

ART. XIII.—*Notice of the remarkable Marine Fauna occupying the outer banks off the Southern coast of New England, No. 3*; by A. E. VERRILL. (Brief Contributions to Zoology from the Museum of Yale College: No. XLIX.)

AFTER the printing of my last article, in the October number of this Journal, an additional trip to the outer grounds, off Martha's Vineyard, was made by the Fish Hawk, Sept. 21. Owing to unfavorable weather, only two successful hauls (1038, 1039) were made, but some very interesting species were procured. One of the most notable additions to the fauna was a large and perfect sea-urchin, with large spines nearly four inches long (*Dorocidaris papillata*). This had not been taken before on this coast, although not uncommon off the coasts of Europe, and beneath the Gulf Stream, off Florida, etc. The specimen taken at station 1038 measured $7\frac{1}{2}$ inches across the spines. A small comatula (*Antedon Sarsii*) was found at station 1038,

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in 146 fathoms, in the greatest profusion, over 10,000 specimens coming up at a single haul. As usual, nearly all the specimens had dismembered themselves before reaching the surface. The great abundance of this and other recent crinoids at certain localities is parallel with the abundance of many ancient fossil crinoids, in particular regions.

In fact, a large number of species, belonging to various zoological groups, in this region are found living gregariously, in vast numbers, at particular spots, while they may not occur at all, or only sparingly, at other stations, in similar depths, and apparently identical in temperature and character of the bottom. Thus, among Echinoderms, the large ophiuran, *Ophioglypha Sarsii*, occurred at stations 918 and 1026, in 45 and 182 fathoms, in vast quantities; at 1026, between two and three barrels (probably over 10,000 specimens) came up in a single haul; the elegant star-fish, *Archaster Agassizii* V., occurred in great numbers at station 997, in 335 fathoms: the more common *A. Americanus* V. has often occurred in very great profusion, many thousands being taken at a haul, at several stations. A slender-armed *Amphiura* occurred in very great numbers at station 920, in 68 fathoms, but was seldom met with elsewhere. Many other echinoderms might also be cited, though affording less conspicuous examples. Several very large actinians, among them *Bolocera Tuedie*, *Urticina nodosa*, and other species of *Urticina*, occurred in great quantities at many stations (924, 937, 938, 998), more than a barrel of them frequently coming up in the trawl. The pretty bush-like gorgonian coral, *Acanella Normani* V., was very abundant at stations 938, 947, 1029. Of the spiny sea-feather, *Pennatula aculeata*, we took over 500 specimens, at station 1025, and nearly a hundred of *Anthomastus grandiflorus* V., at station 1029; both these forms are usually scarce. The coral, *Flabellum Goodei* V., was abundant at 894, 895, 952, 938. The large and curious annelid, *Hyalinæcia artifex* V., remarkable for the very large, quill-like, free tube that it constructs, must be excessively abundant in many places, as at 869, 880, 1025, 1026, 998, 938, for several thousands are frequently taken at a single haul, and sometimes even four or five bushels, as at station 1032. Among Crustacea, such cases are also very common. A species of *Munida* was very abundant at some stations (871, 922, 941), so that 2,000 or more sometimes came up in one haul, and the same is true of several species of shrimp (*Pontophilus brevirostris* Smith, at 865, 871, 878, 941; *Pandalus leptocerus* S., at 870, 878, etc.); certain hermit-crabs, as *Hemipagurus socialis* S., at 871, 874, 877, 878, 940, 941, 944; the maioid crab, *Euprognatha rastellifera* Stimp., at 871-4, 878, 921, 941, etc.

One of the most striking instances was the occurrence of

a very remarkable and hitherto rare hermit-crab (*Parapagurus pilosimanus* Smith), with its associated, investing polyp (*Epizoanthus paguriphilus* V.)* which is a true commensal, forming, out of its own tissues, the habitation of the crab; and hitherto it has not been found elsewhere than upon the back of this particular species of crab, which, likewise, has not been found without its polyp. Of these associated creatures we took about 400 couples, at station 947, in 312 fathoms, at one haul. It had previously only been known by a few specimens taken by the Gloucester halibut fishermen, in deep water, off Nova Scotia, and by ourselves, in 1880.

In October, while on the way south, Captain Tanner made an independent trip to the edge of the Gulf Stream, off Delaware Bay (stations 1043-1049). On this trip, many interesting species were obtained, among which were several fine large specimens of *Echinus gracilis* and *Dorocidaris papillata*. A large species of *Fissurella*, and a very large specimen of a rare crab, *Geryon quinquedens* Smith, also occurred.

