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ART. XXIX.—*Notice of the remarkable Marine Fauna occupying the outer banks off the Southern Coast of New England, No. 9; by A. E. VERRILL. Brief Contributions to Zoology from the Museum of Yale College. No. LV.*

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*Work of the Steamer Albatross in 1883.*

DURING the summer of 1883, the new U. S. Fish Commission steamer, *Albatross*,\* Lieut. Z. L. Tanner, commander, continued the work of dredging in the region of the Gulf Stream, along our coast, from off Cape Hatteras to Nova Scotia.† She is, in construction, well adapted to do deep-sea work, and fully equipped with improved apparatus, and therefore was able to carry the dredgings much farther out to sea than the *Fish Hawk* had been able to, in previous years. The stations most distant from the coast were more than a third of the way to the Bermudas. The greatest depth successfully dredged was in 2949 fathoms, at station 2099, N. lat.  $37^{\circ} 12' 20''$ , W. long.  $69^{\circ} 39'$ , August 2. Besides this, there were four successful hauls in 2033 to 2369 fathoms, and 27 between 1000 and 2000 fathoms. Between 500 and 1000 fathoms there were 19 hauls, and in less than 500 fathoms, 63, making a total of 116 stations. At nearly all these localities a large trawl was used, and in many cases large quantities of specimens were obtained, even at great depths. The bottom temperatures between 1000 and 2000 fathoms were usually between  $37^{\circ}$  F. and  $39^{\circ}$  F., and rarely,  $40^{\circ}$  (in one case, at station 2050,  $49.5^{\circ}$  was recorded in 1050 fathoms, and at station 2052, on the same day,  $45^{\circ}$ , in 1098 fathoms, but these cases may have been due to some accidental cause, for at the same date other trials, at similar depths, gave  $39^{\circ}$ ; I have therefore omitted these two temperatures, in the table). Besides the ordinary temperature observations,

\* Descriptions of this steamer and of her equipment, as well as of some of her trips, have already been published in *Science*. An account of the Crustacea was published in the July number of this *Journal* by Professor S. I. Smith, who has also published a detailed account of that group, with figures, in the *Fish Commission Annual Report*, part x. The writer has published a paper on the Mollusca, with five plates, in the *Trans. Conn. Acad.*, vol. vi. Some of the new fishes have been described by Messrs. Gill and Ryder.

† The naturalists associated with the writer, in this work, in 1883, were Professor S. I. Smith, Mr. Sanderson Smith, Professor L. A. Lee, Mr. Richard Rathbun, Mr. J. H. Emerton (also as artist), Mr. B. F. Koons, Professor Edwin Linton, Mr. H. L. Bruner, Mr. J. E. Benedict (naturalist attached to the steamer), Mr. R. S. Tarr, W. E. Safford, Ensign U. S. N., and others, more or less. Mr. Peter Parker, Mr. John A. Ryder, Dr. Theodore Gill, and R. H. Miner, Ensign U. S. N., worked on the fishes. The parties who went out dredging, on the steamer, varied from time to time. Usually only three or four naturalists, besides Mr. Benedict, could be properly accommodated on board. I took no part in this portion of the work, in 1883, not going out on the steamer at all.

numerous serial temperatures, not given here, were also taken, and the specific gravity of samples of water, from various depths, was determined. The bottom at all the stations below 1000 fathoms was mainly composed of "Globigerina ooze," usually having the consistency of fine sticky mud, commonly of a dull olive-green or bluish color.\* When washed through a very fine sieve a variable, but often large, proportion remains on the sieve, composed chiefly of the shells of *Globigerina* and other foraminifera, of many kinds, but mostly minute. These are usually mixed with a considerable amount of very fine grains of siliceous sand,† among which are some grains of magnetite and garnet. Green grains, apparently of glauconite, are also common.

The deepest localities were all rich in animal life, of many kinds. A considerable number of interesting fishes were obtained, many of them new to our fauna. Some of these are new genera and species of great interest.

