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NEW INVERTEBRATA FROM THE COAST OF CALIFORNIA.

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THE marine animals, described in the following pages, were collected in the months of February, March and April, 1887.[1] During this time, as a guest of Mr. A. Hemenway of Boston, I carried on studies at Santa Barbara and the neighboring island of Santa Cruz, at Monterey and the city of Santa Cruz. My attention was especially turned to the Medusæ of these regions, and a few observations were made on certain novel genera of other invertebrated animals.

MEDUSÆ.

SYNCORYNE OCCIDENTALIS sp. nov.

(PLATE III, FIGS. 2, 3.)

One of the most common genera of Hydromedusæ found at Santa Cruz, is a Sarsia closely allied to *S. rosaria* A.

[1] This paper was prepared for publication while the author was connected with the Museum of Comparative Zoölogy at Cambridge.

I am indebted to the Curator, Mr. A. Agassiz, for assistance in the preparation of the plates and for valuable suggestions.

Ag., but somewhat different from this species or any Sarsia yet described.

The bell of the oldest specimen observed has a pointed apex with thick bell walls. The height of the bell is greater than its diameter. The proboscis rarely projects outside the bell opening, its length not being much greater than that of the height of the bell cavity.

The tentacles are long, filamentous, with scattered nematocysts. The tentacular bulbs are large and prominent and of a yellow color, each with a prominent black ocellus. There are four narrow, unbranched, radial chymiferous tubes.

In a younger specimen (fig. 2) the outer surface of the bell is strewn with clusters of nematocysts. This immature form has but a slight apical prominence and the tentacles are shorter and more stumpy than those of the adult. This species was found in the Bay of Monterey, at San Francisco and at Santa Barbara.

Syncoryne rosaria A. Ag.

(PLATE IV, FIGS. 1, 4.)

This hydroid[1] was collected in great quantities on the spiles of the wharf at Santa Barbara, where it occurs upon the fronds of algæ and the tunics of Tunicates and other animals. It forms small clusters consisting of hydroid heads growing from branching basal tubes. Each tube, bearing a single head, is unbranched.

The head is white, or slightly pink in color, with five terminal, club-shaped tentacles, forming a ring about a central mouth-opening. The remaining tentacles of the head are more scattered, and arranged with little regular-

[1] This is supposed to be the same as the Coryne of A. Agassiz, but as he does not give a figure of *C. rosaria* I am not sure that they are identical.

I have followed Allman in limiting the name Syncoryne to those Corynidæ with free hydroid Medusæ.

ity, but are found in all conditions of growth and of various sizes.

CAMPANULARIA OCCIDENTALIS sp. nov.

Prof. S. F. Clarke mentions three species of Campanularia from our Pacific coast. *C. everta* is recorded from San Diego; *C. fusiformis* from Vancouver Island and Santa Cruz, while the locality of *C. cylindrica* is not given.

A Campanularia, which differs from these, was found by me at Santa Barbara.

The stem is irregularly branched and of light brown color. It is ringed with moderate sized ferrules, with four annulations at the basal joints.

Hydrothecæ are large, cup-shaped, slightly bulging at the sides, with an *entire, not dentiferous rim.*

Gonothecæ large, oval, tapering from attachment to truncated, distal termination. Orifice small, with slightly raised lips. Sporosacs conspicuous, numerous, readily seen through the sides of the gonothecæ.

Polypites have a brownish yellow color; their tentacles are slightly webbed.

ATRACTYLOIDES FORMOSA gen. et sp. nov.

(PLATE IV, FIGS. 2, 3.)

Stems solitary, erect, brownish, with masses of attached algæ on their external surfaces. The distal ends funnel-shaped. Attached to a creeping stem. Each polypite (hydranth) projects from a cup-shaped hydrotheca.

Hydranth with single circle of tentacles; mouth and intratentacular region of whitish color. Hydrothecal base annulated.

The sporosacs arise from the base of attachment on solitary, erect stems. Each male capsule has a central axis (spadix) which has a green and yellow color. Near its

distal end the spadix is enlarged into a disk-shaped structure, and about midway in its length there arise lateral branches from which originate the spermatic masses. The proximal part of the spadix is connected with the inner wall of the male capsule by a network of fibres represented in fig. 3. At the distal end of the same organ the walls of the spadix and those of the capsule are similarly united. Spermatic elements are formed inside the sporosac and are developed from the external walls of the spadix, probably making their way out through an opening in the distal end of the sporosac. The female Atractyloides was not observed.

PERIGONIMUS FORMOSUS sp. nov.

A Perigonimus, which resembles *P. serpens* Allman, was taken at Santa Cruz.

Stem small, creeping, sending up at intervals small, chestnut-colored tubes. No hydrothecal enlargement. Stems simple, branching, slightly annulated.

Polypites with reddish-yellow hydranths, each with from ten to sixteen tentacles and a prominent circumoral knob. External walls covered with unicellular algæ. Tentacular nematocysts prominent.

The gonosac arises from the creeping stalk and is a capsular body found in numbers in different regions of the colony. The ovisac forms at the extremity of a simple tube not unlike that which bears the hydranth. This tube is slightly annulated and at its distal extremity is enlarged into a spherical body of dark crimson color enclosed in a transparent sac.

The mode of formation of the ovisac separates this species of Perigonimus from others which have been described. No medusa was observed and the color is very different from *P. serpens*.

It is believed that the ovum after segmentation devel-

ops into a planula in its sac, and separating from this organ follows a similar course of development in one or two other genera of hydroids. If this supposition be correct, this is an exceptional method of development for this genus.

POLYORCHIS PENICILLATA A. Ag.

(PLATE IV, FIGS. 6, 7.)

Many specimens of this Medusa were found near the wharves at Santa Barbara, Santa Cruz and San Francisco. The jelly-fish is very conspicuous on account of the circles of dark-purple tentacular bases and the extended wreath of the tentacles. It is the most magnificent of all the west coast Hydromedusæ which were observed.

The bell is large, about one and one-half times as high as broad. It has a slightly yellow color and a small, rounded apical prominence. The bell walls are thin and of about uniform thickness throughout.

Radial tubes four. Each radial tube has lateral branches which arise in pairs opposite each other. These lateral branches often subdivide or become forked at their ends. The largest subdivisions are situated about half the distance from the apex of the bell to its margin. The lower extremities of the four radial tubes, at their junction with the circular tubes, are ordinarily destitute of lateral appendages. The motion of the bell is sluggish, not unlike that of Nemopsis.

The length of the tentacles is greater than the altitude of the bell, and these organs are ordinarily, when at rest, carried at right angles to the bell walls. A. Agassiz found, in the specimen which he described, thirty-six tentacles, or eight between each pair of tentacles which hang from the neighborhood of the junction of the radial and marginal canals. In the largest specimens which were taken at

Santa Barbara, there are more than thirty-six tentacles or sixteen on a similar section of the bell rim. Counting all the tentacular appendages in many specimens there are, on an average, sixteen between each pair of radial tubes. The four tentacles of the radial tubes and those from the bell rim, midway between these, are much larger than the remainder, even in adults.

The tentacles arise in three series, at different heights on the bell rim. They vary very much in size and number. The largest and longest tentacles are found at the peripheral ends of the radial chymiferous tubes and arise high up on the outer bell margin. The smaller tentacles are simple clubs with a conspicuous pigment spot. All tentacles have bright pigmented eye-spots.

The larger tentacles are connected with the marginal tube by a small vessel, passing through the substance of the bell to the circular chymiferous vessel. It thus happens that the purple color of the base of the tentacle appears quite a distance from the marginal tube and the tentacular base does not lie directly on the marginal vessel as in some genera of hydroid medusæ. The tube connecting the cavity of the large tentacle with the marginal vessel extends at right angles to the external wall of the bell. The tentacular bases seem to be placed on the outer bell wall and from them the tentacles extend peripherally outwards. The tentacular bases are thickly colored with dark purple pigment. Each tentacular base has a well-defined pigment spot or ocellus, which seems to be situated high up on the sides of the bell, on account of its basal attachment.

The tentacles are long, hollow and flexible. They have a reddish color and bear many clumps of nematocysts.

The smaller or intermediate tentacles, placed on the bell margin between the larger just mentioned, are in-

serted on the bell margin lower down on the bell and nearer the marginal tube. The smallest of these lie directly upon the marginal vessel and have no tube connecting their bases with the cavity of the vessel.

No otocysts were seen. It is important to know whether otocysts exist or not, for in the original description of Polyorchis this point was left in doubt. I have repeatedly searched for otocysts and my search supports the opinion that these bodies are wanting in Polyorchis.[1]

The proboscis is mounted on a conical or rounded gelatinous extension of the bell which is crossed by the four radial tubes. The lateral branches of the tubes hang from this prominence of the bell and are not formed in the wall of the true proboscis.

The sexual bodies have the form of numerous long, filamentous threads, hanging down in the bell cavity, in some instances as far as the bell opening. Their color is yellow and they vary in number since many are small and half developed. Although in former descriptions only four sexual bodies are described on each tube, the number was found in some of my specimens to be much greater.

The proboscis is long and flexible and has a pale yellow color. It is trumpet-shaped at the oral end. The mouth is four-parted and often hangs just at the opening of the bell. Food when present can be readily seen through the walls of the stomach.

Nothing is known of the young of the medusa of Polyorchis. The following description of an immature condition of this genus is thought to be of interest.

The youngest stage of Polyorchis which was taken differs in several details from the adult just described, and in its form indicates the affinities of the genus.

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[1] The importance of knowing whether otocysts exist or not in Polyorchis is seen when we remember that this genus has several features in its anatomy which ally it to those Medusæ possessing these structures.

Its bell is oblong, without a prominent apical protuberance, although somewhat thicker in the apical region. The lateral walls of the bell are of about uniform thickness and are colorless. The outer surface of the bell has clusters of nematocysts which are arranged in lines with regularity. These structures have not the same prominence in the adult as in the young.

There are sixteen tentacles which are distributed as follows. At the end of each radial tube there is a single tentacle, which is somewhat larger and longer than the remaining tube.[1] Midway between these on the bell rim, are four other tentacles approaching in size the radials, and between these again small stumps, indications of eight others. The length of none of the tentacles is more than half the height of the bell.

The bases of the tentacles bear reddish patches of color, and a conspicuous black pigment spot which indicates the position of the future ocellus. These tentacular bases lie immediately upon the marginal vessel, while the short tube, which connects the cavity of the base of the tentacle in an adult with that of the marginal vessel, is not developed. There are no otocysts or structures which can be compared to them.

The radial tubes are four in number. Each tube is broad, with indications of the lateral appendages appearing as simple zigzag notches in the gelatinous wall of the tube.

The sexual glands are not developed, but at the very base of the proboscis there are two small buds, just below the union of the proboscis with the inner wall of the bell.

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[1]It is probable that when the Polyorchis buds from its hydroid it has four radial tubes, four tentacles and possibly the stumps of four similar interradial appendages. As the radial tubes at that time lack lateral branches, we have in this stage a medusa closely resembling the young Sarsia. If my suppositions are correct, there seems no doubt that Polyorchis belongs to the true Anthomedusæ, and that it is allied to Sarsia. The rows of meridionally placed nematocysts on the outer bell wall are suggestive in this interpretation.

These buds are probably the beginnings of the future ovaries.

The proboscis is destitute of its rounded gelatinous base, and hangs downward to within a short distance of the bell-opening. The mouth is formed as in the adult. It is four-parted and has frilled lips.

Intermediate stages of growth between this and the adult were collected in March and April near the wharf and in the zone of kelp at Santa Barbara. There was hardly a day, when the water was smooth, during which multitudes of these medusæ were not observed from landing places at Santa Barbara and Santa Cruz. They appear also to be common in the Bay of San Francisco.

The adult Polyorchis is the largest medusa of Tubularian hydroids, or Anthomedusæ, yet found in American waters. At the same time, it is one of the most beautiful, and its great abundance in California invites one to a study of the unsolved question of its hydroid and early development.

STEENSTRUPIA OCCIDENTALIS sp. nov.

(PLATE III, FIG. 1.)

A hydroid medusa with a single tentacle has never been described from our Pacific coast. Several specimens of a genus which seems to be the same as Steenstrupia were taken by night fishing at Santa Cruz.[1] This is the first mention of this genus from our west coast.

The bell is ovoid, without apical prominence, slightly asymmetrical. There are rows of meridional lasso-cells extending on the outer surface of the bell, from the marginal end of the radial chymiferous tubes towards the apex of

[1]The display of phosphorescence at night in the Bay of Monterey is one of the most marvellous sights which I have ever seen. Although I have seen similar phenomena in many places, I have never seen it brighter than one night near the end of April at Santa Cruz.

the bell. Radial tubes four, narrow, simple, unbranched. A well-marked velum closes in part the entrance to the bell cavity.

The proboscis is simple, without labial appendages. It is richly pigmented near the oral end and at its attachment to the inner bell walls. A spherical pigment spot indicates the terminus of three of the radial tubes on the marginal vessel. These tubes are destitute of tentacles.

A single, long, flexible tentacle arises from the point of union of one of the radial tubes with the marginal tube. This tentacle is ribbed throughout its entire length with ferrules, composed of nematocysts, as shown in the figure.

Immature forms of the young appear budding from the base of the single large tentacle near its attachment. These young medusæ vary in size from a simple enlargement to an individual just ready to separate from its attachment and approximately resembling the adult. Many of these have the single long tentacle developed, but in none were the other tentacles comparatively as long in the young as in the adult. In the very young bud, all the tentacles are simple protuberances of equal size. I have especially considered the relative sizes of all the tentacles in the young, for it seemed to me that possibly the genus might betray in those stages affinities with medusæ with four tentacles. It would seem, however, that the predominance in size of a single tentacle dates back to very early conditions.

There is no apical extension of the umbrella or bell, and no remnant of a "funiculus," or tube by which the radial system of chymiferous tubes were once connected with a hydroid.

