its dorsal edge; this tentacle long, somewhat flattened, abruptly tapering to an acute point, Pl. I, figs. 3 and 7.

Gonads not seen.

Buds. Every large zooid provided with a stolon bearing three buds, the largest of the buds with stolon well developed before it breaks loose from the stolon by which it is produced. Branchial tentacles fewer in number and relatively much larger in young blastozooids than in older ones.

This species differs strikingly in external appearance from any of the described species of Pyrosoma, unless it be *P. spinosum*. The colony is more cylindrical than is usual, is very slender, and especially is altogether flaccid, the test lacking entirely the rigidity of that of *P. atlanticus* and *giganteum*. The most noticeable external difference, however, is the character of the common cloacal opening.

Instead of the muscular diaphragm, which is a characteristic of all species, this one is provided with four non-muscular guarding processes. The test connecting these processes forms a very thin wall. The characteristic vessels bearing muscle fibres run from the zooids down into this wall of test and terminate there. No muscles could be detected in the processes themselves. The processes arise from bulb-like enlargements of the test about the common cloacal opening. These enlargements are somewhat wrinkled, as though by the movement of the processes, Pl. I, fig. 1. It would seem that such movement could only be caused by water currents, however. The spines covering the test of the colony resemble those described by Herdman for *P. spinosum*.

Turning to the interior of the colony, the shape of the zooids is characteristic. In all the previously known Pyrosomae, the mature zooid is elongated antero-posteriorly. In *P. agassizi*, however, all the zooids, young and old, are much broader than long, fig. 3. These proportions obtain also both for the branchial sac and the atrial chamber, as well as for the zooid as a whole. The branchial sac is one third broader than long. The atrium is at least four times as wide as deep. While no gonads have been found, the zooids seem to be fully developed in all other respects, but in no case was there found an appreciable departure from the proportions above given. The zooids are much flattened laterally.

The musculature resembles that of *P. spinosum*, which the species seems most nearly to approach. There are the usual muscles in the prebranchial region, and besides there is a strong sphincter just above the ganglion, Pl. II, fig. 6. The atrial sphincter is strong, especially under the atrial tentacle, where it is at least three times as wide as elsewhere, fig. 7. Its nuclei are arranged in bunches running across the muscle and giving it a banded appearance, figs. 7 and 8. Under the atrial tentacle the nuclei are more irregularly scattered than elsewhere. The mid-atrial muscle is absent (?). At least a prolonged search has failed to reveal it. Its absence is probably correlated with the extreme shortness of the atrial chamber.

The oesophagus is cone-shaped, resembling that of *P. atlanticum*, but instead of entering at the end, it runs back in a fold of the stomach and enters it near the centre, fig. 4. The compactness of the whole digestive tract is characteristic. Instead of spreading across nearly the entire end of the branchial sac, it is confined to a space not much larger than the stomach. In fact, from the right side, only the stomach is visible, Pl. I, fig. 3. The digestive tract is situated a little to the dorsal side of the median line. Both the endostyle and row of dorsal languets approach it, and as a result curve around under the rows of stigmata. The endostyle is very strongly bent, fig. 3.

The peripharyngeal band is not closed on the dorsal side, but turns backward, forms a large angle about the dorsal tubercle, and extends along the dorsal side of the zooid — another point of resemblance to *P. spinosum*.

The large ganglion, Pl. II, fig. 6, has two large and two smaller nerves arising from its posterior end. At the anterior end there are two large ones and two pairs of smaller ones. The duct of the gland is long and bent near its middle.

The shape of the atrial chamber somewhat resembles that figured by Seeliger for young zooids of *P. atlanticum* var. *laevatum*. It is shallow and very broad, and the opening is large, figs. 2 and 3. The presence of the tentacle on its dorsal edge is distinctive, however. As is shown in Pl. II, fig. 7, this is formed of mantle alone. The test about the atrial orifice stops at its base. For a short distance on each side of it the mantle is much thickened. The edges of the tentacle are also thickened.

There does not seem to be as much difference as usual between the ventral tentacle and the other smaller branchial tentacles, Pl. I, fig. 3. This seems due both to the ventral tentacle being somewhat smaller and the others somewhat larger than usual.

There is only one specimen of this peculiar form in the collection. It was taken with the trawl, which had been down 830 fathoms, at Station 25 A. A. (in the vicinity of the Marquesas Islands) on Sept. 14, 1899, Lat. S. 8° 48′, Long. W. 139° 48′. Surface temp. 80°. Bottom temp. 38°.