Very interesting additions to our collections were made in nearly every class of marine invertebrates, including many undescribed species and genera, some of which are of great morphological importance, while many of the described species were previously known only from distant regions, on the European side of the Atlantic, in the arctic or antarctic regions, off the coast of South America, in the West Indies, or even in the Indian or Pacific Oceans. Thus our knowledge of the distribution of the deep-sea forms, both geographically and in depth, has been greatly increased. Some of these deep-sea species were first described as fossils from the European tertiary. Moreover a considerable number of our shallow-water species have been found to have a much greater range in depth than was anticipated, many of them going down below 500 fathoms, while some even go below 1000 fathoms.

On the first trip of the Albatross from Wood's Holl, which was made July 16th to 19th, four successful hauls were made with a large trawl, in 1346 to 1735 fathoms, on the 17th and 18th of July, two each day, besides the soundings and tempera-

\* In recording the character of the bottom, on the vessels, the character of the mud is usually judged of mainly by its appearance to the naked eye, and sometimes by the sense of touch. The finer varieties of "globigerina ooze" are not distinguishable by these tests from "fine blue mud," or "sticky mud," or "fine gray mud." Nor are the coarser foraminifera always distinguished from "sand" or "sandy mud." Thus the official records of this and other similar explorations do not always agree with the determinations of the naturalists who subsequently examine the samples of bottom. In many cases, however, such corrections are eventually made. Very perfect samples of bottom-mud are often enclosed in the hollow, bulbous bases of large *Actiniae*. Such samples, not having been washed free of their finer portions, might often serve to supplement or correct the official records made from the samples brought up in sounding.

## Partial List of Stations occupied by the Albatross in 1883.

Most of those in less than 500 fathoms are omitted.

Stat.	Locality.		Fath.	Bottom.	Date.	Temp. F.		Hour.
						Bot- tom.	Sur- face.	
	N. Lat.	W. Long.						
2034	39° 27' 10"	69° 56' 20"	1346	glb. O.	July 17			
2035	39 26 12;	70 02 37	1362	" "	17			
2036	38 52 40;	69 24 40	1735	" "	18	38°	76°	4.30 A. M.
2037	38 53 00;	69 23 30	1731	" "	18	38	76	1.22 P. M.
2038	38 30 30;	69 08 25	2033	" "	26		76	2.32 P. M.
2039	38 19 26;	68 20 20	2369	" "	28		81	noon.
2040	38 35 13;	68 16 00	2226	" "	29		76	4.20 A. M.
2041	39 22 50;	68 25 00	1608	" "	30	38	72	3.50 A. M.
2042	39 33 00;	68 26 45	1555	" "	30	38.5	71	10.32 A. M.
2043	39 49 00;	68 28 30	1467	" "	30	38.5	72	5.07 P. M.
2044	40 00 30;	68 37 20	1067	" "	31	39	72	5.25 A. M.
2045	40 04 20;	68 43 50	373	bu. M., fine Sh.	31	40	72	10 A. M.
2046	40 02 49;	68 49 00	407	bu. M.	31	40	72	noon.
2047	40 02 30;	68 49 40	389	" "	31	52	72	2.15 P. M.
2048	40 02 00;	68 50 30	547	crs. S., M. & G.	31		72	3.56 P. M.
2049	39 43 40;	69 20 00	1025	bu. glb. M.	Aug. 1	39	71	3.35 A. M.
2050	39 43 50;	69 21 20	1050	glb. O.	1		72	9.15 A. M.
2051	39 41 00;	69 20 20	1106	" "	1	39	72	2.34 P. M.
2052	39 40 05;	69 21 25	1098	" "	1		73	6.16 P. M.
2072	41 53 00;	65 35 00	858	gy. M.	Sept. 2	39	56	6.15 A. M.
2073	41 54 15;	65 39 00	586.5	gy. S.	2	40	58	10.41 A. M.
2074	41 43 00;	65 21 50	1309	fine glb. M.	3	40	69	6.42 A. M.
2075	41 40 30;	65 35 00	855	" " "	3	39	58	3.41 P. M.
2076	41 13 00;	66 00 50	906	bu. glb. M.	4		69	3.20 A. M.
2077	41 09 40;	66 02 00	1255	" " "	4	39	68	8 A. M.
2083	40 26 40;	67 05 15	959	gy. M.	5	40	72	4.30 A. M.
2084	40 16 50;	67 05 15	1290	bu. M., S. F.	5	40	78.5	9.09 A. M.
2093	39 42 50;	71 01 20	1000	F. S. M.	21	39	69	1.12 P. M.
2094	39 44 30;	71 04 00	1022	" " "	21	38.5	68	5.07 P. M.
2095	39 29 00;	70 58 40	1342	glb. O.	30		69.5	9.02 A. M.
2096	39 22 20;	70 52 20	1451	" "	30	37.5	69	2.07 P. M.
Off Chesapeake Bay.								
2097	37 56 20;	70 57 30	1917	" "	Oct. 1		72.5	5.30 A. M.
2098	37 40 30;	70 37 30	2221	" "	1		72.5	1.08 P. M.
2099	37 12 20;	69 39 00	2949	" "	2		82	5.30 A. M.
Off Delaware Bay.								
2100	39 22 00;	68 34 30	1628	" "	3	37.5	69	11.05 A. M.
2101	39 18 30;	68 24 00	1686	" "	3	37	67	4.31 P. M.
2102	38 44 00;	72 38 00	1209	" "	Nov. 5	39	62.5	
2103	38 47 20;	72 37 00	1091	" "	5	39	62	
2104	38 48 00;	72 40 30	991	bu. glb. M.	5	45.5	63	
Off Chesapeake Bay.								
2105	37 50 00;	73 03 50	1395	glb. O.	6	41	63	
2106	37 41 20;	73 03 20	1497	" "	6	41.5	63	

