

ART. IX.—*Crustacea of the Albatross Dredgings in 1883*; by
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VERY little has yet been published in regard to the zoological results of the deep sea explorations carried on during the summer of 1883, by the United States Fish Commission, although the dredgings were among the most important yet made. Some of the remarkable forms of fishes discovered have been described by Drs. Gill and Ryder, but the writer's report on the decapod crustacea (80 pages of text with 10 plates), recently put in type for the Fish Commission Report for 1882, is the first detailed report on the zoological collection made by the Albatross, and affords an opportunity for a brief review of the results of the study of the higher crustacea, which is here published by permission of the Commissioner of Fish and Fisheries.

The dredgings of the Albatross extended from off Cape Hatteras to the region of George's Banks. The number of dredging stations was 116, of which 30 were in less than 100 fathoms, 35 between 100 and 500 fathoms, 19 between 500 and 1000 fathoms, 27 between 1000 and 2000 fathoms, and 5 below 2000 fathoms. The whole number of species of Decapoda determined from these stations is 72, but of these at least 15 are true shallow-water species. Of the remaining 57 species, 40 were taken below 500 fathoms, 29 below 1000 fathoms, 13 below 2000 fathoms, and 6 at a single haul in 2949 fathoms. Of the 29 species taken below 1000 fathoms, 21 are Caridea or true shrimp, and the 8 higher species distributed as follows: 2 Eryontidæ, 3 Galatheidæ, 1 Paguroid, 1 Lithodes, and 1 Brachyuran belonging to the Dorippidæ. It is interesting to compare these results with the lists of the fauna of the North Atlantic below 1000 fathoms, given by the Rev. Dr. Norman in the presidential address to the Tyneside Naturalists' Field Club, published last year. In Dr. Norman's lists only 12 species of Decapoda are recorded, none of them from as great a depth as 2000 fathoms, and of these 12 species, 7 were known only from the Blake dredgings of 1880.

The following are some of the more interesting new forms: a new genus of Brachyura allied to *Ethusa*, 1496 to 1735 fathoms; an Anomuran belonging to A. Milne-Edwards' new genus *Galacantha*, 1479 fathoms; two species of *Pentacheles* (a genus of Eryontidæ allied to *Willemoesia*), between 843 and 1917 fathoms; a stout Palæmonid (*Notostomus*), six inches long and intense dark crimson in color, 1309 to 1555 fathoms; a gigantic *Pasiphaë*, eight and one-half inches long, 1342 fath-

oms; three species of a remarkable new genus allied to *Pasiphaë*, and also to *Hymenodora* and some other genera of Palæmonidæ; which shows that *Pasphaë* is closely allied to the Palæmonidæ; a large Penæid, a foot in length, referred to the little known genus *Aristeus*; and a large *Sergestes* three inches in length.

The great size of some of these new species of shrimp is remarkable, but is far exceeded by two of the previously described crabs. *Geryon quinquedens*, from 105 to 588 fathoms, is one of the largest Brachyurans known, the carapax in some specimens being five inches long and six broad, while one specimen of the great spiny *Lithodes Agassizii* measures seven inches in length and six in breadth of carapax, and the outstretched legs over three feet in extent.

Among the Schizopoda there are two large species of *Gnathophausia*, one over four inches in length, and a *Lophogaster*, all from below 2000 fathoms. One of the most interesting Schizopods is a small *Thysanoessa* (a genus of Euphausidæ) from 398 to 1067 fathoms, of which one female was found carrying eggs. The eggs are carried in an elongated and flattened mass beneath the cephalothorax, are apparently held together by some glutinous secretion, and are attached principally to the third pair of peræopods (antepenultimate cephalothoracic appendages). This apparently confirms Bell's statement in regard to the egg-carrying of *Thysanopoda Couchii*, which is, as far as I know, the only published observation of egg-carrying in any of the Euphausidæ.

The Amphipoda from deep water are comparatively few in number and have not yet been carefully examined, but among them is one specimen of the gigantic *Eurythenes gryllus* Boeck (*Lysianassa Magellanica* Milne-Edwards), probably the largest of all known Amphipoda. This specimen, which is over four and a half inches long, and very stout in proportion, was taken in 1917 fathoms, north lat. $37^{\circ} 56' 20''$, west long. $70^{\circ} 57' 30''$. The few previously known specimens came from Cape Horn, Greenland, and Finmark, and have apparently all been taken from the stomachs of fishes. This species and its occurrence in the extreme arctic and antarctic seas, has been much discussed and is the subject of a long memoir by Lilljeborg, but the apparently anomalous distribution is explained by its discovery in deep water off our middle Atlantic coast.

The great differences in depth through which some of the species range is worthy of notice, several species ranging more than 2000 fathoms, as shown in the list, given further on, of species taken below 2000 fathoms. I have not yet noticed distinct varietal differences due to depth in any species, though there is often a very marked change in the associating species.

