

1000 fathoms. Some of the most interesting forms, such as *Stephanophyllia*, occur at small depths (120 and 92 fathoms); whilst *Haplophyllia* and *Guynia*, believed by Pourtales and Duncan to belong to the Rugosa, are from 324 fathoms and 92 fathoms respectively. The most widely distributed and most abundant deep-sea coral, which extends to nearly twice the depth to which any other coral attains, viz. *Fungia symmetrica*, belongs to a genus which is not known to occur in the fossil state*. The whole family of the Stylasteridæ, of which six genera occur in the deep water (one of them, *Cryptohelia*, being one of the only four genera which extend to a depth of 1500 fathoms, and the only compound coral amongst these), is recent only.

No coral in any way allied to the Rugosa has been dredged by the 'Challenger.'

IV. Preliminary Report to Professor WYVILLE THOMSON, F.R.S., Director of the Civilian Scientific Staff, on Observations made during the earlier part of the Voyage of H.M.S. 'Challenger.' By the late Dr. RUDOLF VON WILLEMÖES-SUHM, Naturalist to the Expedition. (Published by permission of the Lords of the Admiralty.) Received February 14, 1876. Read March 16.

On our way from England to Lisbon we had continually very bad weather, and could hardly do any thing but put books and instruments into their proper places. In Lisbon we paid frequent visits to the Museum, the fauna of Setubal (near the capital) being particularly interesting, as it is one of the few places in which deep-sea animals go up into shallower water and are accessible to fishermen. Professor Barboza showed us the *Hyalonema* which had been got there, and pointed especially to the sharks and Chimæridæ which have been discovered near Lisbon. On our way to Gibraltar we had some dredgings, but were in the latter place more busy at getting up the catalogue of books and instruments, which since that time has been printed by order of the Admiralty. We also visited nearly daily the Gibraltar market, without, however, finding any thing that was particularly interesting.

Only when we left this port we got into proper working order; and I began to examine more especially the worms which were brought up, a class to which I had paid much attention before joining this expedition, more especially the Annelids and Gephyreans. I made sketches of the former, and was, however, very much astonished to find that they all agreed very much with the genera of shallower water—a fact which has since been corroborated by Professor Ehlers's interesting paper on

* Future comparison of specimens may, however, show a relation between some of the varieties of the species here called *F. symmetrica* and some Lophoserinæ.

the Annelids collected in H.M.S. 'Porcupine' and 'Lightning,' as well as by our own experience during our stay in the 'Challenger.' Though I afterwards did not examine them with so much care as at the beginning, I nevertheless have continued during the whole time to collect them as well as possible, and to examine those which wanted to be drawn when alive or which seemed to be particularly interesting. To the latter forms I shall refer in the course of this report.

Of the Gephyreans I have worked out immediately all those forms which were not quite common Sipunculids, and shall give a short account of them below.

The other classes of worms (*Balanoglossus*, Nemerteans, *Polygordius*, Nematodes, &c.) have been met with rarely in deep water, but have all the more been taken care of.

Having caught, on our way from Gibraltar to Madeira, a large female of *Cystisoma Neptunus*, and been able to work out the then perfectly unknown structure of both sexes of this interesting Amphipod, my attention was drawn towards the Crustacea, all the more so as the dredgings from deep water brought up forms which proved to be of the highest interest and peculiar to those depths. These I have, as far as they were anatomically interesting, worked out during our cruises in the Atlantic and the Antarctic, when I found that I had laid a good foundation to our knowledge of the deep-sea Crustacea, and that after that new forms or new and peculiar genera (as far as their anatomy or zoological position goes) rarely turned up. These researches, as far as the Atlantic Crustacea are concerned, have been presented in a paper to the Linnean Society (Linn. Trans. 2nd ser. Zool. vol. i. pp. 23-59, pls. 6-13).