ture determinations, including series of temperatures at various distances from the surface. On this trip about 105 species of Invertebrates were obtained, not including the Foraminifera and other minute forms. There were among these 14 species of Anthozoa; 2 of Hydroids; 22 of Echinoderms; 38 of Mollusca; 15 of Crustacea; 1 of Pycnogonida; 10 of Annelida; 1 of Bryozoa; 2 of Sponges.

The Echinoderms were among the most abundant and interesting of the deep-sea animals. About sixty species were dredged by the Albatross, many of which are new to our coast, though previously dredged on the European side, or in the Caribbean Sea and still more distant regions. Others are undescribed forms. Among the Holothurians were two gigantic species, belonging to a peculiar deep-sea family of which many species were brought to light by the Challenger expedition. These occurred in large numbers at several stations, mostly between 1000 and 1500 fathoms, in some cases more than a barrelful of one of them coming up in a single haul. The largest and most singular one is a new species of *Benthodytes* (*B. gigantea* V.)\* which is a very large, oblong, massive species, flat below and convex above, sometimes 18 inches long and 5 or 6 broad, having a gelatinous, translucent appearance, but with a firm cartilaginous texture when fresh. The cartilage-like walls of the body are very thick, often an inch or more, and the visceral cavity is very small in proportion. Owing to the dense and impervious, cartilage-like tissues, this species is very difficult to preserve in alcohol, the interior decaying before the fluid can penetrate the tissues, even when the visceral cavity is cut open.

The second species is also a new form, *Euphronides cornuta*

\* *Benthodytes gigantea* V. Body massive, usually elliptical or oblong, broadly rounded at the ends, strongly convex on the upper surface. The whole dorsal surface is smooth and lubricous but covered with numerous, minute, soft papillæ, both above and below. On the upper surface two alternating rows of rather small, tapered ambulacral papillæ run from one end to the other, on each side, about midway between the center and margin, but these usually stand so nearly in line as to appear like a single row, consisting of about eleven papillæ. The margin is crenulated, each crenulation is surmounted by a small, tapering papilla, or modified sucker. The mouth is situated on the under side, a short distance from the anterior margin. The tentacles are twenty, short and thick, terminated by a group of small conical papillæ. The cloacal opening is situated on the upper surface, close to the posterior margin. Two rows of small suckers occupy the median ambulacrum on the posterior half of the ventral surface; the two rows are a short distance apart and often lie in a more or less sunken groove; there are about twelve suckers in each row, the anterior ones smaller and farther apart. The color is translucent, pale flesh-color, or purplish white, reticulated with whitish lines or wrinkles, and sometimes irregularly mottled above with dark purple or dull orange, deeper toward the margin. Ventral suckers and tentacles dark purplish brown. Length of the largest specimens, about 18 inches, breadth, 6. Ordinary specimens, in alcohol, are from 250 to 300<sup>mm</sup> long by 75 to 100<sup>mm</sup> broad.

