

No. 7. — *Contributions to the Fauna of the Gulf Stream at great depths (2d series)*. By L. F. DE POURTALES, Assist. U. S. Coast Survey.

(COMMUNICATED BY THE SUPERINTENDENT OF THE U. S. COAST SURVEY.)

THE researches of which an account was given in the preceding number of the Bulletin were continued in the spring of the present year (1868) in connection with the regular explorations of the Gulf Stream by the Coast Survey. The few dredgings obtained in 1867 had given results of so rich and promising a character, that Professor Peirce, the Superintendent of the U. S. Coast Survey, directed me to accompany the party again, and to dredge on all the lines of deep-sea soundings off the Florida reef.

The U. S. Steamer Bibb, Acting Master R. Platt, U. S. N., was assigned to the work. The means of working were much more complete, a small engine having been set up on deck, by which not only a great economy of time and labor was obtained in hauling up the lead or dredge, but it was found perfectly practicable to work both at the same time ; so that our estimate of time, based on the plan of sounding out a line one day and dredging over the same ground the next, was reduced one half, — an advantage which will be understood by those who know the value of a calm day for such work. For the perfection of the mechanical arrangements, and the difficult task of keeping the reckoning in the current with very scanty landmarks, I am again deeply indebted to Captain Platt and his officers.

The region to be explored this season comprised a section of the Gulf Stream from Sombrero, or Dry Rocks Light-house, on the Florida reef, to Elbow Light-house on the Double-headed Shot Keys ; a section of the St. Nicholas Channel from Salt Key to the opposite coast of Cuba ; a section of Santaren Channel from Anguilla Keys to the edge of the Great Bahama Bank ; and a more detailed examination of the slope extending from the Florida reef to the trough of the channel from Sand Key to Sombrero Light. The sections across St.

Nicholas and Santaren channels were quite successful, as far as the soundings and current observations were concerned; but the few dredgings with which we had to be contented, for want of time and good weather, did not produce much of interest. We were more successful on the slope or so-called *apron* of the reef. Here the great advantage of having a safe anchorage every night inside the reef, and within half a mile of the field of work, allowed the soundings and dredgings to be carried on with great rapidity and success.

The six lines run (as far as possible normally to the reef) were the following: Off Coffin's Patches with only two dredgings; off Sombrero Light with seven dredgings, between 111 and 517 fathoms; off Bahia Honda thirteen dredgings, from 19 to 418 fathoms; off the American Shoal fourteen dredgings, from 16 to 266 fathoms; off the Samboes nineteen dredgings, from 13 to 298 fathoms; and off Sand Key twenty dredgings, from 23 to 306 fathoms. Besides these, numerous casts were made in 100 and 120 fathoms off Sand Key, whilst current observations were in progress.

The figures and the character of the bottom developed by the different lines were found quite concordant. At an average the slope, after leaving the reef, is uniform for four or five miles, and the bottom is composed of more or less comminuted shells and corals, with a rather scanty living Fauna. This we may call the first region. The next extends in the form of a band parallel to the reef, ten to twenty miles broad, beginning at a depth of about 90 fathoms, and extending to about 300; the slope being much less inclined than in the first region, and in fact deserving in a great part of its extent the name of a submarine plateau. The bottom is rocky, rather rough, and consists of a recent limestone, continually though slowly increasing from the accumulation of the calcareous *débris* of the numerous small Corals, Echinoderms, and Mollusks living on its surface. These *débris* are consolidated by the tubes of Serpulæ, the interstices filled up by Foraminifera, and further smoothed over by Nullipores. It is not unreasonable to suppose that we have here the foundation of a future reef, which, when in the course of ages it shall have approached the surface, will be covered with a growth of Madreporæ and Astreans, such as we find on the present barrier reef, and as have lived on the former reefs constituting the chain of the Florida Keys, the border of the main-land of the peninsula, and probably some older as yet unexplored ones in the Everglades.

This region ceases at a depth varying from 250 to 350 fathoms; the third region begins with a more rapid slope, and extends over the whole trough of the channel, the depth of which in this part does not much exceed 500 fathoms. This is the great bed of Foraminifera, and more specially of Globigerinæ, which covers so great an extent of the bottom of the ocean, and which, as we shall see, is not destitute of living representatives of the higher branches of the animal kingdom.

The Fauna of the three regions is very distinctly marked. The first region is singularly barren, and shows that the rich Fauna of the Florida reef extends but very little to seaward or into depth. The greater number of the shells brought up are dead and broken, and can scarcely be regarded as characteristic, as large numbers of them have evidently served as food for turtles and fishes, and may have been thus transported some distance. Crustaceans and Annelids are more common. The Echinoderms are represented by a few Ophiurians, and the Corals chiefly by *Balanophyllia floridana*, nov. sp., very abundant in some places, particularly near Sand Key.

The second region, on the contrary, is remarkably rich in animal forms, which may be in part attributed to the hard and rough bottom offering points of attachment and shelter. If this formation were emerged, the geologist would find it to consist of beds of limestone full of fossils, of which we shall point out the most characteristic ones; remarking, however that though the great majority of the animals furnishing those remains now live on the bottom, a few contribute by sinking after death from the higher regions of the superincumbent water (teeth of fishes and shells of Pteropods), and others are brought by currents from littoral regions (bones of Manatee, fragments of littoral plants).

The *Vertebrates* are represented by the bones of the Manatee, chiefly fragments of the ribs. These are quite abundant, no less than ten or twelve casts of the dredge having brought them up, generally several pieces at a cast. Until we are better acquainted with the set of the currents on the west coast of Florida and the coast of Cuba, the former *habitat* of these animals cannot be guessed at with much certainty, as their carcasses, either floated out of the estuaries of those coasts, or when very numerous, as they evidently were, the animals may have been in the habit of migrating across the straits, and may have been frequently destroyed by sharks on the passage. As no fresh addition of

these bones is now made to the bottom, nor has been since these coasts have been settled upon by white men, we have a proof that the deposit due to other causes is very slow, since the dredge finds the bones still lying loose on the bottom.