It seems probable that, like *P. spinosum*, to which it is most nearly related, it is a deep-sea form. It resembles *P. spinosum* in the character of the spines covering the test and possibly in the character of the test itself, though descriptions of this structure in this latter species are meagre. It also resembles it in the arrangement of muscles about the branchial orifice and in the course taken by the peripharyngeal band. It differs in size, in the possession of an atrial tentacle, and probably in the shape of the zooid and in the character of the digestive tract.

It will probably appear to students of the pelagic Tunicata that the species here described is sufficiently distinct from any hitherto known Pyrosoma to deserve being regarded as the type of a new genus. This was the view held by us until a considerable collection of Pyrosomae recently came into our hands through the kindness of Professor C. H. Gilbert of the Leland Stanford Junior University, that was secured by the "Albatross" on her Hawaiian cruise during the summer of 1902. In this collection are several specimens identical with the colony here described, excepting that in some of them the four processes about the cloacal orifice are absent. We had regarded these as the most important characteristic of the new genus which it was our intention to establish. We consequently decided to adopt the more conservative course and, for the present at least, treat the new form as a highly distinct species of the old genus.

Species.	Station.	Date.	Latitude.	Longitude West.	Surface temp.	Depth.
			° ′ ″	° ′ ″		
Cyclosalpa bakeri	7 A. A.	Sept. 1, '99	N. 10 19	134 57	76	Surface.
C. affinis	31 A. A.	Sept. 19, '99	S. 12 20	144 15	80	Surface.
	2928	Jan. 23, '89	N. 32 47 30	118 10	59	
Salpa confoederata-scutigera . . .	2928	Jan. 23, '89	N. 32 47 30	118 10	59	
	2937	Feb. 4, '89	N. 33 04 30	117 42	62	
	2946	Feb. 6, '89	N. 33 58	119 30 45	56.5	
	15 A. A.	Sept. 8, '99	N. 4 35	136 51	79	Surface.
S. democratica-mucronata	2928	Jan. 23, '89	N. 32 47 30	118 10	59	
	2937	Feb. 4, '89	N. 33 04 30	117 42	62	
S. fusiformis-runcinata	2869	Sept. 21, '88	N. 47 38	124 39	60	
		July 12 '87–'88	Beaver	Harbor.		
	Stn. Sur. 35	" " '87–'88				Surface.
	Stn. Sur. 36	" " '87–'88				Surface.
	7 A. A.	Sept. 1, '99	N. 18 19	134 67	76	Surface.
	12 A. A.	Sept. 4, '99	N. 12 07	137 18	81	150 fathoms to surface
	14 A. A.	Sept. 7, '99	N. 6 41	137	82	Surface.
	15 A. A.	Sept. 8, '99	N. 4 35	136 54	79	Surface.
	31 A. A.	Sept. 19, '99	S. 12 20	144 15	80	Surface.
	89 A. A.	Oct. 14, '99	S. 16 03 5	145 43	80	350 fathoms to surface
S. fusiformis-runcinata form *echinata*.	14 A. A.	Sept. 7, '99	N. 6 41	137	82	"
	15 A. A.	Sept. 8, '99	N. 4 35	136 34	79	"
S. cylindrica	2928	Jan. 23, '89	N. 32 47 30	118 10	59	
S. tilesii-costata	2928	Jan. 23, '89	N. 32 47 30	118 10	59	
	236 A. A.	Jan. 28, 1900	N. 6 34	E 170 59	81	
S. zonaria-cordiformis	2 A. A.	Aug. 27, '99	N. 28 23	126 57	66	Surface.
	12 A. A.	Sept. 4, '99	N. 12 07	137 18	81	
	15 A. A.	Sept. 8, '99	N. 4 35	136 54	79	
	31 A. A.	Sept. 19, '99	S. 12 20	144 15	80	Surface.
S. hexagona	8 A. A.	Sept. 2, '99	N. 17 13	136 09	78	3088 fathoms (?)
	12 A. A.	Sept. 4, '99	N. 10 57	137 35	81	
	14 A. A.	Sept. 7, '99	N. 6 41	137	82	Surface.
Pyrosoma giganteum	3474	Dec. 6, '91	N. 21 12	157 38 30	77	
P. atlanticum	14 A. A.	Sept. 7, '99	N. 6 41	137	82	Surface.
P. agassizi	25 A. A.	Sept. 11, '99	S. 8 18	139 48	80	830 fathoms Bottom temp. 38°.