The surface Crustacea had of course during that time also attracted my attention, and had been always collected; but only in the Antarctic and in the Pacific, when I had more time to bestow upon them, I began systematically to work out the development or the anatomy of all those forms which seemed to me especially interesting.

Many drawings and notes have of course also been made on other surface animals, especially Pteropods, mollusks, &c.; and they have, as far as I was able to determine them, been put down in the "surface-book" on the days when they were found.

This surface-book, as well as the "*station-book*," have been during the whole time under my charge, as I also had to bottle and label the Invertebrates which were brought into the laboratory.

Whenever we were in harbour, and the place was little- or unknown, I had to collect the Invertebrata, especially land-shells, insects, Crustacea, and worms, in which excursions I took of course as many of the Reptilia or other Vertebrates as could be procured. Shooting birds has been done by me in some places, especially in the South-Sea Islands, but never regularly, and more for recreation than for collecting systematically.

In the following pages I shall try to give a preliminary account of the

more interesting animals which were got in the dredgings, so far as they fall under the above-mentioned categories, then say something on the surface-animals, and finally on the result of my excursions on shore.

THE ATLANTIC.

Here and there on the coasts of the Atlantic deep-sea animals have been found either washed on shore or floating dead on the surface of the sea. Certain Crustacea and fish on the coasts of Madeira and the Mediterranean, *Umbellularia* and *Cirroteuthis* in the high north, were animals considered very rare, and about the habitat of which nothing certain was known. Much of this uncertainty has been cleared up by the three successive English dredging-expeditions; and I shall give at the end of this report a short statement regarding those animals known before deep-sea dredging began systematically. There is in the Atlantic only one place in which *Hyalonema* had been of late years regularly found, and this was considered to be a place, like Japan, where alone this sponge genus might be procured. Since that time matters have greatly changed, especially as far as the distribution of the glassrope sponges goes; for now we know that genera like *Hyalonema*, *Euplectella*, *Aphrocallistes*, *Farrea*, &c. are the most characteristic inhabitants of the great depths all over the world, and with them ordinary siliceous sponges, some of which rival the *Hyalospongiæ* in beauty.

Umbellularia was found three times in the Atlantic after the Swedes had rediscovered this genus, which nearly a century ago had been found by a whaler on the coasts of Greenland. Professor Kölliker has already worked out this species, which he considers to be different from the northern one. *Alecyonaria* and *Antipathes* have also been constantly brought up, and the latter is especially characteristic of great depths.

We owe to American expeditions a good deal of what was known about the bathymetrical distribution of corals and of Echinoderms; but especially the latter have during this 'Challenger' expedition yielded a very large variety of species, the greater part of which is very likely new and has partly been described already by Professor Wyville Thomson. I have been greatly interested in Crinoids for the sake of their parasites (*Myzostomum*), most of which were, however, got only in the Pacific; and I shall say a few words about their very extraordinary mode of living when giving an account of the worms found in that ocean.

The *Platodes* are a group which has been rarely met with; here and there of course Cestodes or Trematodes in young or old stages might be found inhabiting the invertebrates and afterwards the fish; but nothing has come to my knowledge about them, as the latter were far too precious to be dissected for helminthological purposes. Nemerteans do go down to great depths; but they were rarely got here, only once off the coast of Brazil, in 1200 fathoms; and the worst is that when you do get them they are generally in pieces, either by friction among stones and mud or

by breaking themselves up into small pieces like certain *Synaptae*. Of *Rhabdocœla* and *Dendrocœla* I never saw a trace; but they are still more liable to be spoiled or overlooked than the former.

There are, I think, a few free Nematodes; but certainly they are very scarce. Of great interest is, however, a case of parasitism, which may be compared to the attacks which on shore the young *Gordii* make on our grasshoppers. I found once in a shrimp from a great depth a worm coiled up in its carapax, and afterwards the same thing when on our way to New Zealand; and we made sure that the worm which was contained in the second shrimp was a young Gordiacean. During our Antarctic cruise we have also got two free-living Nematodes, which we suspect very much to be the mature animal; anyhow it is quite certain that shrimps in great depths are liable to be attacked by considerably large Gordiaceous worms.