V.,\* related to *E. depressa* of the Challenger expedition. It has two pairs of large, elevated, teat-like anterior tubercles, to which character the name refers. In form it is not unlike *B. gigantea*, but it is smaller, narrower, less massive, and has a much thinner, reddish brown integument, without the cartilaginous character of the latter.

The starfishes were very numerous in the deep dredgings and are represented by many interesting species. The most abundant starfish was a fine, new, orange-red species of *Zoroaster*, of large size, with slender spinose arms, (*Z. Diomedæ* V.)† About 200 specimens of this occurred at station 2035. It was taken at many stations, in 1000 to 1600 fathoms. The most common genus, as usual in very deep water, was *Archaster*, of which numerous species occurred. Many of these are very large

\* *Euphronides cornuta* Verrill, sp. nov. A very large species, oblong in outline, with both ends rounded, the upper surface strongly convex, the lower flat, in transverse section nearly semicircular. On the upper surface, a little in advance of the middle, are two very large, divergent, blunt tubercles, often more than an inch in length, usually swollen at base, with a narrow central tube. A little in front of these is a similar but smaller pair, usually about half as large, the size and shape varying according to the state of contraction. In front of the second pair there are usually about four pairs of much smaller tubular papillæ, the anterior ones smallest. At about the posterior fourth there is a very large, double median tubercle, swollen at base, rounded or emarginate at the summit, and terminated by a pair of tubular verrucæ. An orange-brown longitudinal band runs along just outside the bases of all these tubercles, on each side, and branches go from these to the central tube of each tubercle. The margin is thin, with small scollops all around, between all these there is a small prominent papilla or modified sucker. The mouth is situated on the under surface, at about the anterior sixth; tentacles eighteen, short, blunt, thick, covered with small papillæ. Cloacal opening situated on the under side, near the posterior end. A median ambulacrum, visible through the skin, runs between the two openings, with two alternating rows of small suckers near together. The general color is dull flesh-color, or pale brownish, usually with fine specks of orange-brown. The dorsal and submarginal ambulacral bands and their branches running to the suckers and tubercles are deep purplish brown, fading to orange at the margin; the bands are bordered on each side by white or pinkish. Tentacles, buccal and cloacal regions dark purplish brown. The whole lower surface is often purplish brown, reticulated with darker lines or wrinkles. When distended the skin is more or less translucent, with a somewhat gelatinous appearance, but in contraction it becomes more opaque and darker colored. The whole surface is roughened with minute dermal plates. Length of an ordinary specimen, 300<sup>mm</sup>; breadth, 70<sup>mm</sup>; height, about 60<sup>mm</sup>.

† *Zoroaster Diomedæ* V., sp. nov. Arms five, long, slender, tapered, angular above, with three or five rows of acute spines; one median dorsal, and one lateral, or in large specimens two, on each side; these spines arise from rows of prominent close plates: the surface between is covered with small sharp spines; two or more rows of large single pores between the dorsal and lateral rows of plates; three to five rows of smaller lateral plates along the sides of the rays, with rows of pores between; each plate bears a single long, slender spine and several much smaller ones. Four rows of suckers on the basal part of arms. Adambulacral plates alternately unequal; the larger ones bear each a transverse row of four or five slender, sharp spines; the inner spine projects inward between the suckers and bears 3 to 12 large, elongated, tapering pedicellariæ. Similar large pedicellariæ are scattered over the back and sides. Madreporic plate very small. Color in life orange-red. (Larger radius of a large one. 150<sup>mm</sup>; lesser radius,

and handsome, and are generally orange or orange-red in color. Several are unlike those species from less than 500 fathoms, taken by the Fish Hawk. A large, rather smooth *Archaster*, with a very large madreporic plate (*A. grandis* V.,)\* and a remarkably spinose species of a related genus (*Benthopecten spinosus* V.),† were associated with the *Zoroaster* at station 2035 and elsewhere, generally between 1000 and 2000 fathoms.