The structure of the tentacle closely resembles that of Steenstrupia. The movements of the medusa are so accurately described by Forbes for his species, and apply so well to the Californian, that I have taken the liberty of

quoting his account. "But when well and uninjured, it is an extremely active and regularly formed creature, though, owing to the weight and unbalanced tail which it is doomed perpetually to drag as its train, it cannot advance through the water with the easy grace and rapidity for which its allies are remarkable, but struggles forward with frantic energy, contracting and expanding rapidly, and without ceasing, reminding us of an escaped felon impeded in his course by the dragging of his heavy fetters."

An asymmetrical genus of hydroid medusæ called Hybocodon, figured and described by Agassiz, is found on the Atlantic coast. The Steenstrupia from California, while in general character it closely resembles the genus Hybocodon, is much larger and has a somewhat differently formed bell.

The Californian Steenstrupia differs also in a marked manner from either *S. rubra* or *S. flaveola* Forbes, from the British seas. The former bears on the apex of the bell a "little tentacle-like, fleshy-red appendage," while the bell of the latter is more conical. Neither of these species is represented by Forbes with young buds on the tentacular bases and there seems some evidence to believe that both of Forbes's species are immature.

I was unable to find the hydroid Corymorpha, nor have I taken this hydroid in California, but it is probable that it will be found in abundance as the medusa is common.

WILLIA OCCIDENTALIS sp. nov.

(PLATE V, FIG. 3.)

There are two species of Willia on the Atlantic coast, both of which are southern in their habitat, although one, *W. ornata*, has been found by me once at Newport. On the Pacific coast, no Willia has ever been described, al-

though a similar and larger genus, Proboscidactyla, is recorded from certain places.

I found at the island of Santa Cruz a medusa which was at first mistaken for a young Proboscidactyla, but which turns out on closer study to have marked differences from this genus.

The bell is semiovate, with a slight constriction in its external outlines on a level with the base of the proboscis. Ovaries are four in number, arranged at the base of a four-parted stomach. Gastro-vessels four, subdivided before their union with the circular vessel into four branches. Opposite the junction of each branch with the circular vessel, there arises a simple tentacle. The margin of the bell bears twenty tentacles. Each tentacle is colorless, and at its base or bulb bears a bright colored, reddish ocellus.

Each tube of the radial system before junction with the marginal is first divided into three divisions, two of which subdivide into two more. The median of the three original divisions extends directly to the bell margin.[1]

On the outer surface of the bell, between each pair of tentacles, there is a cluster of cells,[2] connected with the rim of the bell by means of a simple band, which is narrow and inconspicuous. The cells are similar to structures in an identical position in Gemmaria, and correspond to like organs in our east coast Willia with four tubes, before the lateral branches have formed. In the Atlantic species, *W. ornata*, these structures are evidently embryonic, and the same may be true in the Pacific species of this genus.

The special function of these cells and of this band is not clear to me. They may possibly be comparable with the embryonic tentacles of the larval Glossocodon.

[1] In Willia from the Atlantic each tube is divided into four subdivisions, before junction with the tube of the bell margin. In *W. stellata* there are six of these tubes before division.

[2] I did not detect the coiled thread in the interior of these cells.

MICROCAMPANA CONICA gen. et sp. nov.

(PLATE IV, FIG. 8.)

This interesting medusa was collected under the lofty cliffs of Punta Diablo on Santa Cruz Island. It differs from others in the possession of *six* radial tubes and a simple club-shaped tentacle.

The number of radial tubes among the medusæ of the Anthomedusæ is generally constant, four or multiples of four. The majority of genera have four of these tubes; some have eight and more, while but one or two are said to have six. Four is the constant number which prevails even through the Siphonophora and its multiple is an almost constant feature among the so-called Discophora. The genera with six radial tubes are marked ones as introducing a new unit in an almost universally quadruple series.

The other structural features of Microcampana are different from those of any hydroid genus with six radial tubes, while the character of the tentacle is very exceptional.

The bell is asymmetrical, conical, smooth, transparent, with a long conical apical protuberance. Clusters of nematocysts are irregularly scattered upon its outer surface. The apical protuberance of the bell recalls a similar appendage in Saphenia, Stomatoca and Amphinema.

The bell has six radial tubes, a marginal vessel, and an apical tube or funiculus ending blindly in the apical prominence. The radial tubes are narrow and simple without lateral branches.

The marginal appendages to the rim of the bell are of two kinds. At the peripheral end of five of the radial tubes there are simple projections or protuberances, which are densely pigmented. From the extremity of the remaining radial tube there hangs a club-shaped tentacle which recalls in structure the tentacles of the genus Di-

purena. This appendage is clavate, stiff, enlarged into a globular body at its free extremity. At its base, where it is attached to the bell margin, there is a tentacular bulb which resembles the stumpy appendages of the other five tubes. The club-shaped appendage swings freely on its attachment and is sometimes, by the contraction of the bell, thrown directly across the opening into the bell cavity.

The proboscis of Microcampana is simple, without appendages, having a slightly darker color than the bell. The bell has a pink color, the tentacular bases are bright red, and the proboscis is yellow.

The function of the single, stiff tentacle can hardly be supposed to be the same as that of the long flexible appendages of Sarsia or Steenstrupia. It is almost identical in form with that of the four tentacles of Dipurena and possibly has a similar function.

Its distal extremity is less dumb-bell shaped than in the last mentioned genus, but the internal wall has a similar pigmentation.

VELELLA MERIDIONALIS sp. nov.

(PLATE I, FIGS. 1, 2, 3; PLATE II, FIG. 3.)

The only member of the Velellidæ which has been mentioned from our west coast is a Velella closely allied to *V. Septentrionalis* Esch. Eschscholtz gives a figure which easily distinguishes his medusa, but shows a marked rectangular form in the veil or float which the more southern species does not have. In most of the southern representatives the umbrella is more oval than that figured by Eschscholtz. Although it is possible that the individuals studied by me were young, the many differences which exist between the specimens which I collected and those collected by Eschscholtz, would seem to show that two species of this genus exist on the Californian coast.

Velella meridionalis has an oval-shaped mantle of a blue and yellow color. When seen from the edge it is thin and flexible. This part, ordinarily called the body, floats on the surface of the water. Embedded in it, placed at an angle to the longer diameter of the ellipsoid umbrella or mantle, there is an oval, flat body called the float, which is composed of two thin plates of horny character united by a number of concentric partitions, the edges of which are seen in Plate 1, fig. 3. The concentric chambers separated by these partitions are filled with air or gas, and form an organ of flotation. They communicate with each other by openings and exteriorly by a row of orifices placed diagonally across the upper side of the float. The float is placed left-handed across the umbrella, or if the longer axis extends vertically, the upper end of the float is to the left of the observer, the lower to the right. This was invariably the position of the float of all the specimens examined.

On the upper side of the float there rises a thin chitinous plate of triangular shape, the apex of which is above, the longer side placed slightly diagonally to the longer axis of the float. Over the float is spread a thin membranous body, a continuation of the mantle through which ramifies a system of vessels.

The two sides or edges of the triangular sail which are free, are skirted by a continuation of this membrane forming a contractile extension. The sail is carried upright as the animal floats on the surface of the water.[1]

The float of the specimens studied has a vertical crest which like the float itself is "left handed;" that is, when placed before the observer with the central polyp turned from him, the longer axis of the ellipse being placed ver-

[1] A reversal of the float so that the sail is below is generally fatal to the Velella.

tical, it has the upper portion of the crest on the left hand, the lower on the right. The whole float has its axis left handed as regards the umbrella.

The color of the umbrella is yellow and blue, girt by a brilliant blue border. The portion near the float is yellow. The outer edge of the umbrella is entire.

Seen from below the oval float was observed to bear three kinds of appendages, which may be known as the polypites, the sexual bodies and the tentacles. The polypite, or central polyp, is a highly contractile, flexible body, capable of considerable motion, enlarged at its base and tapering uniformly to a free extremity on which is placed the mouth opening. This opening is very small, although capable of considerable expansion and extension and has thin lips. It bears no tentacles on its edges. Tentacles are absent from the base of the polypite. The cavity of the polypite serves as a stomach and within it the half-digested food was observed. This consists of smaller medusæ, and other small marine animals, with unicellular algæ. Velella is thought to be omnivorous.

The structures formed around the rim of the float on its under side may be called the tentacles. They are long, thread-like bodies, highly flexible, but not very contractile, arranged in several rows, but never arising from the edge of the umbrella. These tentacles are pointed and situated a considerable distance from the edge of the umbrella as in the young of *V. mutica*. They are covered with scattered nematocysts in irregularly defined bands and disconnected clusters. The tentacles are confined to the lower side of the umbrella and lie on that part of the body which is under the float. There are no appendages to that portion of the umbrella which is situated peripherally to the float. Between the marginal tentacles and the central polyp there hang short stalks with botryoidal clusters of small buds

hanging from the lateral branches. These buds are minute medusæ, or sexual clusters, each one of which lives a considerable time after it breaks away from its attachment.

Each medusa, of which many were raised into the adult form, has a bell-like form with short stumpy tentacles and is destitute of a proboscis. It has four broad radial tubes, alternating with other prominent structures often mistaken for tubes.

The lower side of the chitinous float is concave, in which concavity lies the so-called "liver." This organ forms the upper wall of the base of the polypite, and has a dark brown and yellow color. Canals arise from the concavity of the polypite and after anastomosing penetrate the different regions of the liver, forming a "star-shaped body" in the upper part of this organ.

The liver is also penetrated by tracheæ, peculiar tubes, which arising from the lower plate of the float end blindly in the substance of the liver. These tracheæ, which seem to be concerned in the aeration of the fluids of the body, are sometimes branched and apparently convey air from the chambers of the float into the substance of a gland called the "liver." By a contraction and expansion of the umbrella, as described by Dr. Carl Chun, the gaseous products are expelled at intervals or introduced again through these tracheæ. We have in this genus an air-breathing medusa, as shown by Chun, although it is probably true that there is combined with this method another found in all medusæ, viz.: aeration by exposure of the circulatory fluids through the tissues of the body.

The whole surface of the mantle and the membrane covering the "sail" in Velella are exposed to the air, and probably serve in the respiration of the medusa. The exposure of the water-blood fluid to the air is facilitated by a nexus of tubes which are found in these structures.

In the Portuguese Man-of-War[1] in which the float has the form of a huge bag, the feeding-polyps being clustered on the submerged portion, we probably have a similar respiration by direct contact with the air through the walls of the float. In the genus Physalia there is an opening into the float by which air can enter its interior so that there may be a double exposure, inside and out. Among the Rhizophysidæ we have appended to the under surface of the enclosed air-sac a number of finger-like appendages, often branched, which convey the air into the cavity of the stem of the animal, so that their walls alone separate the air from the fluid. These structures are possibly organs of respiration comparable with the tracheæ of Velella.

Among those Physophores, however, which have nectocalyces and covering-scales the function of respiration is probably accomplished, as in all medusæ, by exposure of the outer surface of the body to the water. In Siphonophores, where the nectocalyces are absent, the float is enlarged or the covering scales are well developed.[2]

In the family of Forskalidæ, which move very rapidly and in which respiration must on that account be somewhat active, the spread of covering-scales and nectocalyces is very large, but the float is very small. In Calycophoridæ, the motion of which is the most rapid of all these animals, covering-scales are often very prominent. A diminution in the size of both nectocalyces and covering-scales is accompanied by an enlargement of the float and a more sluggish habit of life.

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[1] The peculiar movements of the float of Physalia in water which is impure, somewhat resemble the respiratory movements recorded by Chun in Velella.

[2] No satisfactory explanation of the physiological role of the covering-scales has yet been suggested. I believe that they are respiratory bodies which may sometimes perform also as in Athorybia the function of locomotion. Wherever they are wanting their respiratory function is performed by the swimming bell (the float is a modified nectocalyx), when the medusa swims below the surface or by an enlarged float when aerial respiration occurs.

ATHORYBIA CALIFORNICA sp. nov.

(PLATE II, FIGS. 1, 2.)

The beautiful Physophore, Athorybia, has never been recorded from our Pacific coasts. The number of localities in which this animal has been found is very limited. It occurs in the Mediterranean, and has been described by several observers from Villa Franca, Naples and Messina. A species is also described from the Indian Ocean. In 1883, I found a new Athorybia, *A. formosa*, at Dry Tortugas, Florida. A large Athorybia is known from the Canary Islands. Other Anthophysidæ are described by Haeckel. While crossing the Santa Barbara channel, from Santa Barbara to the island of Santa Cruz, a new Athorybia was taken in the drag net.[1] This Athorybia is an interesting one and its discovery important as being the first observation of this genus in the eastern Pacific.[2]

Athorybia differs from other Physophores, except Physalia, in the absence of an axis or stem. There are no nectocalyces and their function is performed by the hydrophyllia. The float is large and conspicuous, standing upright as the animal floats in the water. It consists of a pneumatocyst and pneumatophore, forming two separate globular sacs, one inside the other, both fastened at the upper pole, where there is an external opening in both. The contents of the pneumatophore is air or gas. The color of the float is a delicate pink, with a dark red pigment zone on the upper pole about the opening. At the base of the float there arises a circle

[1] It is a circumstance worthy of mention that this Athorybia, like many other medusæ described in this paper, was found in the vicinity of what is known to fishermen on the Santa Barbara Channel as the "Submarine Oil Well." Near the middle of the channel petroleum is always found floating on the surface of the sea. This is supposed to be derived from the upturned beds of asphaltum under the water. Whether the source of this oil supply is submarine or not, many of my best medusæ were found in close proximity to the floating oil.

[2] With the exception of Physalia, Velella and Porpita, no other Physophores have been recorded from our Californian coast. A fragment of Porpita and one or two mutilated specimens were observed near the island of Santa Cruz in my trip across the Santa Barbara channel. I was, however, unable to identify the species to which these specimens probably belong.

of bracts or hydrophyllia. These bodies are transparent, and extend outward at an angle to their attachment. They are capable of more or less movement, and sometimes act as flappers in the propulsion of the animal.