During the summer, the writer made some observations in regard to the phosphorescence of many species. Among those having strong phosphorescence, were *Pennatulula aculeata*; *Acanella Normani*; *Urticina nodosa* (in which it is confined to the tentacles and the smoother, soft portion of the column, near the summit); *Ophiocnida olivacea*; *Ophiacantha bidentata*.

Additional dredging stations occupied by the Fish Hawk, in 1881.

Station.	Locality.		Fath.	Bottom.	Date.	Temperature.	
						Bottom.	Surface.
	<i>Off Martha's Vineyard.</i>						
	N. Lat.	W. Long.			1881		
1038	39° 58'	70° 06'	146	sand & shells	Sept. 21	47° F.	67° F.
1039	39 59	70 06	136	"	"	50	67
	<i>Off Delaware Bay.</i>						
	N. Lat.	W. Long.					
1043	38° 39'	73° 11'	130	sand	Oct. 10	49	65½
1044	38 37	73 12	224	gray mud	"	42½	66
1045	38 35	73 13	212	"	"	40	66
1046	38 33	73 18	104	sand	"	51	66
1047	38 31	73 21	156	"	"	49	66
1048	38 29	73 21	435	mud	"	40	66
1049	38 28	73 22	435	"	"	40	66

* *Epizoanthus paguriphilus* Verrill, sp. nov. Polyps few and very large, stout, with broad, swollen bases, arising from a very thick, smooth, lubricous, gray or mud-colored, translucent basal coenenchyma, which at first invests small univalve shells, occupied by *Parapagurus pilosimanus*, but finally grows far larger than the shell and eventually absorbs it. Disk broad, larger than column; tentacles numerous, rather long, light orange. Breadth of colony, 2 to 3 inches; height of polyps, in expansion, 1 inch or more; diameter, .5 to .7 of an inch.

ECHINODERMATA.

Most of the Echinodermata enumerated last year were again taken this season, in still greater abundance, and several additional species were discovered. Among the latter are four species of *Archaster*, one of which is new;* one of the curious round sea-urchins with a flexible test (*Phormosoma Sigsbei*); large specimens of *Dorocidaris papillata*; the European *Echinocyamus pusillus*; three species of Spatangoids (*Spatangus purpureus*, *Brissopsis lyrifera*, both European species, and a *Schizaster*, like *S. canaliferus*); but the last two were also taken in 1880, though not then enumerated.

The *Astrochele Lymani* V., occurred at 939, 1028, 1029, in abundance, twining its arms closely around the branches of *Acanella Normani* V. It had before occurred off Nova Scotia, in the same way, on this and other gorgonian corals. *Ophiomusium Lymani* Thomson was taken several times, in 238–500 fathoms. Several new ophiurans were taken, some of which have not yet been fully examined; and at least one undescribed holothurian.

Schizaster canaliferus L. Agassiz (? variety).

A number of specimens of this singular *Schizaster* have been taken at several stations, in 65–130 fathoms. It is closely related to the Mediterranean form, *S. canaliferus*, and to the species, *S. Orbignyanus*, recently described from the Gulf of Mexico, by Mr. A. Agassiz. Some of the specimens were sent to Mr. Agassiz, who thought them allied to the last named species, but as he had no time to study them carefully, he kindly forwarded specimens of *S. Orbignyanus* to me, for comparison.

My specimens agree exactly with *S. canaliferus*, in form of test, in the shape of the petals, and in the peripetalous fasciole, except that the latter runs directly across the posterior interambulacrum. It differs from both the forms named, in having the lateral fascioles more or less imperfect or abortive on the sides, though distinct below, where they join the subanal fasciole, which is like that of *S. canaliferus*. In some specimens the lateral fascioles, although extremely narrow and faint, can be traced to the peripetalous fasciole, but in many cases it entirely fades out before reaching it. The anal area is usually round, or but slightly elliptical. From *S. Orbignyanus* it differs, also, in having the lower side more convex and the posterior end more swollen and rounded; in having the anterior furrow shorter, broader and deeper; in having shorter antero-lateral petals,

* These species are *A. arcticus* Sars, 183–310 fathoms; *A. tenuispinus* D. and K., 388 fathoms; *A. mirabilis* Perrier (?), 310 fathoms; and *A. Bairdii*, sp. nov., 388 fathoms.

more abruptly bent near their origin; and in having shorter and more ovate posterior petals.