The other vertebrate remains are teeth of sharks and eggshells of skates. Living fishes were obtained in only two instances at about 100 fathoms: one was a Phycis; another, a small fish of the Lophioid family, not yet determined.

The *Crustacea* are rather abundant, but, the specimens not having been fully examined, we can only give now an imperfect list of the genera represented: *Stenorhynchus*, *Inachus*, *Amathia*, *Pisa*, *Mithrax*, *Lupa*, *Ethusa*, *Pilumnus*, *Dromidia*, *Eupagurus*, *Paguristes*, *Galathea*, *Thysanopoda*, *Alima*, *Caridine*, &c.

Of the *Mollusks*, the most abundant in individuals are the Brachio-pods, particularly *Terebratula cubensis*, Pourt. (Bulletin Mus. Comp. Zoöl. No. 6), of which over 1,200 specimens were collected, and *Waldeheimia floridana*, nov. sp., a little less common. The *Terebratulina Cailleti*, common on the coast of Cuba, was found very rarely on the coast of Florida, and always dead. The Gasteropods are more numerous than the Acephala, but, as well as the latter, are represented by small species. The largest ones are the *Voluta junonia*, and a *Trochus* of about the same size. As the Mollusks of the collection have not yet been determined, a list of the genera must suffice for the present: *Murex* (2 species), *Fusus*, *Nassa*, *Pedicularia*, *Cassis*, *Dolium*, *Pleurotoma*, *Voluta*, *Marginella*, *Natica*, *Vermetus*, *Trochus*, *Monodonta*, *Delphinula*, *Scissurella*, *Fissurella*, *Rimula*, *Emarginulina*, *Pileopsis*, *Dentalium*, *Chiton*, *Marsenia*, *Eolis*; — *Cucullea*, *Pectunculus*, *Nucula*, *Leda*, *Lucina*, *Mactra*, *Neæra*.

The only ones among these abundant in individuals are a *Pleurotoma*, a *Marginella*, a *Vermetus*, a *Monodonta*, and a *Cucullea*.

Bryozoa are also frequent in individuals; but there are less species apparently than on the coast of Cuba in similar depths.

The *Radiates* form perhaps the most interesting part of the collection, being represented in many cases by new or little known genera. The Echinoderms have not yet been determined, with the exception of the Holothurians, of which only three species are found; one of them, *Cuvieria operculata*, nov. sp., is tolerably common; the others are a *Thyonidium*, and another which the imperfection of the specimen has

not allowed us to recognize with confidence. Of *Echinida* there are five or six species, of which a *Cidaris* is very abundant, and an *Echinus* rather common. Both are new species, and the immature specimens found on the coast of Cuba, and referred to *Cidaris annulosa* and *Triptoneustes ventricosus*, in the Bull. Mus. Comp. Zoöl. No. 6, belong in reality to them. The genera *Echinocyamus*, *Amphidetus*, and a new genus near *Parasalenia*, are also represented. The *Asteridæ* are also represented by several new forms of *Ophidiaster*, *Pteraster*, *Asterias*, and *Luidia*, and among the Ophiurians of genera near *Asteroschema*, *Asteropora*, and *Astrophyton*. The *Comatula Hagenii*, Pourt., is found in great abundance. The Gorgonians and Corals will be described at the end of this paper. They belong to the following genera: *Nephthya*, *Primnoa*, 2 sp.; *Gorgonia*, 2 sp.; *Acis*, *Antipathes*, 3 sp. *Cænocyathus*, *Paracyathus*, *Thecocyathus*, *Rhizotrochus*, *Lophohelia*, *Allopora*, *Distichopora*, *Errina*, *Thecopsammia*, n. gen. 2 sp.; *Diaseris*, *Haplophyllia*, n. g. *Pliobothrus*, n. g.

It will be remarked that among the Corals the families of Madreporidæ and Astræidæ are entirely unrepresented, whilst the greater number belong to the families of Caryophyllidæ and Oculinidæ, as defined by Milne-Edwards, or, as we believe, to a new family to be separated from the Oculinidæ, and called Stylasteridæ.

The Sponges are found in this region in numerous forms; they are in general very abundantly provided with siliceous spicula, so much so as to be unpleasant to handle.

The third and last region is characterized by the great Globigerina deposit. No trace of Vertebrates is found here, the accidental remains being probably soon buried in the soft bottom. But other branches of the animal kingdom are still represented as deep as 517 fathoms, beyond which limit we had no occasion to dredge. The Crustaceans are confined to a few small and peculiar forms of Pagurians inhabiting shells of Dentalium and Pteropods. Annelids appear to be comparatively abundant and varied. Of living Mollusks only three species were obtained, — a *Phorus*, a *Dentalium*, and a *Limopsis*, the two latter more numerous; and of dead shells, *Pleurotoma*, *Rimula*, and *Neæra*, besides several kinds of Pteropods, not inhabitants of the bottom. The Radiates comprise a few small Ophiurians; *Bourgueticrinus Hotessieri*, D'Orb. (which will be described further on); *Primnoa*, *Gorgonia*, *Chrysogorgia*, *Acanthogorgia*, *Isis*, *Mopsea*, *Caryophyllia*, *Stephano-*

phyllia, and dead fragments of some of the Corals of the preceding region. Sertularians and Sponges are also found sparingly.

A few general remarks on the deep-sea Fauna may not be inappropriate. First, with regard to dimensions: almost all the species are of small size, compared with the allied forms of the littoral and shoal-water regions in general; the *Voluta junonia*, the largest shell found, is small for that genus. The only exception is an *Echinus*, which is nearly of the average size, and an *Actinia*. The prevailing colors are white, pink, — sometimes playing into orange, — and a pale green. Blue was only seen in a small incrusting Sponge. What proportion of light reaches a certain depth we shall try to determine during our next exploration. It is certain, however, that the deep-sea animals have generally well-developed eyes, larger if anything than those of their congeners of shallow water.