Oikopleura huxleyi (HUXLEY) RITTER.

Syn. **Appendicularia flagellum** HUXLEY.

There is almost no doubt that the species before us is the *Appendicularia flagellum* described by Huxley in 1851, though unfortunately the material at hand is not adequate in either quantity or quality to enable us to reach absolute certainty on the point.

Length of body of largest specimens 2 mm.+; length of tail 7 mm. to

10 mm.; maximum width of tail 1.75 mm. Anterior two thirds of body nearly cylindrical, posterior, visceral third considerably larger.

Tail broadest a short distance behind its attachment and gradually narrowing from here to its long, pointed extremity. Notochord rather thick, though scarcely visible through the highly developed musculature. Muscle layer considerably broader on each side of the notochord than the notochord itself, and leaving but a narrow band between its outer edge and the margin of the tail, unoccupied by muscle.

Branchial orifice very large, elliptical, regular in outline excepting for a broad, short process on its ventral side.

Hypophyseal organ large, cone-shaped, the base of the cone directed ventrally and somewhat backward. Extremely long and strong cilia within the duct, situated on some of the cells at the basal end, and extending up into the apex.

Ganglion considerably smaller than the hypophyseal organ, and apparently connected with the apical end of the latter. *Otocyst*, with its contained *otolith*, rather small and indistinct.

Peripharyngeal band broad, its dorsal limbs reaching far back behind the ganglion and hypophyseal organ.

Endostyle typically very large and conspicuous, owing to the great development of the four series of gland cells.

Oesophagus curved to nearly a semicircle so as to enter the dorsal side of the stomach. *Stomach* large, left lobe much larger than the right, the former rounded-quadrilateral in outline as seen from the left side, the antero-ventral angle extended into a broad coecum which reaches down along the left side of the rectum. Right side scarcely developed into a true lobe. Intestine arising from the right side, running forward, with a sharp bend toward the median line near its middle, then extending on forward in a nearly straight course to terminate close under the posterior end of the endostyle. *Sexual organs*, situated on the postero-ventral side of the stomach, small in all the specimens seen, hence not recognizably composed of male and female elements; apparently consisting of a single compact mass.

The "house," the *gill openings* and the *integumentary glands* alongside the anterior end of the endostyle, we have not found, none of the specimens being well enough preserved, probably, to show the last two structures. Furthermore, we are unable to give any definite information about the different areas of oikoplast epithelium distinguished by Lohmann, 1896, and other writers. Along the dorsal side of the body Pl. II, fig. 9, occurs a band of epithelium with distinct, cuboid cells that may be "membranophasts."

The absence of the enormous secreting cells situated on each side of the body, well toward the anterior end, and constituting what is called by Lohmann the "oval" has surprised us not a little. We were at first inclined to interpret the endostyle, or rather the great gland cells in it, as being these organs; but microtomic sections of the body revealed at once the erroneousness of this conjecture.

The gland cells of the endostyle, fig. 9, are apparently quite similar in size, structure of the cell body, and size and form of the nucleus, to those of the "oval." In none of the species of the genus hitherto described do we find special reference to the great development of the gland cells of the endostyle, though in some, e.g., *O. intermedia*, it appears from the figures of Lohmann, 1896, they do become much like those here described. Again, Salensky, 1903, in his recently published detailed anatomical study of *O. vanhoffeni*, speaks of the organ as being constituted "de grosses et hautes cellules glandulaires." We are unable, however, to recognize an anterior as distinguished from a posterior part of the organ in any such definite way as is described and figured by Salensky. There are, it is true, a few cells at the extreme anterior end, somewhat larger than those of the rest of the organ, fig. 9; but that they are different in character or relation is not obvious. We count about twenty of the large cells in each of the four series. Their nuclei are nearly perfect spheres, regular in outline, and considerably clearer than is the cell body. They are situated at the extreme outer ends of the cells. It should be mentioned that our description of the endostyle is made chiefly from specimens examined in toto, sectionized material not being sufficient to enable us to do much more than make out definitely that the large cells belong to the organ. We do not wish to be understood as casting doubt on Salensky's interesting observation relative to the anterior and posterior coeca of the endostyle, both communicating with the pharynx through a common small orifice. We mean only that, examined in toto, the presence of these coeca is not recognizable in our specimens.