I am, therefore, disposed to consider this a geographical variety of *S. canaliferus*, with which it agrees better than with *S. Orbignyanus*. The latter may also eventually prove to be only a more divergent form of the same species. The variation in the lateral fascioles is a very remarkable one, for this is usually regarded as a generic feature. It approaches *Periaster*.

Brissopsis lyrifera Agassiz.

A large specimen from station 921, after immersion for a short time in alcohol, had the test greenish black above, dark brown beneath, spines dark olive-green. Length, 71^{mm}; breadth, 65; height, 46^{mm}.

Phormosoma Sigsbeii A. Agassiz, Bulletin Mus. Com. Zool., viii, p. 75, 1880.

A specimen from station 1029, after being in alcohol a few hours, had the test pale orange-brown above, with a darker orange-brown skin beneath; sutures, tubercles and areas whitish; shell pale salmon beneath the skin. Dorsal spines very slender, few and small toward the center, glassy, delicately fluted and finely spinulose, whitish, faintly tinged with orange; beneath, the spines are larger and longer (12^{mm} and more); tubercles large, with deep areas. Diameter of test, 80^{mm}; height, 18, in the flattened state.

Dorocidaris papillata A. Agassiz.

Our specimens are near the variety *abyssicola*. The long spines appear nearly smooth to the naked eye, but are finely fluted and minutely spinulose; they increase gradually in size for a short distance and then taper very gradually to the truncate or slightly excavated tips; the ventral spines are clavate and truncate, with the distal half strongly sulcated; those near the mouth flat and curved. Color of test and small spines, pale pink; large spines, at base, mostly pale pink above, with three or four broad, faint bands of dull greenish brown: scattered spines (probably reproduced), are dark purplish brown; ambulacral zones and sutures, greenish. Diameter of test of largest specimen, 65^{mm}; height, 45; length of largest spines, 80; their diameter, 6^{mm}.

Archaster Bairdii Verrill, sp. nov.

Disk, broad; arms, broad at base, tapering rapidly to slender tips; the interbranchial spaces have nearly the form of a segment of a circle. Lesser to greater radii, as 1:2.20–2.38. The abactinal surface is covered with rather large (1.3–1.6^{mm}), regular, well-

defined paxillæ, those toward the center decidedly larger, each surmounted by a regular rosette of short, bluntly rounded, not very small spinules, which, on the larger paxillæ, form a central cluster of 12 to 20 or more, with a regular circle of slightly larger ones around the edge; these rosettes appear more or less hexagonal, and decrease in size toward the margins and on the arms. The dorsal area of the arms is wide at base, but narrow distally. Marginal plates about 20 on each side of the arms, above and below, rather large, not very convex, evenly covered with rounded granules. Actinal surface with large triangular areas, occupied by regular, rather large, clearly defined paxillæ, with regular rosettes of not very fine, blunt spinules. The adambulacral plates bear, each, a group of about five, rather long, slender, tapering, nearly equal spines, which stand in regular longitudinal rows, the edges of the plates projecting inward but slightly; outside the inner group of spines, there is a rosette of shorter blunt spines, of which the three or four innermost are larger and longer than the outer ones, which are small, like those of the paxillæ. Oral plates not swollen, bordered, on each side by seven or eight, rather stout, vertically flattened spines, and terminated at the inner end by two decidedly longer and stouter ones; their surface bears two regular median rows of seven to nine shorter spinules, and usually a row of three or four small ones between these and the marginal series. Ambulacral feet well developed, with a conspicuous, concave, terminal sucker. Greater radius of one of the largest examples, 38^{mm}; lesser radius, 16^{mm}. Color, when living, light orange.

Station 952, in 388 fathoms. Six specimens.

This handsome species has the form and general appearance of *A. Parelii* and *A. Agassizii*. The latter, of similar size, usually has a rather smaller disk, with longer and less rapidly tapering arms, while the dorsal paxillæ, and especially the central ones, are not one-fourth as large, with much finer and more crowded spinules; the marginal plates often bear a central spine; the ventral paxillæ are more convex, with much finer and more crowded spinules; the adambulacral spines are smaller, finer, and more numerous (8 to 10), with finer spinules outside of them; the oral plates are decidedly swollen, with a crowd of fine spinules over the surface, and with the marginal spines, more numerous, smaller and more acute: it also has large, conical ambulacral feet, with a rudimentary sucker.