The Anthozoa were abundant, both in individuals and species, in most of the dredgings below 1000 fathoms. About 40 species were taken, altogether, belonging to all the principal groups. Several were undescribed, while others are new additions to our fauna, though previously obtained elsewhere by the Blake or Challenger. It was also a source of satisfaction to us that we rediscovered, in larger numbers, the few remaining species that the Blake and Challenger had obtained off our coast, but which we had not previously dredged.

Among the Pennatulacea there are some highly interesting forms. The remarkable deep-sea genus, *Umbellula*, originally discovered off the coast of Greenland, but hitherto unknown off the eastern coast of North America, though recently dredged

\* *Archaster grandis* V., sp. nov. Five long, slender, tapering arms; disk small pentagonal, with concave sides. Dorsal surface unusually smooth, covered with small paxillæ, having minute spinules; among these are scattered three-bladed pedicellariæ. Madreporic plate very large, convex, covered with stellate groups of small spinules, larger than the paxillæ. Lateral plates squarish, the upper and lower about equal and opposite, each bearing a single moderately large, tapering spine, but in the interbrachial spaces the lower ones often bear two or three; surface of plates covered with small spinules. The ventral plates, which cover a triangular space, bear small divergent spinules, often with a larger central one. Adambulacral plates bear a curved, longitudinal group of 8 to 10 close spines, the central ones longest. Oral plates prominent, spinulose, with an oval naked space in the middle between them, and margined by many short oral spinules. Larger radius, 110<sup>mm</sup>; lesser, 17<sup>mm</sup>; diameter of madreporic plate, 10<sup>mm</sup>.

† *Benthopecten spinosus* V., sp. nov. Rays five, long, rather slender, except at base flat, and gradually tapered to long narrow tips. Disk not very large and like the arms covered with a smooth skin and covered plates, each with a slender central spine; these become larger toward the center, where there is a group of about 20 long, erect, tapering, sharp spines. A circle of 4 to 6 papillæ, placed singly, surrounds each plate. There are neither paxillæ nor granules. Upper marginal plates rather small, elevated in the middle, more than 40 on each side; each bears several minute spines and a single central, large and long, tapered, sharp spine, the basal ones and those bordering the disk becoming larger and exceeding those of the center of the disk. Lower marginal plates bear each a vertical row of about 3 spines, the upper one much the longest, and along the middle of the arm as long as those of the upper plates, but becoming much smaller at the base of the arm and along the disk, where the latter increase in size. The ventral plates form small triangular areas; they are rounded, raised in the middle, and each bears one or two small acute spines, but no granules. The adambulacral plates project strongly inward, and each bears an inner convex row of 4 or 5 small, slender spines and a transverse outer row of much larger ones, of which one or two inner are much the largest. Suckers large, tapered, pinched up at tip. Larger radius, 150<sup>mm</sup>; smaller, 22<sup>mm</sup>. Still larger examples were taken. Station 2035, in 1362 fathoms, etc.

*Benthopecten*, gen. nov., resembles *Archaster*, but differs in having no paxillæ:

in most other parts of the deep oceans by the Challenger and other expeditions, is represented by several large and fine specimens belonging to two species, one of which is probably *U. Guntheri* Kölliker, taken by the Challenger in the eastern Atlantic, while the other, *U. Bairdii* V.,\* seems to be new. In this genus there is a handsome cluster of large flower-like polyps at the summit of a tall slender stem.