It is rather a matter of surprise to find so great a difference between the Fauna of similar depths on the coasts of Cuba and of Florida, separated as they are by a strait of no great width, and bathed by the same current. The few dredgings obtained on the former coast do not allow us to draw conclusions from the absence of Florida species, but they give still more weight to the inverse. Thus, to restrict our remarks to the Corals, — more carefully studied than the other classes, — of ten species of true Corals from Cuba described in the preceding number of this Bulletin, only two have been found on the Florida coast, and they only in very rare fragments. Something may be due to the gregariousness of Corals in certain spots and their rarity in others. The dredge may come up full of a certain species at one time, and it may never be found again, even in close proximity. This happened to us with regard to *Lophohelia affinis*, n. sp. The botanist is familiar with such instances among land plants.

We hoped to give in this paper a full catalogue of the species collected; but as time is insufficient, it is thought best to publish the following descriptions as far as completed, and, as the dredgings are to be continued throughout the straits of Florida, the descriptions of the other species will be reserved for a more extended final work.

I take this opportunity again to acknowledge the help I have received from Professor Agassiz in the way of advice and of facilities afforded to me in the Museum of Comparative Zoölogy.

*Description of Species.***Waldheimia floridana** POURT.

Shell ventricose, triangular, smooth, wider than long, the widest part being across the front; horn-color. Both valves very convex, the larger one with a shallow longitudinal sinus near the front. Lateral margin of larger valve convex, frontal margin angularly sinuous, and deeply indenting the smaller valve in the middle. Front straight and flattened. Beak prominent and compressed laterally, with a round and rather large foramen. Deltidium small, in two pieces. Loop very long, reaching nearly to the frontal margin of the shell, formed of very thin crura, and a very broad ribbon-shaped reflexed portion. Septum well developed. Lines of growth distinct. Length of shell $\frac{7}{8}$ of an inch, breadth 1 inch.

Very young specimens are flatter, rounder, and have a straight margin; they could scarcely be distinguished from the young of *Terebratula cubensis*, if it was not for the loop and septum seen by transparency. There is also some variety of form in the old; in some specimens the length is greater than the breadth, and there is considerable diversity in the sinuosity of the frontal margin.

This species is quite common off the Florida reef, between 110 and 200 fathoms, on rocky bottom; it is always associated with *Terebratula cubensis*, the latter being still more common (in the proportion of about three to one), and making its first appearance in 100 fathoms.

Cuvieria operculata POURT.

Body oval, flattened, covered with finely and sparsely granulated scales, very compactly imbricated, but overlapping very little except near the mouth and anus. A double row of suckers surrounds the soft abdominal disc, those of the outer row perforating the marginal plates; sometimes two or three suckers indicate a tendency towards a median row near the anterior end. Ten tentacles, of which two are much smaller than the rest. Oesophagial ring of ten pieces shaped like the letter T. The aperture through which the head and tentacles are retracted is closed by five large triangular plates, alternating with and covering five narrow, tooth-shaped ones. In the young the five plates form a very regular pentagonal shield. In the old they close less accurately, and their outside edges are covered by some overlapping body plates. The anus is closed in the same way, but the plates are much less regular or constant.

Length $1\frac{1}{4}$ inches; breadth $\frac{3}{4}$ of an inch. Color light gray.

Not uncommon; in 120 to 150 fathoms off Sand Key.

Thyonidium conchilegum POURT.

Body very flaccid. Eighteen to twenty tentacles of unequal size, very little ramified, short, with conical papillæ; they are quite difficult to count, as some of them are so small that they may be mistaken for lobes of the larger ones. Suckers in five double rows, with others scattered between. The outer layer of the very thin skin contains a large number of calcareous bodies of the usual type; the base being a square plate with more or less rounded corners, perforated by a round central hole surrounded by eight smaller ones, those at the corners being smaller than those corresponding to the sides of the square. From this plate rise four cylindrical processes, converging towards and supporting a small spiny plate, which projects on the surface of the skin like small warts. These bodies are also plentiful in the suckers up to the terminal disc. In the muscular subcutaneous layer there are patches of smaller bodies formed of agglomerations of round granules. Esophagial ring provided with retractor muscles, and composed of ten pieces alternately in the shape of a broad letter X and a thin letter T loosely connected. Anus unarmed. Color white, hyaline. Length 2 or 3 inches.

This animal covers itself with shells of Pteropods, particularly those provided with points, one of which seems to be held by every sucker of the body.

It is probably closely allied to *T. pellucidum* of the northern seas. Not being able to compare specimens, I base this species chiefly on the difference of the number of perforations in the calcareous plates of the skin, the *T. pellucidum* having four large holes surrounded by twelve smaller ones.

Bourgueticrinus Hotessieri D'ORB.

Several specimens of a living Crinoid were obtained by dredging in 237, 248, and 306 fathoms off the Samboes and off Sand Key, in a bottom of Globigerinæ and other deep-sea Foraminifera. They undoubtedly belong to the genus *Bourgueticrinus*, as defined by D'Orbigny. I refer them provisionally to the species named above, founded on some small fragments of the stem discovered in the recent breccia of Guadeloupe, which contained the well-known human skeleton now in the British Museum. D'Orbigny gives it as his opinion that his species is probably still living in the West Indian seas; but his figures are insufficient either to prove or disprove the identity of our species with his. A comparison with his specimens even would leave the matter in doubt. It is to be hoped that further researches in the Guadeloupe formation will bring to light specimens perfect enough to settle the question.

The following description is not as full as could be wished, as the specimens are not numerous or perfect enough to warrant a complete dissection.

The *calicle* is in the shape of a regular elongated inverted cone. It is composed of a cycle of elongated basal (pelvic) pieces, followed by the much shorter first radials (costals) alternating with them. These pieces are all so intimately connected with each other that the sutures are seen with difficulty. The surface is perfectly smooth. The first brachials are flat and square, and connected laterally by a membrane. The arms generally break off between these and the second brachials, and the first might therefore be called second radials, as they in a measure contribute to the formation of the calicle; still, as they are movable on the first radials, and similar in shape to the next two joints, it is more natural to name them as we have done. The next two joints, or second and third brachials, are similar, and but little smaller than the first. The arms contract suddenly at the fourth brachial; they are five in number, simple, and composed of forty joints, every pair of which forms a syzygium. The pinnules arise from the side of the upper joint of each syzygium, alternately on one side and on the other. There are none, however, on the four or five first syzygia. The inner side of the arm is channelled, and the middle of the channel is protected by a row of very thin alternate scales.