Although Huxley's work on Appendicularia is so admirable from the point of view of general morphology, many of the details, upon which the present-day characterization of species and genera rests, he touched very meagrely or not at all. For example, the glandular areas by which the "House" is secreted, the "oikoplast" epithelia of Lohmann, he knew nothing about. In fact his studies on *Appendicularia flagellum* were made without his coming in contact with the "house" at all. Likewise his description of the intestinal tract is rather too meagre to satisfy the importance that this structure has assumed for purposes of classification at the hands of recent students of the group.

These deficiencies in Huxley's description and the incompleteness of our own data render the identification of the two forms as one and the same somewhat less certain than could be wished; nevertheless it is, we believe, justified by the following readily recognizable similarities: The two are essentially of the same size and dimensions (compare the measurements of our specimens given above with the size diagram marked "N. S." in Huxley's Pl. XVIII). This fact will be seen to have special importance when attention is called to the further fact that the length of the tail in this species is nearly three times that of the next largest species of the genus excepting *O. cophocerca*, which it just about equals.

The general outline of the body (compare fig. 9 with Huxley's Pl. XVIII, fig. 1, and fig. 2) of the two forms is essentially the same, and would seem to be rather sharply differentiated from most other species by the relatively large diameter of the anterior end to accommodate the unusually large branchial orifice, or mouth. The great length of the rectum and the far forward position of the anus in both forms is another apparently common characteristic.

Again, the tails agree in being narrowly pointed at the posterior end in both forms, and while this is not an exclusive character, the tails of so many of the other species of the genus are of some other form that considerable weight attaches to this similarity.

Finally the part of the world from which the two animals come supports the view that they are the same. They are both from the South Pacific. Huxley's specimens were taken on the coast of New Guinea, situated in Lat. 0° to 10° S. and Long. 132° to 152° W., while the specimens under consideration in the present paper are from Station 16 A. A. Lat. 2° 38′ N., Long. 137° 22′.

There are two points only in which the information at hand seems to indicate rather important differences between the two forms. Huxley says "a very distinct spherical auditory sac" is attached to the ganglion, and his figures indicate still more distinctly than do his words that this structure is much larger than it seems to be in our specimens. We assume, however, that the difference is due to the fact that Huxley studied living animals, while we have, of course, been able to examine only preserved ones and rather poorly preserved ones at that.

The other seeming difference is in the musculature of the tail. Huxley's figures certainly do not indicate as wide a band of muscle on each side of the notochord as is present in the specimens examined by us. As shown in fig. 11, there is almost no muscleless zone between the outer border of the muscle and the margin of the tail, while Huxley's figures show a wide zone of this kind. So far as this fact by itself is concerned, we might suppose the difference to be due again to shrinkage in preservation suffered by our specimens. It seems, however, that the muscle bands in our specimens are broader *relatively to the notochord* than is Huxley's, and it is not apparent that shrinkage could account for this. However, we cannot believe that in view of the many strong resemblances this one apparent difference should have much weight.

It remains to say a few words concerning the name of our species.

The name *Appendicularia flagellum* applied by Huxley, not only to his New Guinea specimens, but also to all the Appendicularians subsequently studied by him, he adopted from Chamisso, who had given it in 1821 to an animal taken by him "near Behring Sea." Oikopleura was proposed by Mertens in 1831 for an animal discovered in the same region, and called by him *O. chamissonis*. Neither Chamisso nor Mertens defined their genera with much accuracy, Chamisso being especially brief and general in his description. No serious attempt was made to establish the genera of the group on a secure foundation until Fol published his important memoir in 1872. This author satisfied himself of the generic distinctness of the species studied by Chamisso and Mertens, and gave an exact definition of Oikopleura. Fol's treatment of the subject has been accepted by all subsequent writers. There can, it would seem, be no question, then, that our species is an Oikopleura and not an Appendicularia, as these genera are now understood. The important and somewhat difficult question to be answered is should the specific name *flagellum* stand?

Most recent writers have regarded *flagellum* as a *nomen nudum* so far as Chamisso's description is concerned. It would be permissible, by the recognized rules of nomenclature, for us to take this view of the matter, to then consider the name as re-established and adequately defined by Huxley, and so to retain it as Huxley's not Chamisso's. There is, however, the practical objection to this that future research may discover that the name will have to stand for the animal to which Chamisso applied it. We have consequently thought it wiser to name the species anew, and certainly no more fitting name could be selected than that of the famous zoölogist who first recognized and made clear the place of Appendicularia in the zoölogical scale.