Another new species, which was taken in 1362 to 2369 fathoms, belongs to the genus *Kophobelemnon* (*K. tenue* V.)† This genus we had not previously dredged, though a single specimen of a different species (*K. scabrum* V.) had been obtained by the Blake expedition in 1880. This was also taken by the Albatross in 789 fathoms. A very elegant species, apparently new, belonging to the genus *Scleroptilum* K., hitherto known only from off Japan, occurred in large numbers at several stations, in 1467 to 2369 fathoms. This I have called *S. elegans*.‡ It nearly always had a new species of *Astronyx* (*A. tenuispina* V.)§ clinging closely to it, which, like its host, was bright orange.

\* *Umbellula Bairdii*, sp. nov. Stalk very tall and slender; axis quadrangular, with concave sides; basal bulb long, narrow; rachis short, swollen. Polyps eight or nine, bilaterally arranged, large, long, very smooth, with long, slender, regularly pinnate tentacles. Zooids simple, small, numerous on all sides of the rachis, running up on the sides in lanceolate groups between the polyps; a few extend down in a row on each side of the upper part of the stem. Color, deep orange-brown. Height, 400 to 500<sup>mm</sup>; diameter of stem, in middle, 3 to 4<sup>mm</sup>. Stations 2036 to 2038, in 1731 to 2033 fathoms.

† *Kophobelemnon tenue* V., sp. nov. Tall and slender, with a long thin stalk and a long rachis, only a little thicker. Polyps large, short, alternate, in a regular row on each side, well-separated. Zooids small, not crowded, forming a band on each side of the back, leaving the middle naked, and running up in lateral groups between the polyps; a few are scattered on the ventral side. Spicula small and abundant. Color of stem and rachis light yellow; of zooids orange-brown. Height, 4 to 6 inches. Stations 2035, 2038, 2039, in 1362 to 2369 fathoms.

‡ *Scleroptilum gracile* V., sp. nov. Slender, with the polyps occupying more than half the length. The polyps are large, arising from large and somewhat conical incurved calicles, which are swollen at base and covered all over with an abundance of small slender spicula. The calicles are frequently opposite, or nearly so, but more generally alternate; the lower ones become gradually smaller and more scattered, and very small ones extend for some distance down the stem, which is very slender, with a long narrow bulb. The zooids are small but prominent and scattered along the ventral side, mostly in groups of 3 to 6 alternating with the pairs of polyps, but often they occur also between their bases. Color orange in life, yellowish white in alcohol. Height, 185<sup>mm</sup>; of polypiferous portion, 110<sup>mm</sup>; breadth across contracted polyps, 3 to 4<sup>mm</sup>; diameter of rachis and stem, 1 to 1.5<sup>mm</sup>; length of calicles, about 3<sup>mm</sup>; diameter at base, 2<sup>mm</sup>. The swollen bases of the calicles are often filled with eggs. Stations 2036, 2038, 2039, 2041-3, in 1467 to 2309 fathoms.

§ *Astronyx tenuispina* V., sp. nov. A species with a pentagonal disk and five long slender arms, much resembling *A. Loveni*, but easily distinguished by having, instead of hooks, three slender, divergent arm-spines, of which the lower is much the longest and largest, with the distal end enlarged and roughened by little spinules. The genital openings are situated as in *A. Loveni*, but not quite so near together. Mouth-papillæ small and short; the jaws end in a single short spine-

Among the other interesting Pennatulacea is *Anthoptilum Murrayi* K., which was dredged several times in 640 to 1362 fathoms. It was first taken off Nova Scotia by the Challenger. It was associated, in some cases, with the much larger *A. grandiflorum* V., first described by me in this Journal from numerous fine specimens obtained by the Gloucester fishermen on the banks off Nova Scotia, but afterwards described by Kölliker as *A. Thomsoni* from specimens dredged by the Challenger off Buenos Ayres, in 600 fathoms.