The *pinnules* are composed of from ten to fourteen somewhat imbricated plates, of which the first two are narrower than the subsequent ones. The inner side is provided with a row of rounded alternate scales similar to those on the inside of the arms.

The *stem* is composed of a variable number of joints; our largest specimen having fifty-nine and the smallest but thirty. The generic character of having the joints flattened at their two ends in planes alternately at right angles to each other is well marked, particularly near the root; it is less apparent near the calicle, though this conformation may still be recognized to within half a dozen articulations of it; the last joints are sensibly round. The length of a joint is on the average about three times its diameter, except the four or five joints preceding the calicle, which are much shorter. The joints are connected by a ligament passing through the central canal, also by two strong ligaments lodged in parallel oval cavities in the articulating surfaces, and finally by a membrane along the edge. This threefold connection is so strong that by applying force it is more easy to break through the body of the joint than to disconnect the articulation.

The *root* is variable; sometimes all its ramifications start from a single joint, whilst in other specimens some five or six joints send out roots from their upper compressed edges. Each root promptly subdivides into a large number of rootlets; the whole is formed of articulated joints, which become much elongated as they become thinner.

The stem and the outside of the calicle are covered with a rough brown skin, which, under the microscope, presents the appearance of a rough, corrugated reticulation. It contains thin calcareous plates without definite shape, and is very liable to fall off. No muscular fibres could be detected under it. J. Müller denies the power of voluntary motion to the stem of *Pentacrinus*, on account of the total absence of muscles. In *Bourguetierinus* the stem has indeed no great flexibility, but the complication of the ligaments of the articulations, and the hinge-like arrangement of the latter in two alternate directions would seem unnecessary if the motion is to consist merely in a passive swaying to and fro with the oscillations of the water.

Two specimens have, in place of a calicle, a small conical button, composed of two or three joints. I am not prepared to say whether this is an undeveloped form, or the result of an effort to reproduce a lost head.

The length of the largest stem obtained is $5\frac{1}{8}$ inches, exclusive of root and calicle. The smallest and most complete specimen has a stem measuring only $1\frac{1}{2}$ inches. This specimen has three small stylifers adhering to the outside of its calicle. Small round holes, bored probably by these parasitic mollusks, can be seen also on the calicles of some of the other specimens.

Nephthya nigra POURT.

Corallum rising from a membraneous expansion, and forming several small tufts of elongated, costate cells, densely grouped. Every part filled with spicules; those of the polyp-cells being long, fusiform, and particularly numerous in the costæ of the cells. Every corallum bears from 150 to 200 polyps. Height 1 inch; color black. Rather common off Sand Key, Florida, from 120 to 152 fathoms.

Primnoa verticillaris EHRLG.

I refer to this species several branches eight or ten inches long, obtained in 120 fathoms, off Sand Key, Florida. Compared with specimens from the Azores, in the Mus. Comp. Zoöl., some slight differences in the length of the calicles and size of the scales were noticed, but they are not deemed sufficient to warrant a specific separation.

Primnoa trilepis POURT.

Branches irregularly and sparsely dichotomous, subflabellate. Branchlets very thin and flexible. Calicles in verticils of four, or more generally five, formed of three large cylindrical scales, joined angularly to each other, like the elbows of a stove-pipe. Aperture closed by eight triangular scales. The distance between the verticils is equal to or a little less than the length of the single polyps. The cœnenchyma is very thin, and covered

with irregular imbricated scales. Axis hard and brittle, brown in the thicker branches and yellow in the younger. By its simplified scales, this species makes an approach to the genus *Calyptrophora*, Gray.

A few small branches, five or six inches long, were obtained in 324 fathoms off the Florida reef.

Gorgonia miniata VAL.

A small dark crimson Gorgonian, obtained between 100 and 200 fathoms, may perhaps belong to this species. A comparison of the specimens could alone decide, as the description is rather scanty.

My specimens are 3 or 4 inches high, subflabellate; branchlets somewhat flattened at the end. Polyps in two rows, on moderately prominent verrucæ, more closely set than in *G. exserta*. Cœnenchyma rather thick, with fusiform spicules.

Gorgonia exserta ELLIS and SOLANDER.

The same Gorgonia which was obtained in the preceding year on the coast of Cuba, and referred to this species, was also brought up from 324 fathoms on the coast of Florida. Having no specimens for comparison, I do not feel quite sure of the determination.

Acanthogorgia hirta POURT.

Corallum branching irregularly, subflabellate. Stem and branches of about equal thickness. Branchlets flattened and expanded at the end. Cœnenchyma covered with rough fusiform spicules, the upper end of which is free, and raised in the shape of small spires. Verrucæ rather distant on the stems, more numerous towards the ends of the branchlets, irregularly alternate, prominent, lobed, somewhat spinous. Polyps large, filled with long spicules, arranged in a regular pattern, being horizontal near the base, and at length in eight vertical rows, not as long as in most other species. Height about 4 inches; color gray. Dredged in 324 fathoms off the Florida reef.

This species differs from *A. aspera* Pourt. by its thicker stem and branches, less prominent, though thicker, verrucæ, and larger polyps with shorter spines.

Chrysogorgia Desbonni DUCH. and MICH.

The specimens obtained by me in 324 fathoms appear to be more loosely branched, and to bear more numerous polyps, than the species to which I provisorily refer them. The figure given by the above authors is too deficient in details for a conclusive comparison.

The cœnenchyma is very delicate, filled with irregular scales, not imbricated. The sclerenchyma is rather brittle, smooth, yellow, of metallic appearance, resembling brass wire. The polyps are alternate, subpedunculate, numerous, though not contiguous, covered with scales like those of the stem, and closed by eight blunt lancet-shaped scales.

***Acis solitaria* POURT.**

Corallum never branching, five or six inches long. Cœnenchyma thick, covered with large, elongated, flat spicules, which become smaller and converging on the not very prominent verrucæ. Polyps in two rows, rather closely set; a few scattering ones out of line. No longitudinal furrow. Length 5 or 6 inches; color whitish.