A. Parelii agrees nearly with the last in form, but has still longer and more narrowed arms. From *A. Bairdii* it differs in having distinctly smaller, less regular, and more crowded dorsal paxillæ, with more uneven, granule-like spinules; the adambulacral plates project inward over the furrows, and each bears five or six smaller, blunt, rough, marginal spinules in a curved

row, with a group of 10 to 12, or more, smaller, divergent spinules outside of them; the oral plates bear shorter and stouter, round, blunt, marginal spinules; the ambulacral feet have well-developed suckers; the color is dull red, in life.

Ophioglypha aurantiaca Verrill, sp. nov.

Disk large, swollen, nearly round, with small notches, destitute of papillæ, at the bases of the five arms; dorsal surface covered by very numerous, small, imbricated scales, partially concealed by a soft skin; in the central area they are crowdedly arranged around one or more larger central plates; the marginal interradial scales are larger and thicker with a median radial row of two or three still larger ones; ventral scales convex, unequal, imbricated. Radial shields convex, irregularly subtriangular, with rounded corners and outer edge, as broad as long, separated by a group of three or more imbricated disk-scales. Mouth-shields shorter than broad, with an obtuse inner angle, a nearly straight outer edge, and short, notched, lateral edges. Side mouth-shields long and rather broad oblong, meeting within. Mouth-papillæ very small and irregular, 7 to 9 on each side of each angle, those next to the teeth longer and pointed. Teeth slender, acute. Innermost tentacle-pore large, bordered on the outside by about six small flat scales, on the inner by about four. Arms somewhat rigid, rather short and stout, not seen entire; arm-spines three, the upper one rather long and stout, tapered, the others successively shorter and smaller; two tentacle-scales.

Lower arm-plates rather small, transversely rhomboidal, with rounded lateral angles, the four sides concave, and the distal angle prominent; near the base of the arms the plates are in contact, to a small extent, but farther out they are separated by the lateral plates. Upper arm-plates large, thickened, trapezoidal, toward the base of the arms broader than long, broadest distally, the proximal and distal edges nearly straight; farther out they become longer than broad, and much narrowed proximally. Color, in life, bright orange; in alcohol, white. Diameter of disk, 18^{mm}; its height, 7^{mm}; length of arms (minus tips), from center of disk, 45^{mm}. Off Martha's Vineyard, 192 to 310 fathoms. Specimens of this singular species were sent to Mr. Lyman for examination last year. He considered it an undescribed species. It has no near allies on our coast.

Ophioglypha confragosa Lyman (variety).

This remarkable form was dredged, both this year and last, sparingly, in 238 to 410 fathoms. The identification was made by Mr. Lyman, who was kind enough to compare specimens sent to him, with the type-specimens of his species. His specimens were dredged by the "Challenger," off the La Plata, in

600 fathoms. According to Mr. Lyman, our specimens differ but slightly from the type.

Color, in life, yellowish or grayish white. It is easily distinguished by its rigid arms, with decidedly swollen joints; the conspicuously plated, rigid disk; and by the large, supplementary plate, outside the mouth-shields.

Amphiura macilenta Verrill, sp. nov.

A small species, with very long, slender arms, having three slender, acute arm-spines. Disk, in life, nearly round, often becoming pentagonal in alcohol or when dried; upper surface covered with very numerous, small, rounded, naked, imbricated scales, forming a more or less evident rosette at the center; lower side with more minute scales; radial shields long and narrow, wedge-shaped, the outer ends prominent and in contact, the inner ends separated by a narrow wedge of small scales. Mouth-shields shield-shaped, with rounded corners, rather longer than wide, broadest in the middle, inner angle obtuse; side mouth-shields wide. Mouth-papillæ five on each side of each mouth-angle, unequal in size, mostly obtusely rounded; the innermost one, close to the end of the jaw, is longer and stouter than the rest, obtuse, separated by a slight interval from the next, which is the smallest and most acute; the next two are flattened, the fourth being the broadest; the outermost is small and rounded. Lower arm-plates oblong shield-shaped, longer than broad, with the sides and distal edges nearly straight, and a well-marked proximal angle; toward the base of the arms they are in contact, but farther out are separated by the side arm-plates. Tentacle-scales two, minute, flat; tentacles long and slender. Arm-spines three divergent, nearly equal, a little swollen at base, gradually tapered, acute, about as long as the joints. Upper arm-plates transversely rhomboidal with rounded corners and edges, separated by the side arm-plates, even at the base of the arms. Color, light gray. Diameter of disk, of an average specimen, 4^{mm}; length of arms (minus tips), 60^{mm}.

Very abundant, off Martha's Vineyard, at station 920, in 68 fathoms; also taken sparingly at several other localities.

This has been examined by Mr. Lyman, who does not recognize it as a described species.