Of Bryozoa there is a great variety in nearly all depths where animals have been found; but only one of them, being a very striking form and differing in its features from the hitherto known species, has attracted our attention and been described by Professor Wyville Thomson under the name of *Naresia cyathus*. It has been got three times, in 350, 1525, and 1950 fathoms, near the coasts of Portugal, as well as off those of Brazil. In the dredgings near the latter coast the fauna of Bryozoa was especially rich.

Gephyreans were got now and then, especially in cases where a great deal of mud had been brought up. Whether their first order, the chæti-ferous ones, are represented in our collections of the Atlantic (we consider, of course, *Sternaspis* to be an annelid) is uncertain, as I find mentioned on our list only a fragment, which might be ascribed to *Echiurus*, from 39 fathoms, and a very large worm, perhaps allied to *Bonellia*, with which it shares the presence of only one genital pore, but which has lost the anterior portion of its body. The consequence is that we are unable to find out whether hooks have been present or not; anyhow this specimen, which has a length of 76 millims., and which came up off Nova Scotia from 1340 fathoms, is a very interesting one.

The unarmed Gephyreans were more commonly got. Of the genus *Priapulius* we had a specimen from 2750 fathoms on our way from Bermudas to the Azores; and *Chaetoderma* (Lovén's curious little worm with calcareous spines in its skin) was found twice in depths of 390 and 1250 fathoms. I was rather astonished never to find *Halicryptus*, as I had expected that this genus, which inhabits the Baltic and the high north, would be very common in deep water.

A curious intermediate form between Priapulids and Sipunculids came up from 1945 fathoms off the island of Ferro. This worm has no tentacles and no proboscis like the former, but has at the same time the anus in the anterior part of its body (Sipunculids). Its pharynx is very short, and is attached to the body by four retractores. Its inside shows

six to seven folds, and is covered with papillæ, which towards the mouth change into chitinous protuberances. In each of these one finds some unicellular glands, granulated cells showing a nucleus and a nucleolus. Unfortunately the posterior portion of its body had been destroyed before we got it.

The commonest Gephyrean genus is undoubtedly *Sipunculus*, in shallow water as well as in deep water; we got it here three times, in depths from 350 to 2500 fathoms.

We have been particularly looking out for *Phoronis*, but have never been able to find it, and feel now nearly sure that it does not inhabit, as a rule, the great depths. *Sternaspis*, however, has been got in 1700 fathoms of water, and besides this annelid another form (600 fathoms off Gomera), which has an intestine coiled up like that of a Gephyrean, and only three pairs of setigerous feet in the posterior portion of its body. It is in many ways peculiar; but I am unable as yet to determine its systematical position from want of books of reference.

Among the tube-building annelids the Clymenidæ, Terebellidæ, and Serpulidæ are characteristic inhabitants of great depths, and go, like that *Myriochele*, sp., which I have figured ('Nature,' 1873), to a depth of 2900 fathoms. We missed *Chaetopterus*, *Siphonostomum*, and *Pectinaria*, which for various reasons we had expected to find in rather deep water. Of free-living annelids, however, there is a large amount, Aphroditidæ, Palmyridæ, Eunicinæ (*Onuphis* is very common), and Glyceridæ being the families chiefly represented. I found that sometimes genera which have got eyes in shallow water are represented by a blind species in deep water—an observation which, I think, has also been made by Professor Ehlers.

Having described shortly before I joined this expedition a northern form of *Balanoglossus* (*B. Kupferi*, from the Oeresund near Copenhagen, 14 fathoms), I was of course greatly interested in a large fragment of this peculiar worm which came up near the west coast of Africa from 2500 fathoms. Unlike its northern cousins, this species has very bright colours, its head being yellow, its collar bright red, and its body yellowish red. The head alone has a width of 18 and a height of 11 millims. In deep water this genus was seldom again obtained; and I may therefore now mention that in most tropical places in the Pacific I found this genus to be an inhabitant of the shallow water, as I constantly found the larva known under the name of *Tornaria*, and sometimes such stages of its development which have been shown by Mecznikoff and A. Agassiz to belong to *Balanoglossus*.