In 200 fathoms.

***Isis flexibilis* POURT.**

Irregularly branching, subflabellate; branches very long and slender; calcareous joints cylindrical, nearly smooth, or with a few faint striæ, about four times as long as the corneous ones in the thicker branches, but proportionally much longer in the branchlets. Polyps rather thickly set, generally alternate, short, campanulate, armed with short spines. The thickest stems about $\frac{1}{16}$ of an inch in diameter, the branchlets not much thicker than horsehair; the main stems were not obtained. Color dark brown, from a thin cœnenchyma covering the younger branches.

In a few instances the branches appear to arise from the corneous joints.

In 324 fathoms off the Florida reef.

***Mopsea eburnea* POURT.**

Arborescent, slender, dichotomous. Calcareous joints long, cylindrical, faintly striated, seldom quite straight, not swollen at the ends. Corneous joints very short. (In one case a long straggling branch entirely corneous has grown from a calcareous joint, and bears four polyps.) Polyps scattered, bright orange, generally arising from the calcareous joints, but also, occasionally, from the corneous ones, surrounded by a spirally twisted bundle of strong spicules, of which eight longer ones project around the tentacles. The latter are pinnate, and strengthened in their whole length by a chain of blunt cylindrical spicules. The color of the whole corallum, with the exception of the corneous joints and the polyps, is pure white.

A fine specimen, 4 inches high, was obtained in 517 fathoms off Sombrero Light, Florida! — The diameter of the thickest part is $\frac{1}{16}$ of an inch; the root was not brought up.

Antipathes tetrasticha POURT.

Corallum a simple stem, pinnate; the branchlets alternate and double, i. e. two branchlets starting from the same spot at an acute angle, thus forming four rows, two on each side of the main stem. Towards the base one of the branchlets of a pair is frequently abortive. Sclerenchyma black, nearly smooth, showing short spines only under the magnifier. No successive swellings on the branchlets as in *A. filix* Pourt. Polyps small. Height of the corallum 3 or 4 inches.

In 116 and 120 fathoms off Sand Key and the Samboes, Florida.

Antipathes sp.

Fragments of a very slender species were obtained off Sand Key in 26 fathoms, but not sufficient for identification. They are as thin as horsehair, and less, with short blunt spines, and small distant polyps.

Antipathes sp.

Irregularly branching, loosely subflabellate; sclerenchyma black, with very short and scarce spines. Polyps large, as in *A. arborea*, Dana.

Of this species, fragments were dredged up in 195 and 324 fathoms, presenting no very characteristic features in its mode of branching. I shall postpone its identification until an opportunity offers of comparing it with specimens of some of the other described species from the West Indies.

Caryophyllia cornuformis POURT.

Corallum simple, conical, always regularly curved, distinctly but faintly costate. Calicle circular, rather shallow. Septa very little exsert, thin, and somewhat wavy; in six systems of four cycles. Pali opposite the secondary septa only, sometimes twisted. Columella of one or two twisted processes. Height $\frac{1}{4}$ of an inch; diameter of calicle $\frac{1}{8}$ of an inch. Dredged in 237 and 248 fathoms off Sand Key and the Samboes, Florida, on a bottom consisting of Foraminifera.

This species resembles a *Ceratotrochus* more than a *Caryophyllia*, but the single row of pali separates it from the latter genus.

All the specimens obtained have the base broken and apparently decayed, even when living, so that they are probably free when adult. One of them, still alive, was attached to the shell of a *Xenophorus* by the convex part of its wall.

Cœnocyathus vermiformis POURT.

Corallum very elongated, cylindrical. Costæ indicated only by lines of very flat tubercles. Calicle circular, shallow. Septa rather thick, flexuose, not exsert in six systems of three cycles. Pali thick, flexuose, in front of the secondary septa. Frequently one of the systems remains incomplete, and

there are then only five pali. Columella of a single twisted lamellar process. The older parts of the corallum are nearly filled up by the thickening of the septa, but the process is never carried out to a total obliteration of the chambers, which can be traced in the shape of slender canals to the very base. Height 1 to $1\frac{1}{2}$ inches; diameter $\frac{1}{16}$ to $\frac{1}{10}$ of an inch.

This small coral is easily mistaken for a tube of an annelid; it is placed in the genus *Cœnocya* thus, although I have no decided proof of its propagation by budding; in only one case have I found two corallites rising from a common base.

Dredged in 150 to 180 fathoms off Sombrero and Bahia Honda, Florida.

Paracyathus confertus Pourt.

Corallum turbinate, pedicellate. Costæ distinct to the base, not prominent, granulated. Calicle oblong, concave. Septa crowded, thin, entire, slightly exsert, in five cycles, but with considerable irregularity in some of the systems. Pali numerous, difficult to distinguish from the papillæ of the columella.

It resembles *P. De Filippii*, Duch. and Mich., but has a more contracted base and a more elongated calicle.

Rather rare in 50 to 100 fathoms off the Florida reef.

Thecocyathus cylindraceus Pourt.

Corallum attached by a broad base, short, cylindrical. Costæ generally visible through the epitheca which reaches to the border of the circular calicle. Fossa shallow. Septa entire, slightly sinuous, granulated, not exsert, forming six systems of four cycles; one of the systems often incomplete. Pali thick, with sinuous surfaces, fronting all the septa but those of the fourth and fifth order; those of the second order largest. Columella thick; formed of seven or eight papillose processes. Height $\frac{1}{2}$ to $\frac{3}{4}$ of an inch, diameter about $\frac{3}{8}$ of an inch.

Not rare between 100 and 200 fathoms off the Florida reef.

Rhizotrochus fragilis Pourt.

Corallum simple, pedicellate, straight or slightly curved, regularly conical. Calicle subelliptical, deep. Six complete systems of septa, four cycles. Septa very thin, not exsert, finely granulated; those of the first and second order meeting in the centre, and united for about half their height. Costæ not prominent. From the costæ of the second order rudimentary hollow roots arise in pairs at about one third or one half the height of the corallum, and descend along the pedicle to its foot; they are never detached. The wall and the septa are very thin and fragile. Height 1 inch; greater diameter $\frac{3}{4}$, smaller $\frac{1}{2}$ of an inch.