Each hydrophyllium is elongated, leaf-like, thin, penetrated by a median canal. The outer surface of the hydrophyllium is crossed by lines of lasso-cells, the prominent rows of these structures extending longitudinally across the outer surface of the bract. On either edge of the covering scale, opposite each other and midway between the attachment and free extremity, there is a notch or indentation. The polyp-stem, or that region of the axis of the Siphonophore which carries the polypites, tasters, sexual bodies and hydrophyllia, is reduced in length and enlarged into an inflated bag, continuous with the float.

The tasters are long and filamentous, very flexible, and have a slightly pinkish color. Their tentacles, if they exist, which is doubtful, are very small and rudimentary.

A single, immature polypite was observed, and at this stage the Athorybia is monogastric. This single polypite has an open mouth, with trumpet-shaped lips. Three long tentacles were observed, each bearing tentacular knobs. One of the tentacles probably arises from the single polypite, the others from immature organs of the same character. Clusters of half-developed tentacular knobs were observed on the polyp-stem or polyp-sac, for the polyp-stem is here reduced to a globular enlargement, at the base of the larger polypite.

Each tentacular knob, fig. 2, consists of a peduncle, a sacculus, an involucrum, two terminal filaments and a median vesicle. The peduncle, or base of attachment to the tentacle, is long and flexible, highly contractile, transparent and colorless. The involucrum forms a button-like structure, not unlike an enlargement of the peduncle at its distal end. It is prolonged on one side into an apex, or

finger-like extension, at right angles to the axis of the knob.

The sacculus has thickened walls, and is a cylindrical body with a single turn, closely studded with nematocysts. In my notes I have written that the sacculus is colorless, but this would be such an unusual character for this structure, that it must be a mistake but refers to the involucrum.

The two terminal filaments are of medium length and arise on each side of the terminal vesicle. They are transparent, flexible, scattered with nematocysts, sometimes retracted into short, stumpy appendages.

The terminal vesicle is ovoid, thin walled, colorless and has a few nematocysts.

The sexual bells, male and female, of *A. Californica* were undeveloped. From this fact, as well as the small size of the specimen, I am led to regard this as the young or larval form, and that the adult was not seen by me.

The genus Athorybia is a most interesting one in our studies of the phylogeny of the Physophores. Especially is this true of those forms related to Athorybia in which we have but a single polypite, for they closely resemble the young of such genera as Agalma, while several other details of anatomy, which seem to characterize the adult Athorybia, are found also in the larval Agalma.

It is, of course, not impossible that the form *A. Californica* is the young of a species, more like *Diplorybia formosa*, and it may be true that all monogastric Athorybia-like genera are larval forms of polygastric Anthophysidæ.

SPHÆRONECTES GIGANTEA gen. et sp. nov.

Up to the present time this interesting Calycophore has not been found in American waters on the Atlantic or Pacific coast. I have taken what may be its diphyozooid at Newport, R. I. This diphyozooid of Sphæronectes is fig-

ured in my notice of certain medusæ from Narragansett Bay as *Diplophysa inermis*, a name under which it is described by Gegenbaur and others. The adult Sphæronectes, however, has never been reported from the Atlantic coast, although it is well known from the Mediterranean.

In an evening's fishing at Santa Cruz I captured several specimens of a gigantic Sphæronectes, which is so different from that from Villa Franca, which I have often collected, that I have no hesitancy in declaring the Californian representation to be a new and undescribed species.

There is in Sphæronectes (Monophyes) but a single nectocalyx, and in this respect it differs from most other known Calycophores. This nectocalyx in *S. gigantea* is almost a half-inch in diameter and is globular, slightly flattened on one side, where the entrance into its cavity lies. This entrance is partially closed by a thin velum. The cavity of the bell is shallow. The walls of the nectocalyx are thick, especially at its apex. In this thickened part of the nectocalyx, there lies a groove or depression, out of which hangs the stem. The somatocyst, a blindly ending tube, in communication with the point of junction of the stem with the bell at the fundus of the depression, extends parallel to the radial tubes of the nectocalyx in the thick gelatinous walls of the bell. The somatocyst is filled with "spongy cells" as in Diphyes.

The axis of *S. gigantea*[1] is small and short, and can be wholly retracted into the groove of the nectocalyx. When extended, it was several times the diameter of the nectocalyx in length.

All the diphyozooids upon the stem were immature, which fact leads me to think that the specimens which I had were young, and that the adult has a nectocalyx larger than that of any known Sphæronectes.

[1] The name *gigantea* is suggested for this species.

CHRYSAORA MELANASTER Brandt.

This beautiful medusa was taken off the lighthouse at Santa Cruz. The specimen differs somewhat from the description by Brandt, whence it has seemed well to give a new diagnosis. The umbrella is flat, disk-shaped, the diameter being about double the height. Color, reddish-brown; thirty-two marginal lappets are found on the border of the bell. The surface of the bell has brown radial lines, extending from the center to the periphery of the disk. The marginal lappets have a rectangular shape.

There are eight hooded otocysts. The surface of the bell above the otocyst is swollen into a rounded prominence in the center of which there is a conical pit, or "Riechgrübchen."[1] The otocyst has a bright yellow and brown color. Between each pair of otocysts there are three marginal tentacles. There are therefore twenty-four tentacles in all on the rim of the umbrella. Each tentacle is more highly colored than the bell, and their tips especially have a brighter red color. Tentacles are unbranched, long and simple, with many nematocysts.

The lower floor or sub-umbrella of the bell has a whitish color. The actinostome hangs from the sub-umbrella by four pillars which are transparent. The structure of the mouth is like that of *C. Mediterranea* Per. et Les.

The specimen which I had was younger than that so beautifully figured by Mertens, which may account for the fact that the shape of the marginal lappets is very different. In addition to a single specimen collected by myself, the Santa Cruz fishermen brought me one or two broken examples of others collected from the Bay of Monterey. At certain times of the year the genus appears to be very common, but

[1] Possibly a special sense organ.

during my stay at Santa Barbara and Monterey, they were rare and were seldom seen.

AURELIA LABIATA Cham. et Eys.

(PLATE V, FIG. 2.)

The Pacific Aurelia is readily distinguished from the Atlantic species, found from Greenland to Newport, by the pinkish color of the umbrella, while the specimens which were found are much smaller than those of *A. flavidula*. The largest specimen seen was about sixteen inches in diameter. I am, however, told by fishermen that in the summer months much larger specimens occur. There is no doubt that the species is a characteristic one, but with the exception of the above differences and a few others, it closely resembles our common eastern species. The eye spots appear browner than those of *flavidula* and the pyramidal extension of the bell in the stomach is not so marked. This latter character may, however, be a consequence of the diminutive size of the specimen, for in the young of *flavidula* this structure is wholly wanting.

I found several specimens of Aurelia in the Bay of Monterey and one near Point Conception.

Several of the former specimens were found to be infested by a Hyperia, as is also the case with *A. flavidula*.

PELAGIA PANOPYRA Per. et Les.

(PLATE V, FIG. 1.)

The common large Pelagia from southern California (Santa Barbara) is supposed to be the same as *P. panopyra*. The other species of Pacific Pelagias, which have been described, are *P. denticulata* Brandt, and *P. flaveola* Esch. From both of these it differs in this, that while the mouth arms of both *denticulata* and *flaveola* are very short,

as compared with the diameter of the bell, those of *panopyra* are very long. As for the most part we have nothing but figures to guide in the determination of the different species of Pacific Pelagias, a short description of the Pelagia found by me is here given.

Bell hemispherical or flat, rounded, flattened at the apex. The diameter of the bell is about double its height. Nematocysts strewn in clusters over the outer surface. Color pinkish. Color of cluster of nematocysts, white. Marginal lobes, pointed or rounded, one between each tentacle and otocyst, making in all eight long, flat, dark red tentacles. Eight hooded sense-bodies alternating with the tentacles. The sense-bodies are bright orange in color.

The oral arms, four in number, are long and slender, several times the diameter of the bell. Surface covered with nematocysts, and lips furnished with fimbriated edges. Color pinkish. The specimen which is represented (Plate v, fig. 1) has a bell eight inches in diameter. The oral arms of this specimen when extended were three feet in length. Another specimen had oral arms *six feet* long. The tentacles are much longer than the oral arms, and have a bright red color while the bell and oral arms are pinkish. The marginal sense-bodies are bright orange. The specimens were found in the Santa Barbara Channel off Santa Cruz Island.

Pelagia panopyra has thus far been described from the tropical regions of the Pacific and from Australia in the South Sea. Our knowledge of it has been built up for the most part from Lesson's figure. Of this figure, Agassiz says, "Nothing can be worse than the figures of this acaleph published by Lesson." Special descriptions and figures have also been published by Eschscholtz and Brandt. Peron and Leseuer have also given a figure, and Haeckel has brought together in a collated form what is known of

the species. My specimens agree in the two most important features regarded by Haeckel as characteristic, viz.: a thin walled umbrella and very long slender mouth tube.

ACTINOZOA.

BUNODES CALIFORNICA sp. nov.

(PLATE VI, FIGS. 5, 6.)

This species is the most common Actinozoan at Santa Barbara. It forms colonies upon the rocks even left bare at low tide, and has a habit of covering itself with small stones or bits of shell so that such a colony on the rocks resembles an encrustation of pebbles.[1] These colonies protected by their sandy covering are exposed for an hour or more to the burning rays of the sun and are found oftentimes six or seven feet from low-water mark. The different members of the colony are closely huddled together, and when contracted, as they necessarily are when in such masses, could readily be mistaken for numbers of Ascidians. The majority of the specimens are about the size of a silver half dollar, but large examples were found several inches in diameter. The sand covering the body is found most abundantly on the oral pole of the animal on the external walls. This is really the only exposed portion, the individuals are so closely crowded together. Bunodes clings voluntarily to the bits of sand which forms its coat-

[1] *Zoanthus sociatis* has this same habit of covering itself with small foreign bodies, sand and fragments of shell. It is supposed that the members of the colony grasp the grains of sand when in mechanical suspension in the sea water. Several genera and species of Actiniaria have the same habit, but I have never seen it as well marked as in *B. Californica*. McMurrich (Journal of Morphology, Vol. III, No. 1, pp. 65, 66) describes in a new species of Gemmaria, *G. isolata*, enclosures of sand and other foreign bodies in the "Mesoglœa."

Students of the Hydromedusæ following McCrady's suggestion use the term Gemmaria for a genus of Medusæ. It might be better to adopt another name for the Actiniarian genus, Gemmaria of Duchassaing and Michelotti; still there is something to be said in support of the use of the name for the Actinian.

ing, and when a foreign object as the end of a pencil be placed upon that region of the body where the knobs are thickest, it is quickly caught hold of and retained by these structures. The region of the object immediately around the circle of tentacles is thickly set with these knobs which here appear to have the form of immature tentacles, and may be homologous with these structures. The object of the Actinian in covering itself with pebbles and bits of shells may be protection.

This species is closely related to *Bunodes papillosa* Verr., figured by Lesson in the "Voyage Coquille," Pl. III, fig. 2. It also resembles *B. pluvia* Verr. (see Notes on Radiata, Trans. Conn. Acad., Vol. I, p. 468. It is closely allied to Urticina of Ehrenberg in the greater or less irregularity in the arrangement of the tubercles. The descriptions of our West Coast Actiniaria often unaccompanied by figures are often perplexing, and the diagnosis of the species not all that might be wished for. While my name is probably a synonym, the characters of the species are somewhat different from those recorded for other forms of Bunodes.

The species is also related to *B. Sabelloides* And.

The following description of the soft parts of the body may give some idea of its general external form.

Body column cylindrical, with thick opaque leathery walls crossed externally by vertical lines of tubercles in indistinct rings. These knobs increase in numbers about the oral disk. When the oral disk is fully expanded the knobs in this region are closely crowded together and resemble immature tentacles. Margin tuberculate. Color of body uniform yellow and green. Rows of knobs pale chocolate or brown. No acontia observed. No cyclides. Tentacles simple, stumpy, arranged in many rows, entac-

mæous. When expanded, their tips extend about double the diameter of the body. Radial lines of the septa, on the perioral region, appear as silvery, double lines, extending from the mouth to the tentacles. Small simple mouth, with slightly raised perioral prominence. Mouth has the form of a longitudinal slit. Body adherent, tentacles wholly retractile. Sphincter muscle strong. The genus lives in colonies covering rocks which are bare at low tide. Whole colonies are hidden by coating of small shells and gravel, and seem to retain considerable water from one tide to another in their body walls.

Found abundantly on the rocks at Point Castillo. Magnificent specimens of this Bunodes, ten inches in diameter, were found on the island of Santa Cruz. The tentacles are a beautiful green and yellow color. In these specimens the tubercles situated about the ring of tentacles formed a thickly crowded zone on the body, and have a dull yellowish or brownish color. Like the specimens from the rocks of Punta del Castillo these Bunodes likewise collect foreign bodies upon the knobs, but in places where there is little sand these aggregations are for the most part pieces of shells and fragments of seaweeds.

Large numbers of the young of all sizes occur at the bases of the older specimens, and evidences of fission can be readily seen. That the colony is formed in that way and by gemmation from the base seems to be doubtless true.[1]

[1] M. Nussbaum gives a very short account of fission in an unknown Actinia from the coast of California. This may possibly be the same genus as that which I call Bunodes, but there is nothing to prove that such is the case as his notice is so imperfect that the animal studied cannot be identified. I have often taken Bunodes with young clustered at the base, and the form of the colony would indicate that this mode of reproduction is very common. (See Nussbaum, Vorläufiger Bericht über die Ergebnisse einer mit Unterstützung der Königlichen Akademie ausgeführten Reise nach Californien. Sitz. der Kön. Akad. der Wiss. zu Berlin, 1887, Nos. L, LI.)