BIBLIOGRAPHY.

APSTEIN, CARL.

1891. Die Thaliacea der Plankton-Expedition.
B. Vertheilung der Salpen.
Ergebn. d. Plankton-Expedition d. Humboldt-Stiftung, Bd. II, E. a. B.

BROOKS, W. K.

1893. The Genus Salpa.
Memoirs from the Biological Laboratory of the Johns Hopkins University, No. II.

CHAMISSO, A.

1820. De anim. quib. e classe Verm.: De Salpa.
Oken, Isis, Bd. I (Lit. anz.), col. 273–276. Jena.

EISEN, GUSTAF.

1871. Vexillaria speciosa n. sp. ett Bidrag till Appendiculariornas anatomi.
Kongl. Svenska Vertenskaps-Akademiens Handlingar, Bandet 12. No. 9, Stockholm.

FOL, H.

1872. Études sur les Appendiculaires du détroit de Messine.
Mém. Soc. Phys. Hist. nat. Genève, tome 21, Genève et Bâle.

FOL, HERMANN.

1876. Schleimdruse der Tunicaten.
Morpholog. Jahrb. Bd. I.

HERDMAN, W. A.

1888. Report on the Tunicata.
Scientific Results of the Voyage of H. M. S. Challenger, Zoology, Vol. XXVII.

HUXLEY, T. H.

1851. Observations upon the Anatomy and Physiology of Salpa and Pyrosoma.
Phil. Trans. Roy. Soc. of London, pt. II, p. 267.

HUXLEY, T. H.

1851. Remarks upon Appendicularia and Doliolum, two Genera of the Tunicata.
Philosoph. Trans. of the Royal Soc. of London for the year 1851, pt. II, p. 595.

LOHMANN, H.

1896. III. Die Appendicularien der Expedition.
Zoologische Ergebnisse d. v. d. Gesellsch. f. Erdkunde z. Berlin u. Leitung Dr. v. Drygalski's ausgesandten Grönlandexpedition nach Dr. Vanhoffen's Sammlungen bearbeitet.
Bibliotheca Zoologica, Hft. 20, Lfg. 2.

1896. Die Appendicularien der Plankton-Expedition.
Ergebnisse der Plankton-Expedition der Humboldt-Stiftung, Bd. II, E. c.

Quoy et Gaimard.
1835. Voyage d. découv. de l'Astrolabe sous Dumont d'Urville.
Observ., etc. Isis, col. 850. Jena.

Ritter, Wm. E.
1904. The Pelagic Tunicata of the San Diego Region, excepting the Larvacea.
Univ. of California Publications Zoology, Vol. 2, No. 3, pp. 51–112.

Salensky, W.
1903. Études anatomiques sur les Appendiculaires. I. Oikopleura vanhoeffeni Lohmann.
Mém. de L'académie impériale des sciences de St. Pétersbourg, VIII^e Ser., Classe phys.-math., Vol. XIII, No. 7.

Savigny, J. C.
1816. Mémoires sur les Animaux sans Vertèbres.

Seeliger, Ostwald.
1895. Die Pyrosomen der Plankton-Expedition.
Ergebn. d. Plankton Expedition d. Humboldt-Stiftung. Bd. II. E. b.

Traustedt, M. P. A.
1885. Bidrag til Kunskab om Salperne.
Vidensk Selsk. Skr., 6 Række, Naturvidng Math. Afd. II, 8. pp. 339–400, Pls. I, II. Kjobenhavn.

Traustedt, M. P. A.
1893. Die Thaliacea der Plankton-Expedition.
A. Systematische Bearbeitung.
Ergebn. d. Plankton-Expedition d. Humboldt-Stiftung. Bd. II. E. a. A.

Vogt, Carl.
1854. Sur les Tuniciers nageants de la Mer de Nice.
Mém. de l'Instit. Genèv., t. II, p. 1.

ABBREVIATIONS.