The color of the polyps is generally greenish, sometimes pale brick red.

Dredged in considerable number from 94 to 324 fathoms off the Florida reef; most abundant about 120 fathoms. It is frequently found growing on a living *Cucullæa*, much smaller than its parasite.

Oculina disticha POURT.

Mode of branching unknown. Branchlets slender, with alternate calicles, distant about one diameter from each other. Costæ giving a plicated appearance to the border of the slightly prominent and moderately deep calicles. General surface faintly striated. Septa of the first and second order well developed, those of the third rudimentary, all finely granulated and dentate. Pali fronting the septa of the first and second order. Columella formed by one or two papillæ.

A few dead branchlets only were obtained in 43 fathoms off the American shoal, Florida. They bear a general resemblance to the fossil *Diplohelio* *ravistella*, but the presence of pali prevents the generic association of these corals.

Diplohelio profunda POURT. (Bull. Mus. Comp. Zoöl. No. 6.)

A few small pieces of this coral were obtained in 324 fathoms off Bahia Honda, Florida. They are in rather a decayed condition, like nearly all the specimens of this species that I have ever seen.

Lophohelio affinis POURT.

Corallum branching irregularly, sometimes coalescing; the polyps budding in alternate series from the border of the calicle. Surface smooth, or very finely granulated. Calicles very deep. Septa smooth, entire, exsert. Systems unequal. No columella. Color white; polyps flesh-colored, with about twelve club-shaped tentacles, hiding the mouth when contracted. Dredged in some quantity in 195 fathoms off Coffin's Patches, Florida, but no trace of it was found in the numerous other dredgings in the vicinity.

I am unable at present to distinguish this coral from *Lophohelio prolifera* Edw. & Haime (*Madrepora prolifera* Pallas), except that the latter has the calicles a little less expanded, as figured by Ellis. It is rather singular that the largest coral of northern Europe has never been figured since Esper, whose representation is much inferior to Ellis's.

Stylaster erubescens POURT.

Branching densely, flabellate, not coalescing; younger branchlets slender, with rather dense alternate calicles; older branches much thickened with calicles in irregular rows on one surface, interspersed with ampullæ. Cœnenchyma smooth. Calicles slightly prominent, about $\frac{1}{3}$ of an inch in diameter, deep. Septa nine to twelve, most commonly eleven, equal, shaped

like folds of the wall, joined with each other at a little distance below the edge of the calicle, and thus forming pitlike interseptal chambers. Each one of these chambers encloses a small secondary septum in the shape of a dense vertical fringe of small points resembling hairs, which, when seen foreshortened from above, appears like a small columella.* Columella deep sunk, rounded, and hirsute. Color white, with a delicate pink blush when fresh. Dimensions, 4 to 6 inches in length and breadth of flabellum. Rather common between 120 and 324 fathoms off the Florida reef.

Some of the branches are thickened and hollow, with openings near the end; and the cavities are inhabited by annelids, as has also been noticed by Professor Verrill, in *Allopora californica*. In our specimens the tube seems to be entirely formed by the coral, the annelid contributing nothing himself.

Allopora miniata Pourt.

Corallum branching, flabellate, the main trunk rather massive and flattened. Surface finely and sharply granular. Branchlets thick and obtuse. Calicles irregularly but densely distributed on one surface of the branches, becoming obsolete on the main trunk. Small ampullæ abundant between the calicles on the younger branches. Calicles slightly prominent about half a line in diameter, fossa deep, columella spherical, deeply immersed, hirsute. Septa from seven to ten, generally eight, formed as in *Stylaster erubescens*, but the enclosed secondary septa are much larger and distinct, giving the appearance of a calicle surrounded by a number of smaller ones, all provided with columellæ. The edge of the calicle and of the folds is crowded with small sharp points.

The branches seem to have grown in a horizontal trailing manner, as the lower surface often shows signs of contact with foreign bodies.

Color brick red; length, 5 or 6 inches; breadth, 3 or 4 inches. Dredged in depths from 100 to 324 fathoms off the Florida reef, not as frequently as *Stylaster erubescens*.

This species is the most massive of our deep-sea corals; it undoubtedly belongs to the genus *Allopora* as defined by Milne-Edwards & Haime, if

* This arrangement is particularly apparent in *Allopora miniata* next described, where it was first noticed. It is very distinct also in *Stylaster complanatus* Pourt. I have seen it also in *St. roseus*, Edw. & Haime, *elegans*, Verrill, *tenuis*, Verrill, and *Allopora californica*, Verrill (very distinct); but I failed to see the small septum in *Allopora bella*, Dana, where it is probably more deeply seated, as is the small columella. The character of closed interseptal chambers, containing or not small secondary (or tertiary?) septa, being so general, I see no necessity for separating the genus *Cyclopora*, Verrill, from the true *Stylasters*. This character, furthermore, unites still more closely the genera *Stylaster* and *Distichopora*; in *Errina*, also, the pores mistaken by Gray for calicles are probably only interseptal chambers, soon separated from the calicle by the irregular growth of the cœnenchyma.

we leave out from their generic characters the absence of ampullæ. The two genera *Stylaster* and *Allopora* are, however, very closely allied, and in very young specimens the difference in the mode of germination is hardly to be distinguished.

***Distichopora foliacea* Pourt.**

Corallum branching, flabellate, much compressed, finely striated and granulated. The calicles in a somewhat irregular row a little on one side of the edge, which is sharp and finely serrated. One of the rows of lateral pores on the summits of the denticulations, the other not well defined, represented by scattered tuberculated pores. The plane towards which the calicles are situated is thickly studded with ampullæ, each of which has a small lateral opening. They are less numerous on the other surface. Columella deep-seated, but long, hirsute, in the shape of a pointed club. Color orange pink. Height about 2 inches; breadth of the branches about $\frac{1}{4}$ of an inch; thickness $\frac{1}{20}$ of an inch.