ANEMONIA STIMPSONII sp. nov. (?).

(PLATE VI, FIGS. 3, 4.)

Among the many Actiniaria which people the waters of Santa Barbara[1] one of the most beautiful is a species of Anemonia to which is given the specific name *Stimpsonii* out of profound respect to the memory of one of our best students of marine animals, Dr. William Stimpson. This anemone was found abundant in the pools and reefs of Santa Cruz island, where it was first seen, but it was also collected at various points on the main land.

A. Stimpsonii is a small Actinian of bright red color, with blood-red crimson stripes on the smooth body, especially on the region of the external body wall near its attachment. When the tentacles are retracted they are wholly hidden, and the body forms a wart-like structure on the base of attachment, not unlike a Metridium, but of bright crimson color. When expanded the margin of the circumoral region is reflexed, by which the tentacles are widely expanded.

The tentacles are brownish in color, stumpy, without lateral appendages, and armed with powerful lasso-cells.

The region between the single row of tentacles and the mouth is smooth, destitute of appendages. The ring about the mouth has a whitish color. The mouth is circular, slightly linear. The base of the tentacles is whitish with a white spot at the tips. Tentacles, smooth, menocyclic. The whitish spots at the bases of the tentacles are conspicuous.

When the polyp is wholly expanded the upper region of the body immediately contiguous to the base of the ten-

[1] Santa Barbara lies between the region from which most of the specimens of west coast Echinoderms recorded by Verrill (Trans. Conn. Acad., Vol. I, part II, No. 2) and those of Stimpson (*op. cit.*) were taken. It therefore presents an interesting collecting ground for this group, and affords interesting facts in the study of the geographical distribution of west coast Echinoderms.

tacle forms a marked ferrule, separated from the remainder of the body by a shallow constriction. Specimens of the same genus, apparently the same species but of a yellow color, were found.

This Actiniarian is so different from any of those described from the west coast that I have ventured to regard it a new species.

ECHINODERMATA.

DERMASTERIAS IMBRICATA St.

The following facts may be added to those already recorded in regard to this starfish. It has been described and figured by others, but in none of the published accounts has reference been made to its coloration. The genus is one of the most brilliantly colored of the group.

The external surface body is leathery, and when seen from above is soft and destitute of spines. The color of the abactinal region is bright orange and red; on the actinal side the body is white or brown, slightly cream colored. There is a single row of feet on each side of the water tube on the actinal surface of the arm. The size of large specimens is eight inches in diameter. Anus central or subcentral. There is a single bright yellow madreporic body.

Dried specimens of Dermasterias show the marginal plates, like those of Astropecten, very conspicuously. These plates are, however, hidden in the live specimens by the thick leathery dermal covering. Claus's description of a species from the Red Sea has the plates much more prominent than the living *D. imbricata*, and corresponds with a dried specimen of the same.

The soft skin stretched over the calcareous plates and the absence of spines on the aboral surface of the body give a most exceptional appearance to the genus. When

the animal is alive the plates are not visible, but when dried these structures are plainly brought out. This genus is one of the most highly colored of all the Asteroidea in Californian waters, and the contrast between the colors of the upper and lower surface is very marked.[1] The very bright red and orange specimens of Dermasterias are female, while the male is dark brown. The ova have a yellow color.

In connection with the above description it may be of interest to record the colors of *Asterias*[2] *exquisita*. The abactinal surface is brown, with white knobs or rounded spines which are very conspicuous. Each knob is surrounded by a circle of purple colored, filamentous, tentacular bodies which are almost black.

The starfish, *Hymenaster miniatus*, which is very common at Santa Cruz, was often observed to be infested by a parasitic worm which from its intimate association is thought to be parasitic upon the external surface of its body.

OPHIOTHRIX RUDIS Lyman.

Balfour records that the gastrula cavity, archenteron, of a species of Ophiothrix which he studied is formed by invagination. Apostolides says that this structure in another species is formed by delamination.

The archenteron of *Ophiothrix rudis* is formed by invagination. The following observations support this statement.

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[1]The genus Dermasterias is so markedly different from other Asteroidea that a new family is needed for its reception. I suggest the name Dermasteridæ with the following characters.

Arms five, covered with a thick, soft, leathery skin. No spines. Single row of suckerless feet. Mouth as in Astropecten. Marginal plates smooth, prominent. Dorsal plates of uniform size; no marked median dorsal.

[2]The differences of this species from other known members of the genus Asterias are great enough to separate it and to form a new genus for which the name Calliasterias is suggested.

Male and female organs are found in different individuals. The ovaries are orange colored; the spermaries, white or cream colored. Artificial fecundation was accomplished by methods similar to those already described in my paper on the development of Echinarachnius. Sexual organs are capable of fertilization in the month of March.

The ovum of Ophiothrix has a central, more opaque and a peripheral transparent zona radiata, as in Ophiopholis. Eggs fertilized at 12 M. passed into a four-celled stage at 8 P.M. and into a ciliated gastrula at 9 A. M. of the following day. All the successive stages in the infolding of the blastoderm to form the gastrula were observed and they were found to closely resemble those which I have elsewhere figured for Ophiopholis. My observations support those of Balfour and do not agree with those of Apostolides.

ANNELIDA.

SABELLARIA CALIFORNICA sp. nov.

(PLATE VII, FIGS. 3, 4.)

The inroads of the sea have worn the soft rock of Punta del Castillo into caverns on the roof of which many honeycomb-like formations of sand and fragments of shell are found. This incrustation, bare at low tide, forms in places a continuous mass several feet across and from a foot to two feet in thickness. It is a solid aggregation of worm tubes, the openings of which are found to be closed by the conical operculum of a Sabellaria. A fragment of this incrustation is represented on Plate VII, fig. 3.

The mass is easily crushed, is very fragile, and composed of particles of shells and grains of sand cemented loosely together. These worm tubes can be easily cut from the mass and the bodies of the Sabellaria readily ex-

tracted, for the aggregation is exposed for several hours between tides.

The body of the Sabellaria which forms these tubes is composed of two regions, a spiniferous anterior, and a non-spiniferous posterior body region. The anterior is segmented; the posterior unsegmented. Both are capable of great extension; the former being much thicker than the latter, which resembles somewhat an appendage to the former.

The operculum is round, low conical, with black radial ridges. On its edges there is a marked coloration. It is mounted on a contracted base and when the worm is retracted the operculum effectually closes the openings of the worm cases.

On each side of the operculum there is a tuft of filaments which are the branchiæ. They are simple, unbranched, flexible, extensile appendages and have a purple color at their bases. They lie on the oral and lateral regions of the head.

The mouth bears on each side a bifid structure of somewhat cresecntic shape, and is enclosed by three lips, an anterior and two lateral posterior.

The first body segment lies just below or behind the oral aperture, and bears a bundle of serrated spines. The second, third and fourth body segments are somewhat different from those which follow. They bear on each side a comb-like structure, on the ventral side of which there is a small prominence with serrated setæ, and on the dorsal a filamentous branchia. The first body segments bear the two clusters or clumps of spines of the mouth, and the two small filamentous appendages.

The fifth and following body segments support on either side a fin-like protuberance of rectangular shape, without comb-shaped structures. This fold has on its outer edge

elongated bodies. There is a projection with setæ and a ventral cirrus on the ventral side, and on the dorsal a pair of filamentous appendages on each segment.

The most distal from the head of all the segments of the larger region of the body has the rectangular lateral bodies reduced to spatulate appendages. Here also the dorsal appendages are smaller, and the tuft of setæ more conspicuous. These setæ are simple, unjointed, serrated spines.

The posterior region of the body is unjointed, non-spiniferous. The anus is terminal, surrounded by a colored zone or ring.

The operculum has the appearance of being morphologically formed of a consolidated crown of black chitinous spines, similar to the ordinary body spines. On my visit to England last summer I examined fragments of the worm tubes of *Sabellaria alveolata* and find them very different from the masses of tube-cases of *S. Californica*. The Atlantic *Sabellaria vulgaris* mentioned by Verrill is also very different.

The ova of *S. Californica* were observed to be deposited singly, not in clusters or strings. They are white and opaque and each ovum is peripherally surrounded by a transparent cortical covering.

Sabella Pacifica sp. nov.

(PLATE VII, FIGS. 1, 2.)

At many places on the cliffs at Punta del Castillo, at Santa Barbara, I found what seemed to be a compact greenish rock riddled with tubes of a worm belonging to the genus Sabella. At first this was regarded as the work of a species of boring annelid, but afterwards it was found that the clay and foreign matter had simply packed in about the worm tubes forming a solid rock-like mass.

The head of this Sabella is armed with club-shaped ten-

tacles, four on each side. In one or two instances there are more than four of these structures. Each tentacle when retracted is dark colored on the distal end and more transparent at its origin from the head. The first cephalic segment is prolonged into a rounded, more or less triangular flap. The tentacles are inserted one behind the other, and are penetrated by blood vessels in which a red fluid can be readily distinguished through the body walls.

The body tapers uniformly from anterior to posterior extremity, the terminal segments of the tail being much reduced in size. The anterior segments are brownish, transparent; the terminal segments are almost opaque. The blood vessels with highly colored red fluid are conspicuous through the body walls.

The spines are small and inconspicuous. They resemble those of *S. alveolata*, to which species *S. Californica* and *S. Pacifica* are closely allied.

SPIO CALIFORNICA sp. nov.

A Spio which is different from any described species occurs under the cliffs of Punta del Castillo at Santa Barbara.

The tubes of this worm resemble those of Sabellaria but differ from them in color, size and form of the openings. The edges of the orifices are sharper and the tubes themselves are more compact.

Head with two long tentacles. Each tentacle has on its anterior border a double ridge of pigment bodies which enclose a ciliated groove. These pigment bodies are mounted on papillæ and resemble rudimentary eye-spots.

The tentacle is folded or annulated, almost jointed, and transparent. The tentacles are inserted on the dorsal cephalic region and through them there runs a yellow colored vessel through which circulates a red blood or a similar fluid.

The dorsal medium cephalic region is prolonged forward

into a median unpaired appendage which forms the roof of the mouth and extends considerably beyond the anterior margin of the head. On the ventral side the mouth is enclosed by two labial lobes, one on each side, and a median posterior lip.

Four dorsal eye-spots of dark color are found on the head. At the base of the cephalic tentacles there are two clusters of small spines. In one of these clusters the spines are directed forward and are larger than in the other. Both clusters lie at the base of the tentacles. The parapodia of the body are arranged as follows. On the second, third and fourth body segments, counting from the head, we find a dorsal and ventral bundle of setæ, and a dorsal and a ventral cirrus. The ventral cirrus is smaller than the dorsal. In the fifth body segment there is a fan-shaped deeply embedded bundle of large spines in addition to the dorsal and ventral clusters.

The segments following the fifth have in place of the ventral spine a collection of large, stiff setæ projecting in a fan-shaped form. These are at least five in number, often more, and notched on one side at their free edges. Dorsal cirrus long, simple and of a yellow color. The terminal body-segment is bifid, and the anus is situated at its tip.

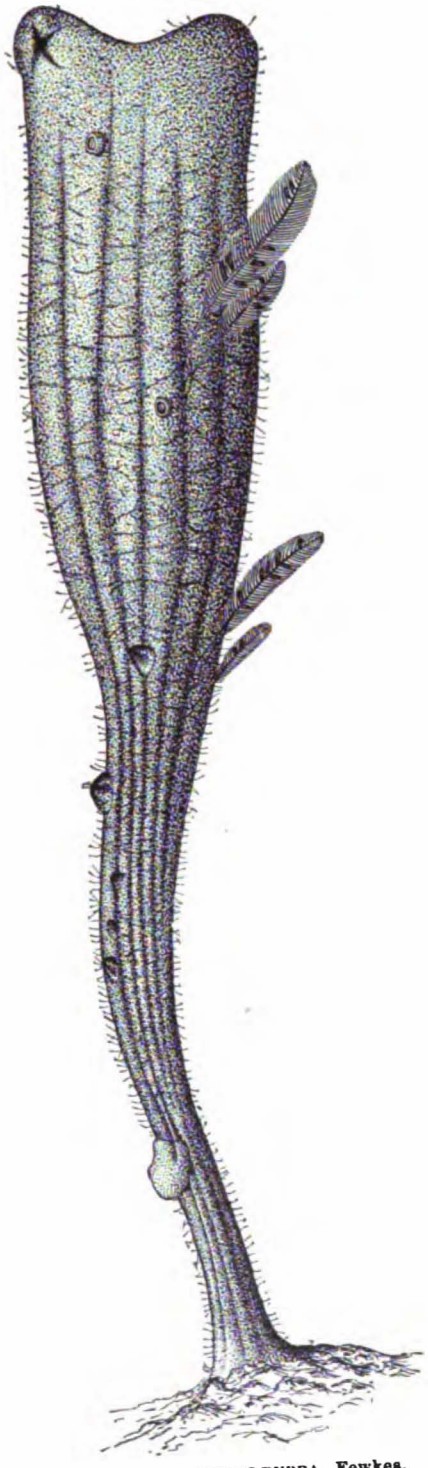
The digestive canal has a brown and yellow color and is easily seen through the body walls.

TUNICATA.