A. S.	Atrial sphincter muscle.
A. T.	Atrial tentacle.
B. mus.	Branchial siphon muscle.
D. L.	Dorsal languets.
D. T.	Digestive tract.
End.	Endostyle.
Es.	Esophagus.
Gang.	Ganglion.
Gon.	Gonad.
L. B.	Longitudinal bars of branchial sac.
L. lo. st.	Left lobe of stomach.
M.	Mantle.
N.	Nerves from ganglion.
O.	Orifice of hypophyseal duct.
P. B.	Peripharyngeal band.
P. O.	Phosphorescent organ.
R. lo. st.	Right lobe of stomach.
S.	Branchial stigmata.
S. O.	Duct of subganglionic gland.
St.	Stolon.
St. f. B.	Bud still attached to stolon.
Sub. Gl.	Subganglionic gland.
T.	Test.
Ten.	Atrial tentacle.
Tl.	Tail.
V. T.	Ventral tentacle of branchial circle.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. *Pyrosoma agassizi*, shows the open end of the colony, with the four processes around the orifice.

Fig. 2. " " three nearly adult zooids, looked at on the posterior side; *i. e.*, the side of the atrial orifice, and each with a stolon and two younger zooids.

Fig. 3. " " a single zooid seen from its right side.

Fig. 4. " " the intestinal tract, with a portion of the branchial sac, and of the posterior end of the endostyle.

Fig. 7. " " the atrial tentacle and the atrial sphincter muscle, with its groups of nuclei.

PLATE II.

Fig. 5. *Pyrosoma agassizi*, the circle of branchial tentacles, showing the larger ventral one.

Fig. 6. " " the ganglion and hypophyseal gland and adjacent structures, seen from the inside.

Fig. 8. " " an enlarged view of one of the groups of nuclei of the atrial sphincter muscle.

Fig. 9. *Oikopleura huxleyi*, the body of the animal, seen from the right side.

Fig. 10. " " the intestinal tract and gonad, seen from the ventral side.

Fig. 11. " " the tail.

The following Publications of the Museum contain Reports on the Dredging Operations in charge of Alexander Agassiz, of the U. S. Fish Commission Steamer "Albatross," during 1891, Lieut. Commander Z. L. Tanner, U. S. N., Commanding.

Three Letters from ALEXANDER AGASSIZ to the Hon. Marshall McDonald, U. S. Commissioner of Fish and Fisheries, on the Dredging Operations of the "Albatross" in 1891. Bull. M. C. Z., Vol. XXI. No. 4. June, 1891. 16 pp.

I. A. AGASSIZ. On Calamocrinus Diomedæ, a new Stalked Crinoid from the Galapagos. Mem. M. C. Z., Vol. XVII. No. 2. January, 1892. 95 pp. 32 Plates.

II. A. AGASSIZ. General Sketch of the Expedition of the "Albatross," from February to May, 1891. Bull. M. C. Z., Vol. XXIII. No. 1. February, 1892. 89 pp. 22 Plates.

III. A. GOËS. Neusina Agassizi. Bull. M. C. Z., Vol. XXIII. No. 5. December, 1892. 4 pp. 1 Plate.

IV. H. LUDWIG. Vorläufiger Bericht über die erbeuteten Holothurien. Zeit. Anz., No. 420. 1893. Bull. M. C. Z., Vol. XXIV. No. 4. June, 1893. 10 pp.

V. GEO. P. MERRILL. The Rocks of the Galapagos. Bull. M. C. Z., Vol. XVI. No. 13. July, 1893. 3 pp.

VI. W. FAXON. Preliminary Descriptions of new Species of Crustacea. Bull. M. C. Z., Vol. XXIV. No. 7. August, 1893. 72 pp.