This species differs from *D. sulcata* Pourt., from the coast of Cuba, by its smaller calicles not placed in a furrow, irregular lateral pores, and serrated edge.

Dredged rather frequently between 100 and 200 fathoms off the Florida reef.

***Errina cochleata* Pourt.**

Of the two species of *Errina* found quite abundantly on the coast of Cuba, only this one is found on the Florida side, and that is exceedingly rare, only one small specimen having been obtained in 183 fathoms off Sombrero Light-house.

***Balanophyllia floridana* Pourt.**

Corallum elongated, conical, straight, pedicellate. No epitheca; wall porous, costate to the foot. Calicle rather deep, elliptical. Septa entire, slightly exsert, finely granulated, in six unequal systems of four cycles, with rudiments of the fifth in some of the systems. The septa of the fourth cycle, bent and united in front of the tertiaries, and protracted as one septum to the columella, which is flattened and papillose.

The polyps are red; the mouth very oblong; height about 1 inch; longer diameter $\frac{1}{2}$, shorter $\frac{3}{8}$ of an inch.

Dredged in abundance off Sand Key, Florida, in 26 fathoms. I refer also to this species some dead and worn specimens obtained off the coast of Cuba in 270 fathoms.*

* A *Dendrophyllia* was also obtained in the same dredging off the coast of Cuba, but too much worn to be identified or described.

Genus Thecopsammia POURT.

Corallum simple, attached, without costæ, covered with a complete epitheca. This genus is intermediate between Balanophyllia and Heteropsammia; like the latter, it is destitute of costæ, but it has an epitheca like some of the Balanophyllia, but still more developed.

Thecopsammia tintinnabulum POURT.

Corallum subcylindrical, or almost hemispherical, with turbinate base and small, abruptly constricted peduncle. Wall thick, very porous and vermiculated. Epitheca well developed, seldom rising quite to the border of the calicle, its tissue penetrating the mural pores and solidifying the wall. Calicle slightly elliptical, moderately deep. Septa in six unequal systems and four cycles, entire, thin, not exsert, covered with fine granulations; those of the fourth and fifth order scarcely bent towards those of the third, and not connected with the latter or with each other. The septa of the first and second order connected with the columella. The two opposite systems on the longer sides of the calicle always incomplete in one of their halves; and one or two of the other systems also sometimes incomplete in the same manner. The columella is papillose and porous, sometimes sublamellose, and forms three indistinct masses in the adult, of which the middle one is largest.

Height $\frac{3}{4}$ of an inch to an inch; longer diameter of calicle about $\frac{1}{2}$ an inch, shorter about 0.44. Common between 100 and 300 fathoms off the Florida reef.

The mouth of the polyps is elongated, and surrounded by not very numerous conical tentacles; the color, when living, is a handsome pinkish orange.

Thecopsammia socialis POURT.

Corallum turbinate, rather long conical, with a thick, not constricted, peduncle frequently attached to each other. Wall and epitheca as in the preceding species. Calicle elliptical, fossa moderately deep. Septa entire, smooth, crowded, not exsert; thick, near the wall. Five cycles of septa in six unequal systems. The septa of the fourth cycle bent towards each other, and meeting in front of those of the third, in the deeper part of the calicle (only visible in a horizontal section). The septa of the sixth and seventh order appear only in a few of the systems in old specimens; they become larger than those of the preceding cycle; the tertiaries generally remain the smallest of all. The columella is papillose and porous, though more compact than in the preceding species, and nearly always forms three distinct masses, of which the middle one is largest.

Found in the same depths as the other, but more common towards Sombrero than near Sand Key.

Stephanophyllia folliculus POURT.

Corallum free, without mark of adherence, purse-shaped, or broader at the base than at the calicle. Costæ broad, granulated, nearly meeting at the apex, the primary ones continuous, the tertiaries uniting with the secondaries. Intercostal furrows narrow. Calicle circular or subhexagonal, slightly concave. Septa in six complete systems of three cycles, covered with large papillæ, not exsert. The primaries and secondaries meet in the centre with each other, and with an indistinct columella; the tertiaries connect with the secondaries at about half the length of the radius.

Height 0.12, diameter of calicle 0.10, diameter of base 0.11 of an inch. Dredged in 237 fathoms off the Florida reef.

I refer this coral, of which I have but one specimen, to the genus *Stephanophyllia* with some doubt. It has most of the characters of the genus, except the discoid shape. It is, most likely, a very young specimen.

Diaseris pusilla POURT.

Corallum subelliptical, very fragile. Wall flat or slightly concave, imperforate, very thin, finely costate. Costæ thin, alternatively large and small, finely dentate. The base shows the traces of lobes joined together, often very imperfectly. Septa strongly dentate, laciniate, and perforate, marked with strong ridges and furrows, connected with each other by synapticula near the base. Six unequal systems and five cycles of septa, one or two of the systems generally incomplete. The primary septa more lobed and much higher than the others; those of the lower cycles tending to unite with those of cycles preceding them. Fossa well marked, oblong. Columella rudimentary, in the shape of a narrow ridge. Mouth of the polyp in the shape of a long slit. Color dark brown. Diameter $\frac{1}{2}$ an inch.

Numerous fragments of the living coral were obtained, but it is so fragile that only one was brought up entire. Found in 119 to 143 fathoms off Sand Key.

I suspect from some of the fragments the existence of a second species, with more equal, not lobed septa, and less distinctly costate base, but there is not enough of it for a good description.

The singular Coral next to be described strikes one at first sight by its resemblance to some of the members of the group of the *Rugosa* of Milne-Edwards & Haime. A closer examination tends to confirm that view, much as it seems improbable to find a living representative of a group so long extinct. In no other division of the corals is the septal apparatus subdivided into systems that are multiples of four; but such is the case in our specimen, though a little obscured by accidental causes. Another, though perhaps less important, character is the smoothness of the septa, which present neither perforations, nor synapticula, nor granulations

Tabulæ, however, there are none, the interseptal chambers being open from top to bottom. Among the Rugosa this character is only found in the family of Cyathaxonidæ, to or near which, therefore, our coral must find its place. From the genus Cyathaxonia it differs in being attached by a broad base, and also by the absence of a septal fossula. The following genus is proposed for its reception : —

Genus *Haplophyllia* Pourt.