Parasitical Cirripedia are by no means rare on the shallow-water shrimps, and are found as well among those coming from great depths. We have noticed a *Peltogaster* here and there, but feel sure that a careful examination of the Macrurous Decapods will show many more cases.

Both groups of the Cirripedia Thoracica are well known in a fossil state;

and it is not uninteresting to find that *Balanus*, a crustacean which was eminently developed in the Tertiary formation, is now nearly entirely confined to shallower water, but that the Lepadid *Scalpellum*, which is mostly found in the Cretaceous formation, is now-a-days widely spread in the greater depths. Indeed it has been the only Cirriped which we have often met in depths from 925 to 2850 fathoms, and was got in the Atlantic six times, one of them having been described by Professor Wyville Thomson under the name of *Scalpellum regium* ('Nature,' 1873).

Of free-living Copepods there are none on our list, nor do I think that any are living below the range of the so-called surface-animals; but their parasitical relations are found as well on the deep-sea fishes as on those from shallower water—as, for example, on a Lophioid allied to *Ceratias*, which came up from a depth of 2400 fathoms, and is sure, from the mode of living peculiar to that group of fish, to have come from the bottom.

There are no Ostracoda to be mentioned here; and of Amphipoda (which, however, are by no means wanting in deep water) only one specimen of *Eusirus cuspidatus* has been put down by me; but perhaps some more might be found among the siftings.

Very peculiar are the deep-sea Isopods; for besides the ordinary *Arcturus*-form which we got from 450 fathoms, there is a very peculiar family of which Sars has described five genera from the Norwegian coast, all of which are blind. The body is divided into two portions; the anterior one, consisting of a head with four segments of the pereion, is short, and the posterior, consisting of the three remaining pereion-segments, rather long. The first pair of legs is short and prehensile; but the three following pairs have an extraordinary length, and are very thin and slender, and the last three pairs are terminated by paddle-shaped joints and act as natatory organs. Very peculiar is also their abdomen, which consists of only one segment, on the end of which we find two small setigerous papillæ. Of these Munopsidæ, the legs of which break unfortunately very easily, we got a large and very soft species from 2175 fathoms on our passage from Bermudas to the Azores, and another spiny species not far from there from 1675 fathoms.

When dredging off the coast of Brazil near Pernambuco we fell in for the first time with an Isopod, which, from a superficial resemblance with the fossil Trilobites, has enjoyed for some time a certain notoriety; I mean *Serolis*, the flat crustacean which has long been known as inhabiting the southern coast of America. We never found it again in the tropics, neither in deep nor in shallower water, but shall have to mention it frequently among the Crustacea of the Antarctic.

A blind *Tanaïs* was brought up from 1400 fathoms.

Cuma, which, according to Claus, has its nearest relations among the Isopods, is not common in deep water, and was found only once in 1000 fathoms near San Miguel, Azores.

Stomatopoda are entirely confined to the shallower water of the tropical and temperate regions. We never met with one far away from the land, though their young stages are widely spread all over the surface of warmer seas.

The most interesting Crustacea which have been got are undoubtedly the Schizopods, several new genera of which were brought up, which are both interesting for anatomical and physiological reasons. These have been partly figured in 'Nature' (*Gnathophausia*, 'Nature,' 1873), and afterwards fully described by me in a paper "On some Atlantic Crustacea," which has been or will be published by the Linnean Society. Here only a few words about them.