A very remarkable case is that of *Parapagurus pilosimanus*, which was taken at fifteen stations and in 250 to 640 fathoms by the Fish Hawk and Blake in 1880-'81-'82, and in great abundance at one station, in 319 fathoms, where nearly four hundred large specimens were taken at once. All these earlier specimens were inhabiting carcinoecia of *Epizoanthus paguriphilus*. In the dredgings last summer the *Parapagurus* was taken at seven stations ranging in depth from 1731 to 2221 fathoms, but none of the specimens were associated with the same species of *Epizoanthus*, some being in a very different species of *Epizoanthus*, others in naked gastropod shells, and still others in an actinian polyp.

A striking characteristic of the deep-sea crustacea is their red or reddish color. A few species are apparently nearly colorless, but the great majority are some shade of red or orange, and I have seen no evidence of any other bright color. A few species from between 100 and 300 fathoms are conspicuously marked with scarlet or vermilion, but such bright markings were not noticed in any species from below 1000 fathoms. Below this depth, orange red of varying intensity is apparently the most common color, although in several species, very notably in the *Notostomus* already referred to, the color was an exceedingly intense dark crimson.

The eyes of these abyssal species are even more remarkable than their colors, as the following list of the Decapoda and larger Schizopoda taken below 2000 fathoms by the Albatross, with the notes which follow, will show:

1. <i>Parapagurus pilosimanus</i>	1731 to 2221 fathoms.
2. <i>Pontophilus abyssi</i>	1917 to 2221
3. <i>Nematocarcinus ensiferus</i> ...	588 to 2030
4. <i>AcanthePHYRA Agassizii</i>	105 to 2949
5. <i>AcanthePHYRA</i> , sp.	2929
6. Gen. allied to <i>AcanthePHYRA</i> ...	1395 to 2929
7. <i>Hymenodora glacialis</i>	888 to 2030
8. <i>Parapasiphaë sulcatifrons</i> ...	516 to 2929
9. <i>Parapasiphaë compta</i>	2369
10. <i>Amalopenæus elegans</i>	640 to 2369
11. <i>Aristeus?</i> <i>tridens</i>	843 to 2221
12. <i>Hepomadus tener</i>	2949
13. <i>Sergestes mollis</i>	373 to 2949
14. <i>Gnathophausia</i> , sp.....	858 to 2033
15. <i>Gnathophausia</i> , sp.....	959 to 2949
16. <i>Lophogaster</i> , sp.	1022 to 2949

In every one of these sixteen species the eyes are present, in the normal position, and distinctly faceted. In Nos. 3, 4, 5, 6, 11 and 12 the eyes are well developed, black, and while somewhat smaller than in the average *Palæmonidæ* and *Penæidæ*,

are not conspicuously smaller than in many allied shallow-water forms. In 1 the eyes are black but conspicuously smaller than in the allied shallow-water species. In 13 the eyes are black and of moderate size. In 9 they are apparently black or nearly black and small. In 2 they are nearly colorless in alcoholic specimens and rather larger than usual in the genus, but considerably smaller than in *Pontophilus gracilis*, a very closely allied species found in 200 to 500 fathoms. In 7 and 8 they are small and light colored. In 10 they are rather small and dark brown. In 14, 15 and 16 they are not conspicuously different in size from those of allied shallow-water species and are dark brown.

However strong may be the arguments of the physicists against the possibility of light penetrating the depths from which these animals come, the color and the structure of their eyes, as compared with blind cave-dwelling species, show conclusively that the darkness beneath two-thousand fathoms of sea-water is very different from that of ordinary caverns. While it may be possible that this modification of the darkness of the ocean abysses is due to phosphorescence of the animals themselves, it does not seem probable that it is wholly due to this cause.

The large size of the eggs is a marked feature in many of the deep-water Decapoda. The eggs of *Eupagurus politus* from 50 to 500 fathoms, are more than eight times the volume of those of the closely allied and larger *E. bernhardus* from shallow water, and in *Sabinea princeps*, from 400 to 900 fathoms, they are more than fifteen times as large as in *S. septemcarinata* from 25 to 150 fathoms. The most remarkable cases are among the deep-water genera. *Galacantha rostrata* and *G. Bairdii*, from between 1000 and 1500 fathoms, have eggs 3^{mm} in diameter in alcoholic specimens, while in the vastly larger lobster they are less than 2^{mm}. The largest crustacean eggs known to me are those of *Parapasiphaë sulcatifrons*, a slender shrimp less than three inches long, taken between 1000 and 3000 fathoms. Alcoholic specimens of these eggs are fully 4 by 5^{mm} in shorter and longer diameter, fully ten times the volume of the eggs of *Pasiphaë tarda* from 100 to 200 fathoms, more than three hundred and fifty times the volume of those of a much larger shallow-water *Palæmon*, and each one more than a hundredth of the volume of the largest individual of the species. From the peculiar environment of deep-water species it seems probable that many of them pass through an abbreviated metamorphosis within the egg, like many freshwater and terrestrial species, and these large eggs are apparently adapted to producing young of large size, in an advanced stage of development, and specially fitted to live under conditions similar to those environing the adults.