Corallum simple, fixed by a broad base, covered with a thick epitheca; columella styloform, strong, (sometimes double?) very thick at the base. Interseptal chambers deep, uninterrupted by tabulæ or dissepiments.

Haplophyllia paradoxa Pourt.

Corallum subcylindrical, short, fixed by a broad base; epitheca thick, wrinkled, reaching higher than the calicle, and forming around the latter several concentric circles, as if representing the separated borders of several superposed layers. Calicle circular, fossa deep. Septa smooth, without granulations or perforations, not reaching the border of the calicle; like all the internal parts of the calicle, their surface is like enamel. Columella formed of two smooth conical processes, very thick at the base and tending to fill up the chambers. Eight septa larger, and connected with the columella, alternating with smaller ones, which touch the columella at a much lower level. A further cycle is indicated by small ridges of the wall surface, in some of the chambers. No distinction can be made between primary and secondary septa among the eight larger ones, as they all appear equal. This arrangement seems to be the norm. In the specimen before us, the only one unfortunately, there are disturbances in two of the systems or half-systems (systems if we call the eight larger septa primaries, half-systems if we suppose them equivalent to primaries and secondaries). In one case two of the larger septa are joined by a horizontal plate at the top, thus excluding the intervening chamber from the calicle. This structure is probably abnormal, and the result of an effort to exclude a parasite or other foreign matter. A small supernumerary septum has grown out in the next chamber. Nearly on the opposite side of the calicle, one of the secondary septa (counting eight as primaries) has grown to the size of a primary one, and the adjacent tertiary to the size of a secondary, thus disturbing the symmetry.

Height about $\frac{1}{2}$ an inch; diameter of calicle the same.

This coral was living when obtained; the polyp was of a greenish color, but was not otherwise examined when fresh. After having been in alcohol, it could be lifted out entire from the calicle, presenting an exact

cast of the chambers. The mouth is surrounded by a circle of about 16 rather long tentacles, bluntly tuberculated at the tip. Outside the circle of tentacles extends a membranous disc with radiating and concentric folds.

This unique specimen was dredged in 324 fathoms off the Florida reef.

Genus *Pliobothrus* POURT.

Tissue more compact than in *Millepora*; larger pores scarcer, smooth, without any rudiments of septa; smaller pores tubulated; cœnenchyma with still finer linear pores. Form generally branching regularly. Differs from *Heliopora* by its tissue not being prismatic. I refer to this genus two species described by me as *Heliopora tubulata* and *carinata* (Bulletin Mus. Comp. Zoöl. No. 6), and a third species.

Pliobothrus symmetricus POURT.

Corallum ramose, rising from an incrusting base and a short trunk, branching into a regular semicircular flabellum. Branches not much divided, cylindrical, and a little flattened and expanded at the tip, which is blunt and rounded. The tendency in branching is towards considerable symmetry between the two halves of the flabellum. Three kinds of pores; very small, linear, over the whole cœnenchyma; larger tubulated, with very minute aperture when unbroken, and larger round or oval ones scattered irregularly. Internal structure somewhat like *Millepora*, but much coarser. Larger pores interrupted by few but massive tabulæ, but communicating laterally with other canals.

This species is much larger and more branched than *Heliopora tubulata*, and has shorter tubes to the pores.

Color gray; height $1\frac{1}{2}$ inches; spread about three inches; diameter of branches 0.63 of an inch. Not rare between 100 and 200 fathoms off the Florida reef.

CAMBRIDGE, MASS., December 8, 1868.

I deeply regret the absence of Count Pourtales from Cambridge at this moment, even though his return to the field of observations which has already yielded him such a rich harvest cannot fail to benefit science in the highest degree. My regret arises chiefly from the fact that he is thus prevented from reaching some conclusions which belong to him by right. But the very day he started on his third journey of

exploration in the Gulf Stream, leaving with me the manuscript of this paper for publication, the memoir of Sars on the *Rhizocrinus* of the Lofoten reached me also, and I at once recognized the identity of the *Bourgueticrinus Hotessieri*, described above, with Sars's *Rhizocrinus lofotensis*, — as far as such relations can be predicated without a direct comparison of the specimens. The identity of animals found at great depths in the Gulf of Mexico and on the coast of Norway would show how extensive the influence of the great Atlantic current is in modifying the geographical distribution of organized beings. The close resemblance of these Crinoids will no doubt lead to a renewed comparison of the *Lophohelia affinis* Pourt. and *Lophohelia prolifera* Milne-Edw. & Haime (*Madrepora prolifera* Pallas). It is now highly probable that Pourtales's species is identical with that long known from the northernmost coasts of Europe, and to which it has very likely been transported by the Gulf Stream; and I doubt not that the identity of other species from Florida, in which a close resemblance to northern species has already been noticed, will also prove identical, as soon as an opportunity is afforded for direct comparisons. Thus happily blended with the investigation of the Gulf Stream, the study of the geographical distribution of animals at great depths cannot fail to make rapid progress, now that — thanks to the comprehensive views of the Superintendent of the Coast Survey — it will no longer be left to chance discoveries, but form a part of the systematic work of the Survey. In this connection it becomes highly important to explore the ocean floor in the vicinity of the Bermudas, as those islands form, as it were, a half-way station between Florida and Norway. On the other hand, the discovery of a coral, *Haplophyllia*, allied to the extinct type of the *Cyathaxonidæ*, foreshadows unexpected revelations, as soon as the animal population of the abysses of the ocean shall be extensively explored, instead of being obtained from a few localities only.

I may add that the Museum will supply other institutions with specimens of all the species described above of which duplicates were collected.

LOUIS AGASSIZ.

CAMBRIDGE, December 10, 1868.



Pourtalès, L. F. de. 1868. "Contributions to the fauna of the Gulf Stream at great depths (2nd series)." *Bulletin of the Museum of Comparative Zoology at Harvard College* 1(7), 121–142.

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