The Gorgonacea are represented by several fine species, some of them conspicuous on account of their large size and bright colors. The bush-like *Acanella Normani*, as usual in deep water, occurred abundantly. *Lepidisis caryophyllia* V., which grows in the form of tall, slender, unbranched stems, often two or three feet high, with long, hollow, calcareous joints, alternating with short horny ones, and with very long spiny calicles, occurred alive several times, in 1098 to 1735 fathoms, and dead in many localities, where its joints are very abundant on the bottom and afford solid support for the attachment of other species of Anthozoa, etc. Fine living specimens of *Acanthogorgia armata* V. were taken in 407 to 640 fathoms, and a number of specimens of *Primnoa lepadifera* were dredged on the outside of Brown's Bank, off southern Nova Scotia, in 101 to 131 fathoms. A very elegant plumose coral, the *Dasygorgia Agassizii* V., which has a slender, iridescent, calcareous axis, with the main branches spirally arranged and the large polyps obliquely seated, was dredged in 1346 to 1362 fathoms. It belongs to a peculiar deep-sea family, Chrysogorgidæ,\* recently established by me for this and several related genera, nearly all of them elegant in form and colors. A new genus, belonging to this family, was dredged in 858 to 1735 fathoms (*Lepidogorgia gracilis*).†

\* Blake Anthozoa, Bulletin Mus. Comp. Zool., xi, p. 21, 1883.

† *Lepidogorgia*, gen. nov. Axis simple, iridescent, with calcareous, ramose roots; polyp-cells large, oblique, covered with fusiform spicula; coenenchyma thin, covered with small oblong scales.

*Lepidogorgia gracilis* V. Axis tall, slender, terete, tapering to a flexible tip; roots large, thick, irregularly but finely arborescently branched, the branchlets white, round, tapering and coral-like. Polyp-calicles large, prominent, distant, obliquely seated, often thicker than the stalk, covered with large spicula, longitudinally placed. Spicula of the coenenchyma small, flat, oblong, or constricted in the middle, with rounded ends. Color, when fresh, orange or salmon. Height, often 900<sup>mm</sup> or more; diameter of axis, at base, 1-1.5<sup>mm</sup>; of polyps, 1<sup>mm</sup>; distance between polyps, 5 to 10<sup>mm</sup>. Station 2072, off George's Bank, in 858 fathoms; stations 2036 and 2037, in 1735 and 1731 fathoms. A large lot from station 2037.

ART. XXX.—*Geology of the Blue Ridge near Balcony Falls, Virginia; a modified view; by JOHN L. CAMPBELL.*

IN this Journal, vol. xviii, Dec. 1879, will be found a paper on the geological structure of the Blue Ridge, at Balcony Falls, Rockbridge County, Virginia, illustrated by a map and geological section. As to their main features the facts there presented are correct; and the descriptions given have been corroborated by subsequent observations—at least so far as relates to the Cambrian formations that rest against the western flank of the igneous and metamorphic core of the Blue Ridge at this point.

But, as regards the stratified beds flanking the main ridge on its eastern slope, subsequent observations have modified the views expressed on page 439 of the paper referred to above, where the following paragraph occurs:—

“The bedded rocks (1, *a b*,) that rest upon the syenite are very much metamorphosed, are gneissoid in character, and dip toward the southeast. [Correct so far]. Then follows a bed of forty or fifty feet of conglomerate and quartzite, bearing some resemblance to the conglomerate sandstones on the opposite side of the ridge, but so different in composition, texture, position and thickness as to preclude the idea that they have any historical connection. Over this again we find another bed of slate. These beds all dip toward the southeast while their upper margins reach beyond the underlying syenite and granulite, and with their edges support the lowest beds of Primordial rocks, where both extend high up on the ridges, beyond the limits of the igneous beds.”

It was a mistake, as will appear farther on, to class these as *Archæan beds*. But some apology may be found for my mistake in the fact that Prof. W. B. Rogers, in his notes on the geology of Virginia, as found in Macfarlane's Geological Railway Guide, speaks of the rocks between Lynchburg and Balcony Falls as all belonging to the Laurentian and Huronian (his A and B) formations. I had not, however, seen that note of his before the paper above quoted was published; so that I am entirely responsible for my own partially erroneous conclusion.

After my paper on this subject had been published, suspicions arose in my mind that the conglomerate and slate beds along the eastern flank of the main Blue Ridge might be of Cambrian age, and so modified by the metamorphic agencies as to have their characteristic features obscure; but engagements