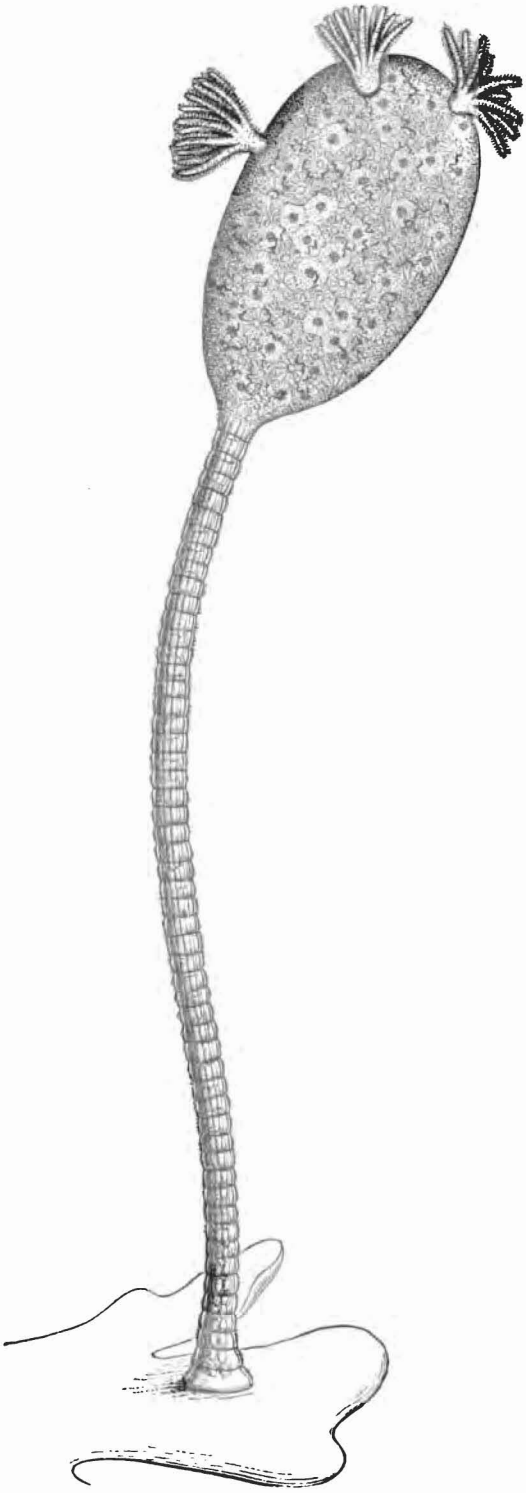
CLAVELLINOPSIS RUBRA gen. et sp. nov.

Specimens of this large red Tunicate are abundant on the piles of the wharf at Santa Barbara.[1] The animal is found in clusters, its leathery tunic being coated with many

[1] Many genera of free Tunicates were found in the Santa Barbara Channel. A large Oikopleura with its "*House*" is at times abundant. Doliolum was taken on



CLAVELLINOPSIS RUBRA Fewkes.



ASCORHIZA OCCIDENTALIS **Fewkes.**

low forms of life, Plumularidæ, Cirripeds, small Actinians and Tunicates.

The body is elongated, club-shaped, enlarged at the distal extremity and tapering to its attachment. Throughout its length it is furrowed on its outer surface by parallel creases or longitudinal indentations which impart a characteristic appearance to the external surface of the body. The color is a bright red, becoming darker along the stalk. The outer tunic is opaque.

The excurrent and incurrent openings into the tunic are terminal, arranged side by side on the upper extremity of the body.

Associated with Clavellinopsis many specimens of a beautiful Clavellina were also found.

BRYOZOA.

Ascorhiza occidentalis Fewkes.

This strange Bryozoan was dredged in twenty fathoms from the channel between Santa Barbara and Santa Cruz.

The body consists of an ovate capitulum[1] mounted on a slender, flexible, sensitive stalk. When this stem was irritated it was observed to sway slowly backward and forward, and even to quickly double itself forming a coil.

The whole animal is an inch in height, and its color is a

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two excursions. A large Salpa, resembling in size and shape *S. maxima* of the Mediterranean, was collected under the lofty cliffs of Santa Cruz Island. The solitary form of this Salpa is over four inches long.

[1]Mr. R. Kirkpatrick, to whom I am indebted for many valuable suggestions in regard to the structure of Ascorhiza has suggested the term "capitulum" to designate the compound zoœcium of this genus.

uniform dark brown throughout.[1] The capitulum is ovate, fastened to the stem at one pole of an axis passing through the longest diameter which is ordinarily carried upright. The external surface is covered with small warts, in places quite smooth, but there are no elevations to denote the position of the polypides. In confinement the polypides did not readily extend themselves, and the openings through which they protrude were difficult to discover. The wall of the capitulum is tough and translucent, while through it a ramifying system of delicate pink fibers extends. There are also many clusters of small yellow pigment spots in its substance.

The polypides were studied by a dissection of the capitulum. After many trials in which it was impossible to see these bodies extended, longitudinal incisions were made with the scalpel through the outer wall of the capitulum into the interior, where the polypides were found to be retracted. They lived for some time after this rough treatment of the capitulum. Each of the numerous polypides has an extended, saccular body fastened at one end and extended at the free extremity into a circle of tentacles. The polypides are confined to the capitulum, and in no case were they found expanded in the living animal.

Each polypide has a white, transparent outer wall, with yellow-brown colored stomach. At the base of the stomach there is seen through the body wall a globular mass. The mouth opening is uncovered and entire. The tentacles which are long, stiff and non-contractile, are readily moved

[1]The color closely approximates that of the giant kelp, Nereocystes, for which it was at first mistaken. The animal was found attached to the base of one of these algæ which rendered the likeness even more striking.

Numerous genera of Bryozoa people the Santa Barbara Channel. One of the most interesting of these is an Idmonea (Pl. VI, fig. 1) which is found in clumps sometimes as large as a man's head, and called by the fishermen a "coral." A Salicornaria is abundant all the way from the Bay of San Francisco to San Diego.

in all directions, but more especially centrifugally and centripetally. Their motion is very rapid, and they often twist themselves in a single coil. Their mode of movement is similar to that of other Bryozoa and markedly different from that of the hydroids. Their external surface is richly ciliated.

Many wheel-like structures were observed through the outer body walls of the capitulum. These bodies bear a close likeness to immature polypides with the undeveloped tentacles retracted giving them a radiated appearance, their tips being folded inward. The wheel-like structures are often pressed together and are most numerous near the lower pole of the capitulum at its point of union with the stalk. The more developed polypides thus lie at the distal pole of the capitulum.

The stem or stalk has a somewhat exceptional anatomical structure. It is a long, jointed body fastened at one extremity to some foreign body, and supporting the capitulum or colonial body of the animal. Its wall has a tough leathery character and is of the same color as the capitulum. The stalk is composed of a number of segments, externally indicated by ferrules of uniform size with the indentations well marked.

The stem is flexible and may be so bent as to bring the capitulum to the level of attachment of the stem, forming a bow. It is sensitive and quickly responds when pinched or otherwise irritated. The motion is slow and graceful. The stem is without appendages or lateral branches; the joints are of uniform size, with the exception of the basal, which is slightly expanded. The division of the joints is superficial.

The outer layer of the stem is translucent, pale brown or dark amber colored. A system of muscular blocks which near the capitulum become spherical can be seen through

the outer wall of the stem in the interior. These muscular blocks do not always correspond in dimensions with the size of the separate nodes externally indicated by constrictions in the stem.

What are the zoological affinities of Ascorhiza among Bryozoa?

The character of the carnose capitulum, in which the polypides are wholly drawn out of sight, recalls the genus Alcyonidium. No known ctenostomatous genus has a stalk like that of Ascorhiza and none of the genera allied to Alcyonidium have this structure.

From the entoproctous genera Pedicellina, Loxosoma and Urnatella which have a pedunculated habit, Ascorhiza differs in the character of the capitulum. We find a homologue of this structure in the last mentioned genus, the fresh-water Bryozoan described by Dr. Leidy. The capitulum is thought to be homologous with the "polyp-head" of Urnatella, for if we suppose this structure to be greatly enlarged and consolidated we have a structure almost identical with the capitulum. The stem of Urnatella, as so beautifully figured by Leidy, resembles that of Ascorhiza in many particulars.

While, however, Ascorhiza differs from all known entoproctous Bryozoa in the colonial form of the capitulum, the stem is found in several entoproctous genera, but nowhere does the likeness appear to be so close as in the genus Urnatella.

In Ascopodaria likewise we have, as figured in the report on the "Challenger" Bryozoa by Busk, at the base of a peduncle a barrel-shaped body which in some particulars resembles the jointed stem of Ascorhiza. This structure in Ascopodaria forms a cup-shaped socket from which the stem arises and which lies at the very base of the peduncle. Other resemblances between the two genera

are not close, for while one has a colonial capitulum the other has but a single polypide to each stem.

A possible interpretation of the combination of structural features which we have in Ascorhiza is that the genus belongs to the Ctenostomata somewhere near Alcyonidium, but that it possesses a sensitive, flexible jointed stem, a feature very rare in this group. It seems probable also that this stem is homologous to the stalk of Urnatella, a fresh-water genus, and more distantly related to a barrel-shaped structure at the base of the peduncle of Ascopodaria. If these comparisons are borne out by more intimate knowledge of Ascorhiza and it is found that there is a true homology between the structures in question it may be found that we have in Ascorhiza a genus connecting two great groups of Bryozoa to which the genera mentioned above belong. So characteristic are the structural peculiarities of Ascorhiza, and so different from any known genus, that it may be necessary to make a new family for its reception.

From my limited knowledge of the internal anatomy, especially of the relative positions of the oral and anal aperture, I am unable to discuss this important anatomical feature in my reference of the genus to Ctenostomata or Cheilostomata. The external features alone stamp it as different from any known genus of either group.

NUDIBRANCHIATA.

CABRILLA gen. nov.

At the time of my visit to Santa Cruz Island, the anchor of a buoy in Prisoner's Harbor was pulled up and with it came a new genus of Nudibranchs for which the name Cabrilla is suggested.[1]

[1] From Cabrillo, the intrepid discoverer of the Santa Barbara Islands.

CABRILLA OCCIDENTALIS gen. et sp. nov.

The body is irregularly globular, elongated, depressed above and of greenish-brown color. It is covered with light-green spots. The dorsal appendages are biserial, one on each side of a median line as in Triopa. These appendages are stumpy, slightly dendritic, bearing lens-like bodies at their tips. Four of these appendages are larger than the remaining and more laterally placed. The remainder are more dendritic and anterior. Two pairs of dendritic appendages are found behind the branchiæ.

There are two dorsal tentacles, one on each side of the medial line. These appendages are conical, linear or subclavate and brown at their tips, which can be readily retracted. The branchiæ are stellate, bipinnate, consisting of primary arms and lateral branches, of white color, transparent. These branchial plumes are situated near the posterior end of the body.

Foot disk-like, and of a brownish-green color. The body is *four* inches in length.

Cabrilla resembles Triopa of Johnston, but is most closely allied to Plocomorphorus of Rüppel.

The lateral appendages are slightly dendritic, as in Dendronotus, but unlike this genus there are branchial plumes. Triopa has but three branchial plumes and is smaller than Cabrilla. Plocomorphorus has a cloakless, slug-like body, with expanded cephalic veil and lateral appendages, plumose branchiæ and two retractile tentacles. Cabrilla dif-

fers from *P. Ceylonicus* in the form of the cephalic veil, the square truncated anterior and bluntly rounded, posterior extremity.

Plocomorphorus has but four pairs of branched lateral appendages between the tentacles and the posterior end of the body — one pair of which lies between the plumose branchiæ and the tentacles — while Cabrilla has four pairs of lateral appendages between the branchiæ and the tentacles and a single *additional* pair *behind* the branchiæ. It has, therefore, *five* pairs in addition to those on the veil.

The lateral appendages of Plocomorphorus are not represented by Alder and Hancock,[1] as having structures corresponding to the highly retractile bodies at the tips of the lateral appendages of Cabrilla. These lens-shaped bodies have been observed by me in several genera and from their prominence it seems not unreasonable to regard them as highly important organs. They recall in their general appearance otoliths, and it seems possible that they are organs of special sense.

Chioræa leontina Gould.

(PLATE VI, FIG. 2.)

This Nudibranch described by Gould in the "Mollusca of the Wilkes Expedition" and again mentioned by Cooper[2] was collected at Monterey. My specimens closely resemble Gould's figures and descriptions and are much younger than his. Dr. Cooper describes the head of his specimens as "nearly conical" and "the branchial processes five on each side larger than represented in Gould's figure, imbricated and decumbent." The "head" of my specimens is unlike that of those described by Cooper from Santa Barbara, and is rounded like Gould's specimen from

[1] Indian Nudibranchiate Mollusca, Trans. Zool. Soc., London, Vol. v, 1866.
[2] Proc. Cal. Acad. Nat. Science, Vol. III, p. 60.

Puget Sound. The number of branchial appendages is the same as in Cooper's specimens and less than in those of Gould.[1]

Mr. A. Agassiz has kindly loaned me drawings of an unidentified Nudibranch taken by him in 1859 at Port Townsend, Washington Territory. One of these represents a side view (Pl. VI, fig. 2), another a dorsal and a third the head from below looking into the mouth. The last mentioned shows the two rings of cephalic tentacles and the slit-like character of the mouth in addition to the features already mentioned. From the resemblance of these figures to those given by Gould I had referred them to Chiorœa.

The main anatomical features of Chiorœa are given by Gould and Cooper, whose accounts differ only in subordinate particulars. In the main, my observations resemble theirs, only differing in details. No one has yet discussed the affinities of Chiorœa with other genera, although new genera, closely akin to it, have been described. It may not be out of place to call attention to certain affinities of this rarely[2] mentioned animal. Its systematic position is near Melibe, of which we have a species *M. rosea* Rang, from the Cape of Good Hope, and *M. fimbriata* described by Alder and Hancock. Kalaart's species, *M. viridis*, seems different from either. It is more closely allied to Tethys which is not yet known to occur in the Pacific. Its remarkable differences from either Tethys or Melibe, entitle it to membership in a new family, the Chiorœadæ, in which it stands alone, but if we follow Alder and Hancock's classification it would be an aberrant member of the Tethydæ.

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[1] Cooper justly suspects that this difference may arise from immaturity. Gould's specimens were five inches in length; Cooper's, two and three-fourths inches.

[2] This genus is not mentioned in several monographs of the Nudibranchs and its systematic position has remained hitherto undetermined.

EXPLANATION OF PLATES.