VII. S. H. SCUDDER. The Orthoptera of the Galapagos. Bull. M. C. Z., Vol. XXV. No. 1. September, 1893. 25 pp. 3 Plates.

VIII. W. SCHIMKÉWITSCH. The Pygnogonidæ. Bull. M. C. Z., Vol. XXV. No. 2. December, 1893. 17 pp. 2 Plates.

IX. W. McM. WOODWORTH. The Planarians. Bull. M. C. Z., Vol. XXV. No. 4. January, 1894. 4 pp. 1 Plate.

X. TH. STUDER. Note préliminaire sur les Alcyonaires. Bull. M. C. Z., Vol. XXV. No. 5. February, 1894. 17 pp.

XI. S. F. CLARKE. The Hydroids. Bull. M. C. Z., Vol. XXV. No. 6. February, 1894. 7 pp. 5 Plates.

XII. H. LUDWIG. The Holothurians. Mem. M. C. Z., Vol. XVII. No. 3. October 1894. 183 pp. 19 Plates.

XIII. R. BERGH. Die Opisthobranchien. Bull. M. C. Z., Vol. XXV. No. 10. October, 1894. 109 pp. 12 Plates.

XIV. A. ORTMANN. The Pelagic Schizopoda. Bull. M. C. Z., Vol. XXV. No. 8. September, 1894. 13 pp. 1 Plate.

XV. W. FAXON. The Crustacea. Mem. M. C. Z., Vol. XVIII. April, 1895. 292 pp. 67 Plates.

XVI. W. GIESBRECHT. Die Pelagischen Copepoden. Bull. M. C. Z., Vol. XXV. No. 12. April, 1895. 20 pp. 4 Plates.

XVII. C. H. TOWNSEND. The Birds of Cocos Island. Bull. M. C. Z., Vol. XXVII. No. 3. July, 1895. 8 pp. 2 Plates.

XVIII. C. HARTLAUB. Die Comatuliden. Bull. M. C. Z., Vol. XXVII. No. 4. August, 1895. 26 pp. 4 Plates.

XIX. G. W. MÜLLER. Die Ostracoden. Bull. M. C. Z., Vol. XXVII. No. 5. October, 1895. 10 pp. 3 Plates.

XX. A. GOËS. The Foraminifera. Bull. M. C. Z., Vol. XXIX. No. 1. February, 1896. 103 pp. 9 Plates.

XXI. O. MAAS. Die Medusen. Mem. M. C. Z., Vol. XXIII. No. 1. September, 1897. 92 pp. 15 Plates.

XXII. H. J. HANSEN. The Isopoda. Bull. M. C. Z., Vol. XXXI. No. 5. December, 1897. 38 pp. 6 Plates.

XXIII. A. AGASSIZ. Preliminary Report on the Echini. Bull. M. C. Z., Vol. XXXII. No. 5. June, 1898. 18 pp. 14 Plates.

XXIV. E. L. MARK. Preliminary Report on Branchiocerianthus urceolus. Bull. M. C. Z., Vol. XXXII. No. 8. August, 1898. 8 pp. 3 Plates.

XXV. C. F. LÜTKEN and TH. MORTENSEN. The Ophiuridæ. Mem. M. C. Z., Vol. XXIII. No. 2. November, 1899. 114 pp. 22 Plates and Chart.

XXVI. S. GARMAN. The Fishes. Mem. M. C. Z. Vol. XXIV. November, 1899. 426 pp. 97 Plates and Chart.

XXVII. W. McM. WOODWORTH. Preliminary Account of Planktonemertes Agassizii. Bull. M. C. Z., Vol. XXXV. No 1. July, 1899. 4 pp. 1 Plate.

XXVIII. L. STEJNEGER. Two new Lizards of the genus Anolis, from Cocos and Malpelo Islands. Bull. M. C. Z., Vol. XXXVI. No. 6. November, 1900. 6 pp. 1 Plate.

XXIX. W. E. HOYLE. The Cephalopoda. Bull. M. C. Z., Vol. XLIII. No. 1. March, 1904. 71 pp. 12 Plates.

XXX. H. V. WILSON. The Sponges. Mem. M. C. Z., Vol. XXX. No. 1. July, 1904. 161 pp. 26 Plates.

XXXI. R. VON LENDENFELD. The Radiating Organs of the Deep Sea Fishes. Mem. M. C. Z., Vol. XXX. No 2. August, 1905. 49 pp. 11 Plates. 1 Chart.

XXXII. A. AGASSIZ. The Panamic Deep Sea Echini. Mem. M. C. Z., Vol. XXXI. November, 1904. 10, 243 pp. 112 Plates.

XXXIII. E. VON MARENZELLER. Stein-und Hydro-Korallen. Bull. M. C. Z., Vol. XLIII. No. 2. August, 1904. 16 pp. 3 Plates.

XXXIV. E. VON MARENZELLER. Lagisca Irritans, sp., nov., ein Symbiont von Hydrokorallen. Bull. M. C. Z., Vol. XLIII. No. 3. August, 1904. 6 pp. 1 Plate.

XXXV. H. LUDWIG. Asteroidea. Mem. M. C. Z., Vol. XXXII. July, 1905. 12, 292 pp. 35 Plates, 1 Chart.

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