All the figures with one exception were drawn from nature by the author. The pen-and-ink reproductions are by Mr. S. F. Denton and the author. The original drawings were free-hand, and were often made under very unfavorable circumstances, on board ship, in temporary working places, or in the open air. All figures, unless otherwise indicated are very much enlarged.

The figure of *Chiorœa leontina* (Pl. VI, fig. 2) was made by A. Agassiz, copied by Denton.

PLATE I.

Fig. 1. *Velella Meridionalis* sp. nov. Probable not an adult, although from a specimen much larger than that shown in figs. 2, 3.

Fig. 2. The same seen from the under side. The central body of bright blue color is the "feeding polyp" and the small blue tentacle-like structures about it mark the limit of the "float" (see description) as seen from the lower side. The oval body forming that portion outside the float is the umbrella seen from below.

The umbrella also forms a conspicuous part of fig. 3, but from the fact that it is seen from the edge is not so conspicuous in fig. 1.

Fig. 3. Velella seen from above. The oval body forming the great mass of the animal is the umbrella as explained above. The smaller oval body placed diagonally on the larger is the float seen from above. In this float the concentric lines indicate the edges of the chambers which make up the float. The thin plate extending across the float is the triangular sail, shown from the side in fig. 2, and seen in perspective. This sail is much larger in the specimen figured in fig. 1, than in that shown in fig. 3. The upturned edge of the umbrella shown on the right of fig. 1 corresponds with the upper pole of fig. 3.

Plate II.

Fig. 1. *Athorybia Californica* sp. nov., side view, showing a single full grown polypite, tentacles (three are represented), tasters and covering scales. It will be noticed when compared with published figures of other Athorybiæ that the float is very prominent and that the mouth opening of the polypite is more trumpet-shaped than is ordinarily the case. This figure was a free-hand drawing made on shipboard. Later a better examination was made on land in which I detected but *one* tentacle. I am confident that in my first examination *three* tentacles were seen and so have reproduced my *original* drawing.

Fig. 2. A single tentacular knob of the above, showing the peduncle, the involucrum, two terminal and a single median tentacles or filaments. The median is inflated into the terminal median vesicle.

This figure also shows the sacculus. The knob closely resembles that of other Athorybiæ and differs from that of the young Agalma. A young Agalma of the same age would have those tentacular knobs which I have called "embryonic tentacular knobs" (see figures in Bull. Mus. Comp. Zool., Vol. VIII, No. 9).

The apical prolongation of the involucrum is a character of the genus Athorybia. This projection is shown on the lower side of the involucrum.

Fig. 3. View of *Velella Meridionalis* sp. nov. Seen from above looking down on the float. Compare with the colored figures of Plate I.

Plate III.

Fig. 1. *Steenstrupia occidentalis* sp. nov. Very much enlarged, showing budding young at the base of the single long tentacle.

Fig. 2. Young medusa of *Syncoryne* (*Sarsia*) *occidentalis* sp. nov.

Fig. 3. Adult of the same. Very much enlarged.

PLATE IV.

Fig. 1. Head of the hydroid *Syncoryne rosaria* (A. Ag.). Showing budding medusæ among the tentacles. The figure is taken from one of the life-size specimens shown in fig. 4.

Fig. 2. Hydroid *Atractyloides formosa* sp. nov. The tentacles are half retracted. External wall covered with algæ. This figure is an enlarged view of one of the following.

Fig. 3. Cluster of the last-mentioned hydroid (life-size).

Fig. 4. Cluster of *S. rosaria* (life-size).

Fig. 5. Male capsule of Atractyloides. These clusters are found at the base of the hydranth stem arising from the branching basal tubes and not from the stem of the hydroid. The central dark body is the spadix, from the left-hand side of which a curved body, " spermatic mass"? is seen in process of formation.

Fig. 6. Very young Polyorchis before the lateral branches of the radial tubes form.

Fig. 7. Adult *Polyorchis penicillata* A. Ag.

Fig. 8. *Microcampana conica*, gen et sp. nov.

PLATE V.

Fig. 1. *Pelagia panopyra*. Size reduced.

Fig. 2. *Aurelia* sp. incog.; possibly *A. labiata*.

Fig. 3. *Willia occidentalis* sp. nov.

PLATE VI.

Fig. 1. *Idmonea* sp. nov.

Fig. 2. *Chiorœa leontina* Gould. From a drawing of a specimen taken by A. Agassiz at Port Townsend, W. T., in 1859.

Fig. 3. *Anemonia Stimpsonii* sp. nov. The tentacles are half retracted.

Fig. 4. The same with tentacles more retracted.

Fig. 5. *Bunodes Californica* sp. nov. The Actinian is rep-

resented as expanded with the oral disk turned towards the observer.

Fig. 6. The same partially contracted with oral disk turned from the observer (life-size).

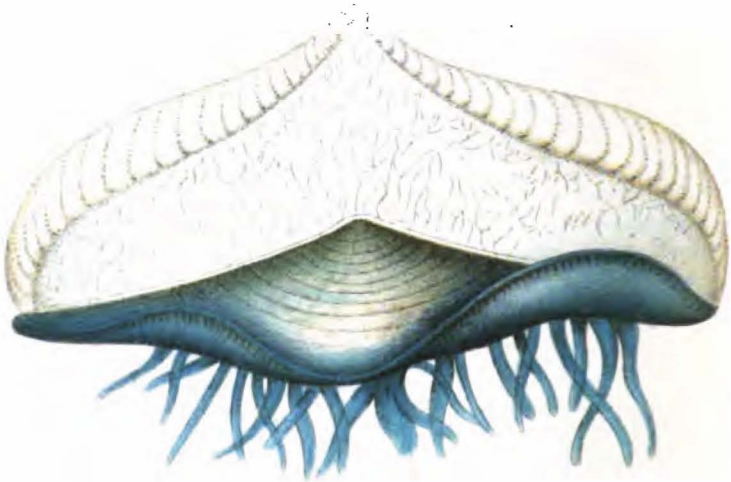
Plate vii.

Fig. 1. A rocky mass formed of the worm tubes of *Sabella Pacifica* cemented together. The section of this mass with the ramifying tubes appears in the foreground: the external tube openings on the smooth, upper side. The intervals between the tubes is filled up by a clay-like material semi-solidified. A pit is seen in the middle of the figure, from which protrude the edges of the shells of several small mussels which were alive when the mass was drawn and which have become embedded in the growing mass, hermetically imprisoned in this pit.

Fig. 2. *Sabella Pacifica* removed from the mass figured above.

Fig. 3. Portion of a large cluster of sand tubes of *Sabellaria Californica* sp. nov. This was cut from a mass four feet long and of about the same width and eighteen inches thick. The upper part shows the external openings, the lower foreground sections of the tubes. On either side the tubes are shown. The rounded bodies or disks shown closing several of the external orifices of the tubes are opercula of the inhabitant of the tube.

Fig. 4. *Sabellaria Californica* extracted from its tube. The dorsal region is on the lower side of the figure. The body is very much contracted, and the posterior end of the body is bent downward. Its position, when alive, is probably bent to the other side of the anterior end, the posterior opening being thus brought near the operculum.



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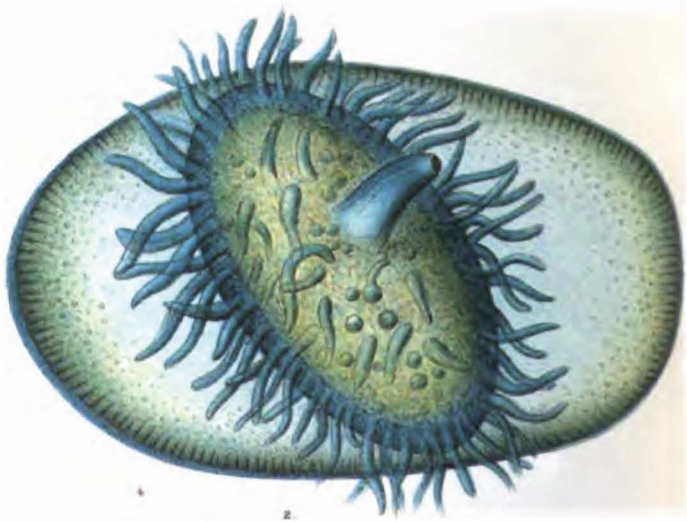

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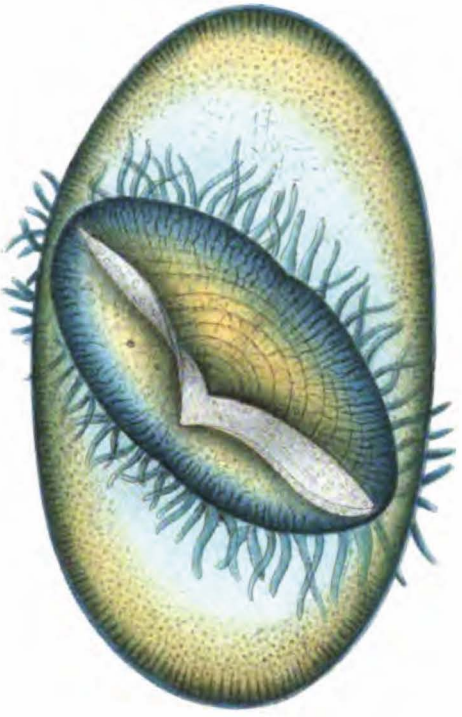

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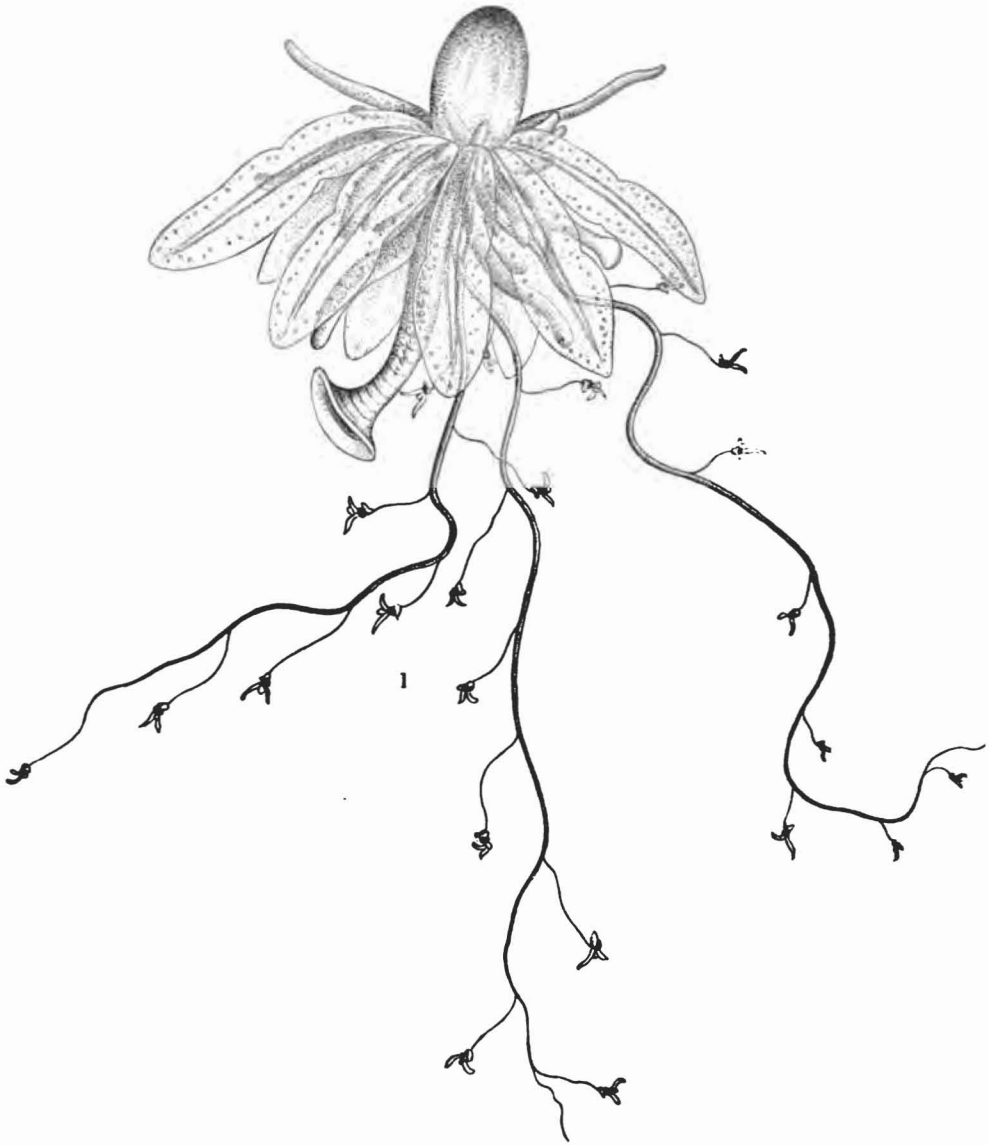

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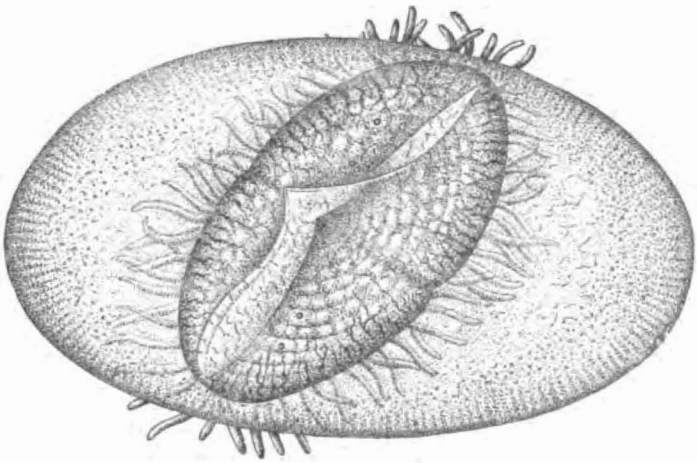

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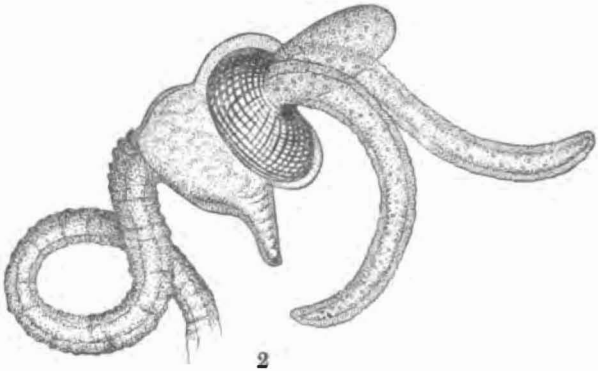

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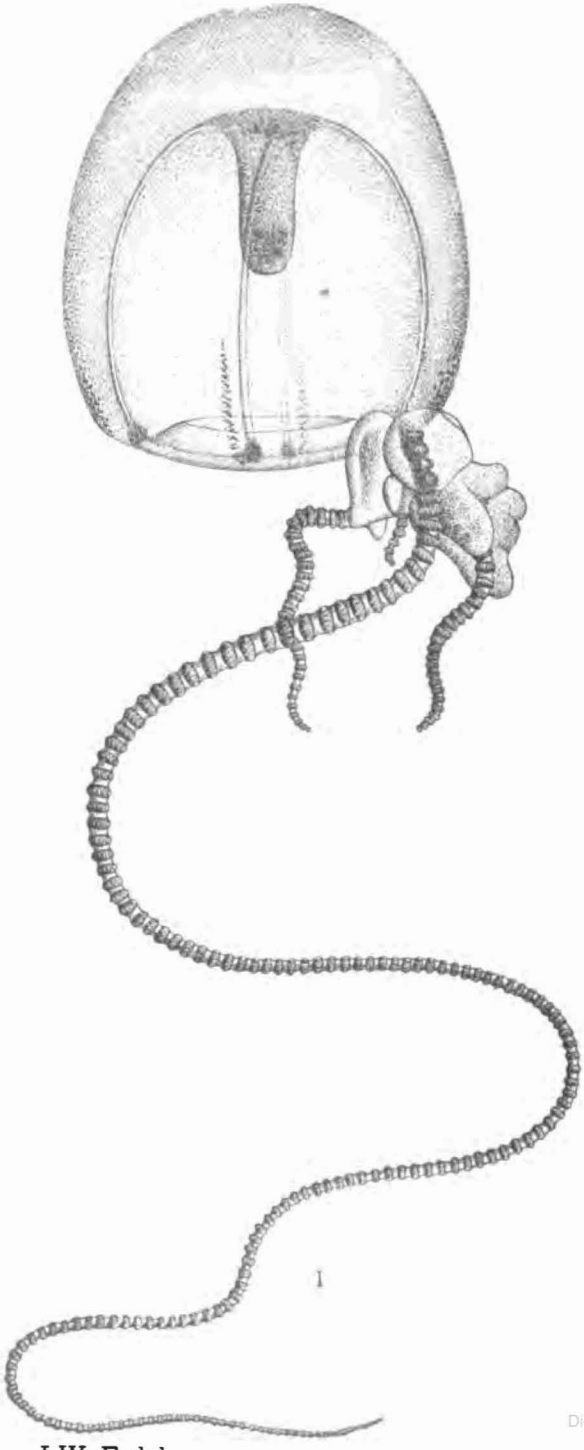

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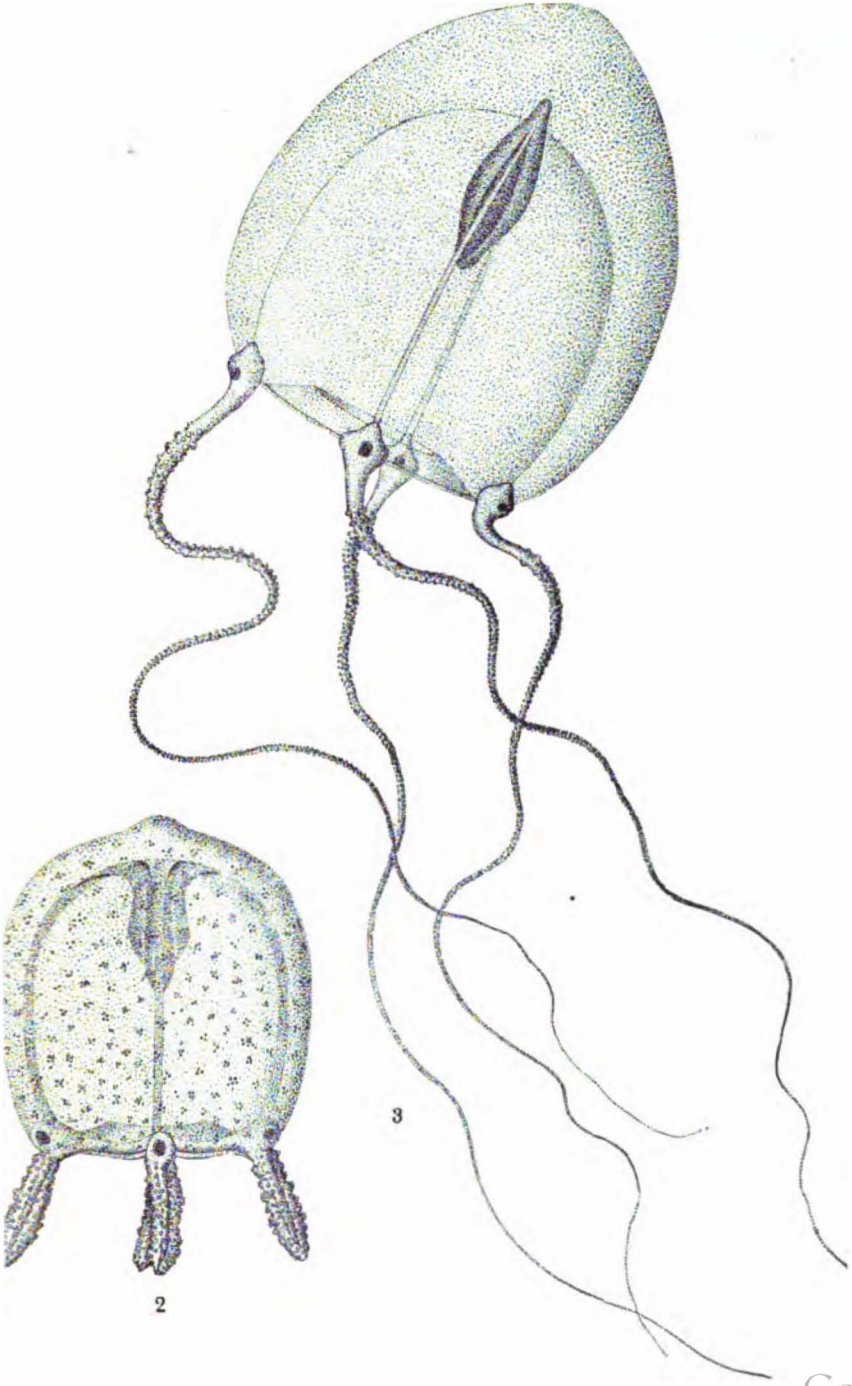

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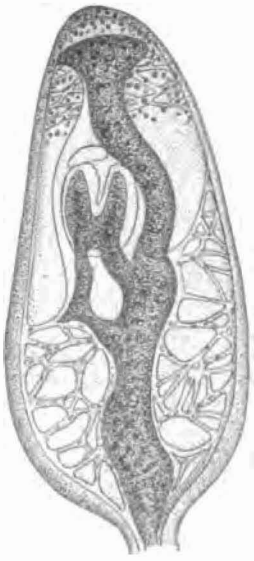

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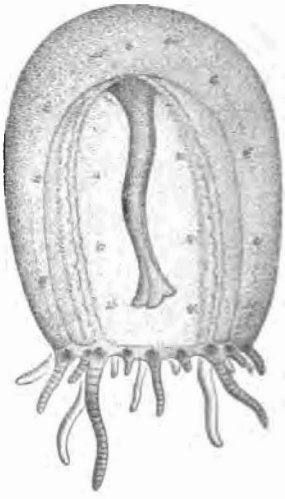

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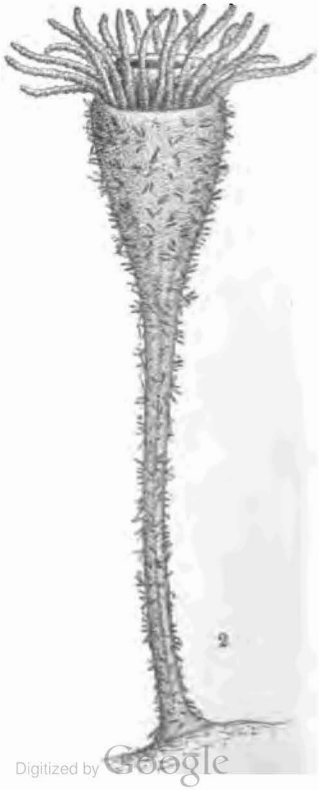

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PLATE IV

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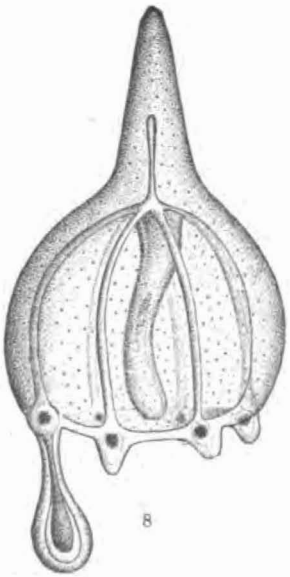

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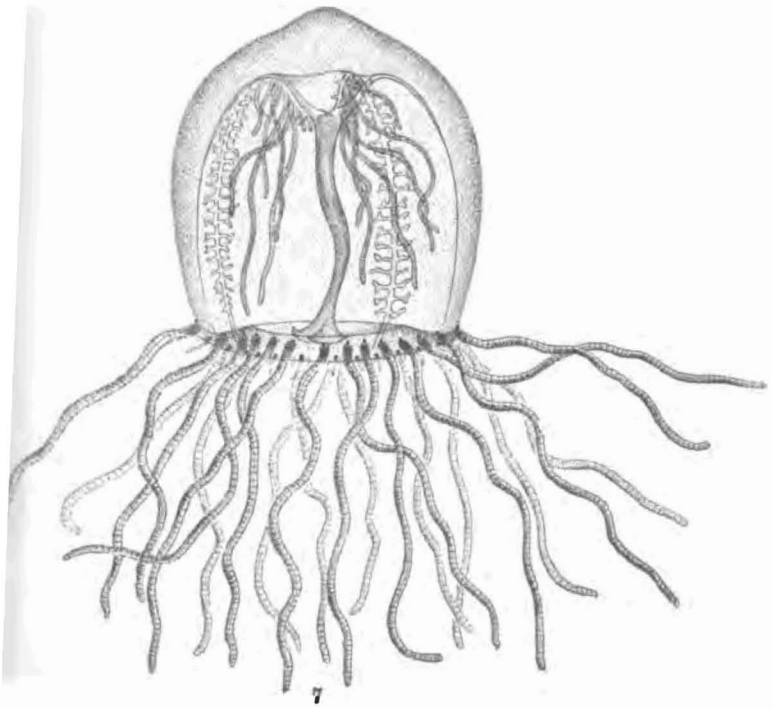

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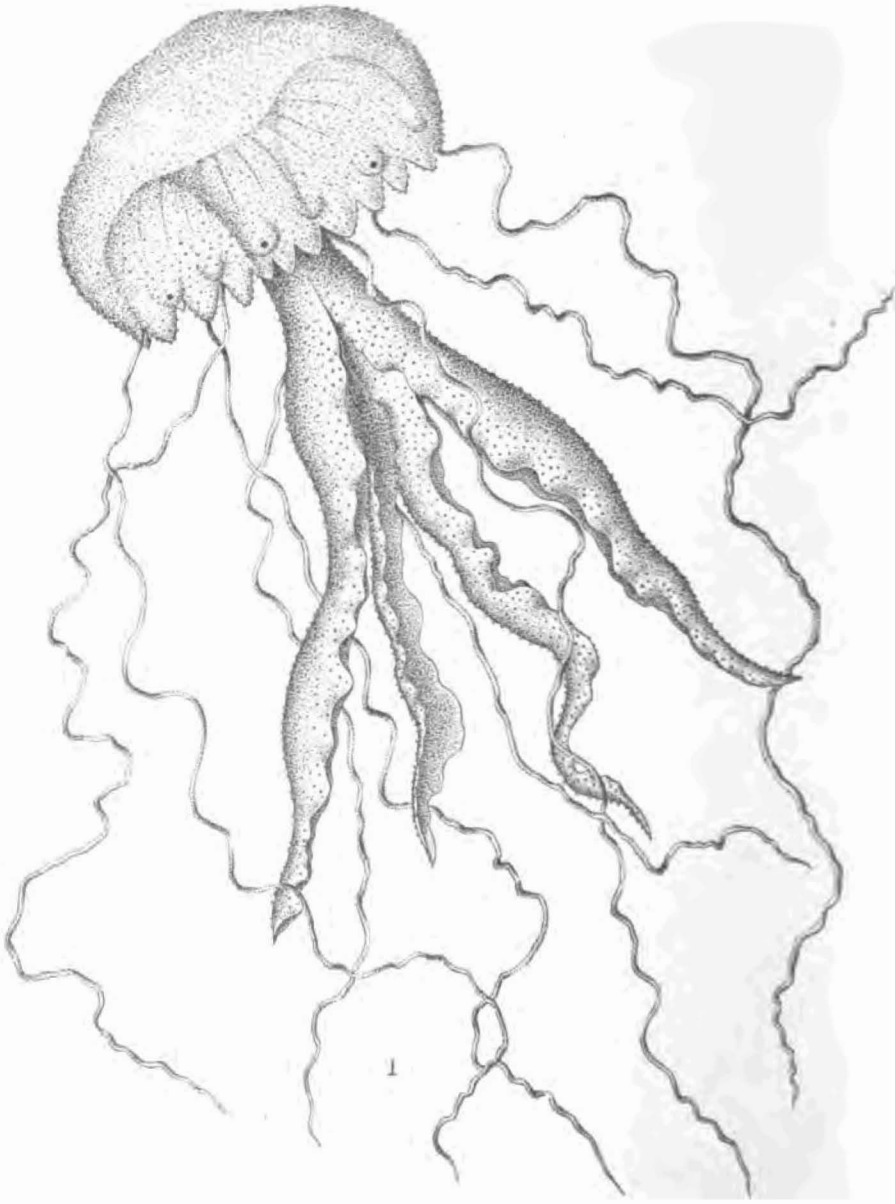

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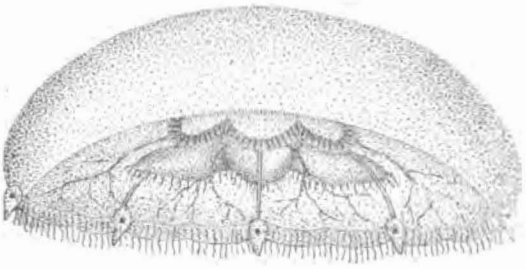

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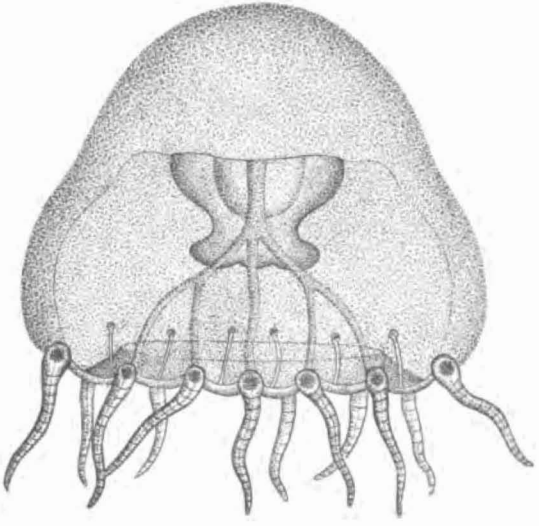

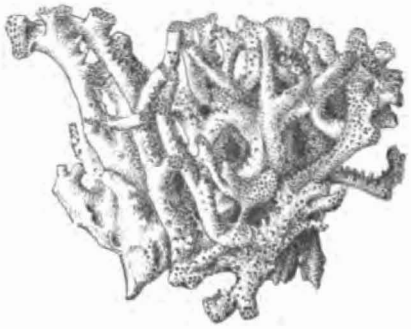

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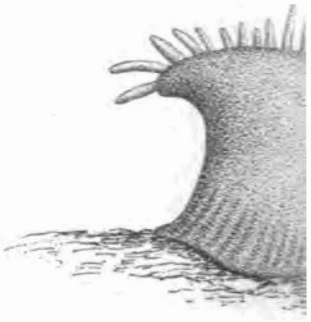

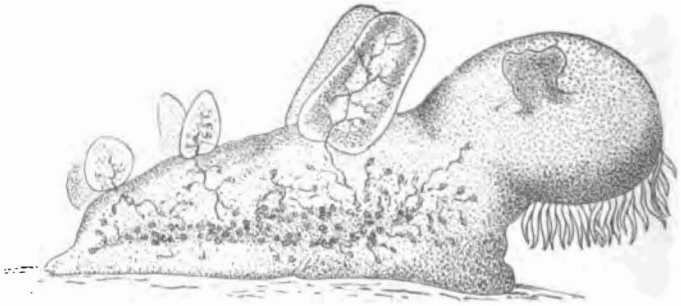

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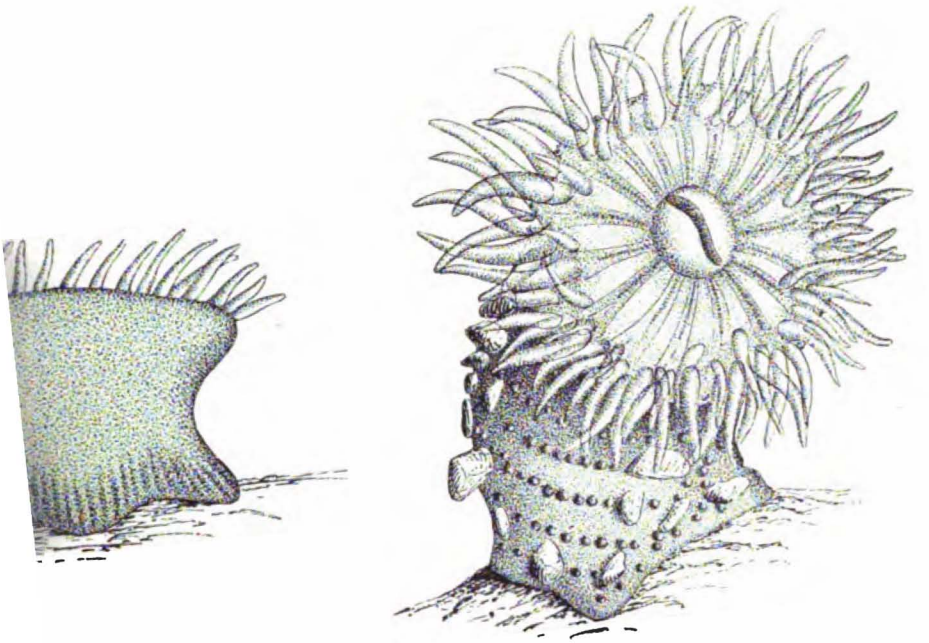
PLATE VI.



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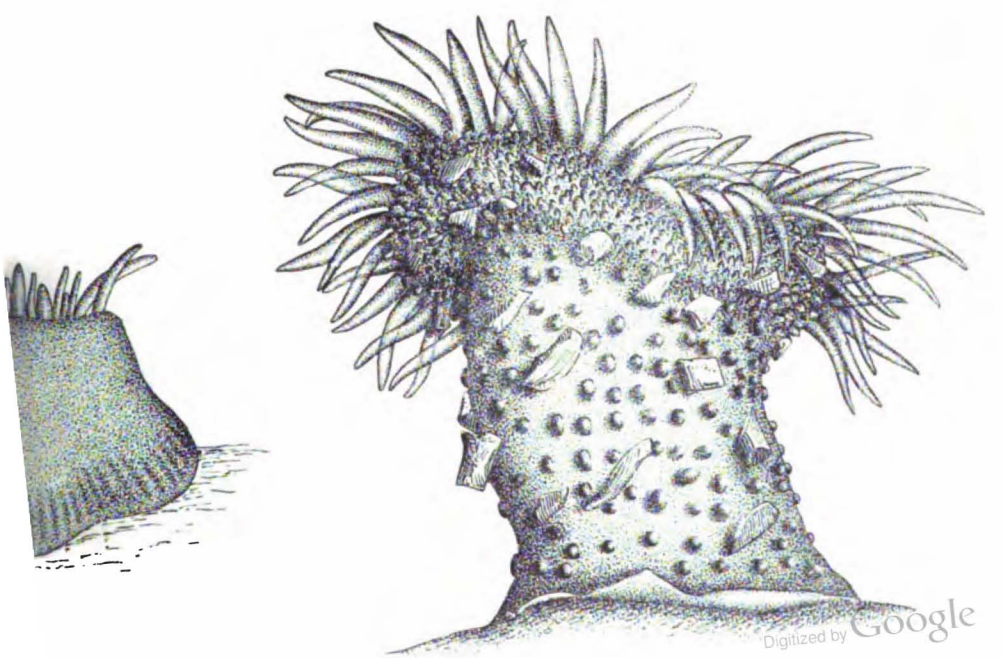

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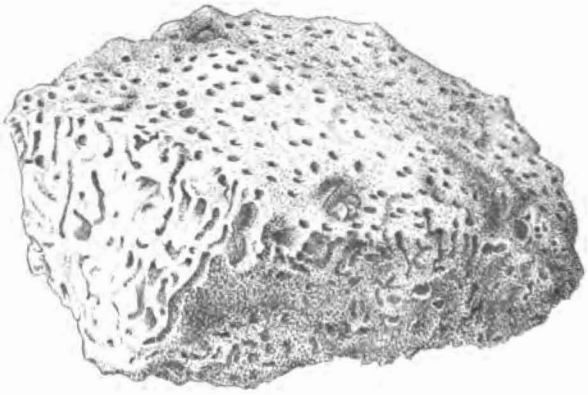

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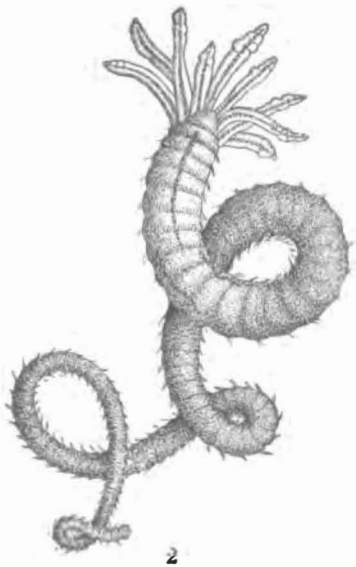

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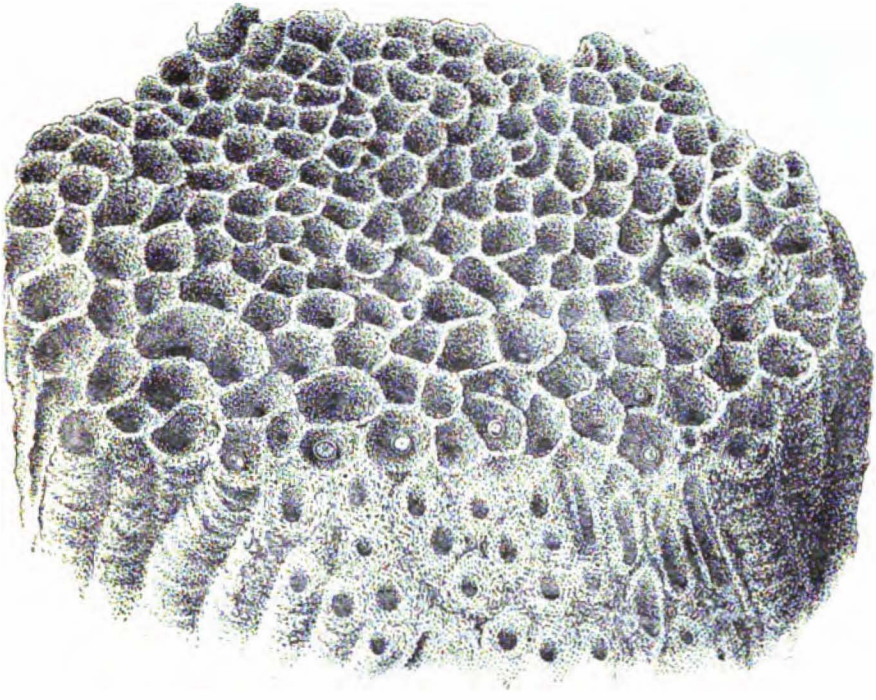

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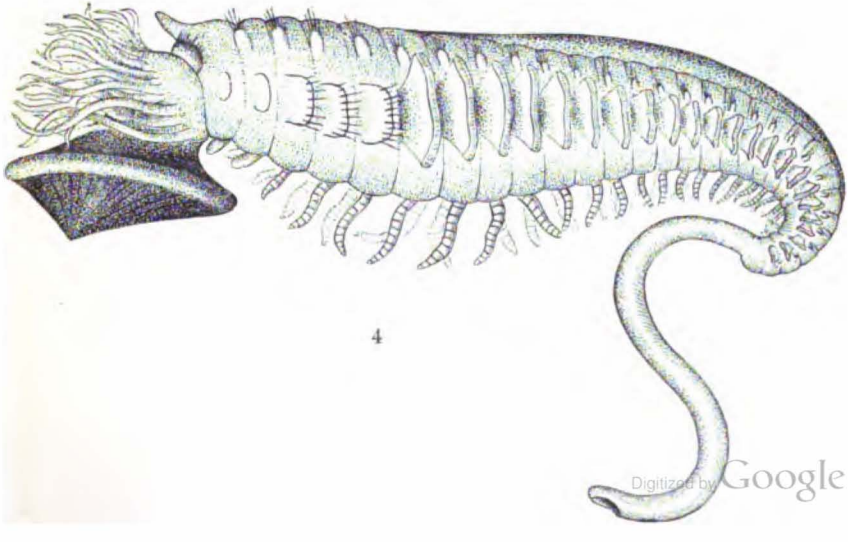

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BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 21. SALEM: OCT., NOV., DEC., 1889. NOS. 10–11–12.

ANNUAL MEETING, MAY 20, 1889.

The annual meeting was held this evening at 7.30 o'clock, the President in the chair. Records of the last annual meeting read and approved.

The reports of the Secretary, Librarian, Curators and Committees were read and accepted.

The reading of the report of the Treasurer was postponed to an adjournment of this meeting, on account of the absence of the Treasurer, Mr. Phippen, being on a journey for his health.

On motion of Mr. Whipple

Voted that when this meeting adjourns, it will be at the call of the Secretary.

The President called attention to photographs of two old oil paintings recently presented to the Institute by Mr. Waldo Higginson of Boston, whose letter explanatory of the same was read.

The first represents a scene in Madras about 1694, with portraits of Governor Nathaniel Higginson and wife, and Stephen Aynsworth who afterwards married Sarah Higginson, their daughter, born Dec. 2, 1697.