The normal Schizopods, as is well known, have their carapax fixed to the pereion, with the exception of the aberrant genus *Nebalia*, in which the latter is unattached, and resembles a shell enclosing the anterior portion of the body. Our deep-sea genera, however, have (at least most of them) a carapax which is neither the one nor the other, but resembles very much the shield-like carapax of the Phyllopod genus *Apus*. In other respects they are, however, nearly allied to the established families, though some of them have characters which are peculiar to several of the shallow-water forms, but have as yet not been found united in one genus. Moreover some of these abyssal Crustacea are blind, or show peculiar modifications of the organs of sight, as well as of the chitinous outer parts, which have lost the optical apparatus.

Petalophthalmus inermis is the name which I have given to the most remarkable of these Schizopods, as in it the optical apparatus of the eye is entirely wanting, while its chitinous parts have remained in the shape of a concave plate-like organ supported by a peduncle. This plate shows neither a trace of the organs of vision nor any appendages; it consists of a double chitinous layer, and nothing is to be seen in it but the fluid of the body and the attachment of the muscles, which are to be found in all stalked-eyed Crustacea. Its appendages show this form to belong to the family Mysidæ, there being six legs (second gnathopod and the five pereopods), no branchiæ, large breeding-lamellæ in the female, and only rudimentary pleopods in the male. The carapax, as we have said above, leaves in both sexes five segments entirely uncovered.

But besides the looseness of the carapax there are peculiarities in the male of this Schizopod which have been found nowhere else; for its first antennæ, the palpus mandibularis, the maxilliped, and the first gnathopod have been converted into enormous prehensile organs, and the latter shows a large lamellar appendage like the maxilliped in the female. These elongated appendages have in the male six times the length which they have in the female.

This is the only Mysid which was got from great depths (1900 and 2500 fathoms). The next family, the Euphausiidæ, was represented by a very large species, red and opaque, which came up in the South Atlantic

from a depth of 1900 fathoms. It is in so far remarkable as it was in the Atlantic the only Schizopod in which the carapax is attached to the posterior segments of the pereion.

The most characteristic Schizopods in great depths belong to the Lophogastridæ, from which they differ, however (like *Petalophthalmus* from the shallow-water Mysidæ), by the looseness of the shield, and by a pair of lateral eyes, which hitherto were only known among the Euphausiidæ. These lateral eyes, however, in *Gnathophausia* never exceed two in number, and are invariably fixed on the outer margin of the second maxilla. The carapax here is bent backwards, and thus leaves a place open, which enables these sense-organs to perform their duty.

In all other respects these Schizopods are true Lophogastrids, some of them, however, exceeding very much in size the small shallow-water species (*L. typicus*) which Sars has described from the Norwegian coast. There are three species:—1. *Gnathophausia gigas*, length 142 millims., found only once in the Atlantic from a depth of 2200 fathoms near the Azores. It is not impossible that this is the animal which Dohrn has got in a very badly preserved state from the coast of Africa (without any appendages, and evidently somewhat crushed), and described under the name of *Lophogaster ingens*. He does not, however, mention the eyes on the second maxilla, and says that the carapax was fastened to the pereion; and for this reason I have to wait until I can myself compare the specimen in the Hamburg Museum with those caught by us. This would of course in no way affect the validity of the characters upon which the genus *Gnathophausia* has been established, but induce one to put the specific name of *Gn. ingens*, Dohrn, instead of *Gn. gigas*, mihi. 2. *Gn. zoëa*, a smaller form, length 60–80 millims. This species is the commonest Schizopod, as we got it five times from 1000–2550 fathoms. Many males and females have been caught, and its anatomy has been thoroughly worked out. 3. *Gn. gracilis*, a still smaller spiny species, of which only one specimen was got from 1500 fathoms, not far from the rocks of St. Paul.

A third genus in which the carapax is not attached is *Chalaraspis*, which has got very long walking-legs with large claws to them (*Ch. unguifer*), and is most nearly allied to the Lophogastridæ, though it may perhaps be necessary to establish for it a new family. Its organs of vision offer nothing particular. I must refer about further details to my above-mentioned paper, and can here only state that it was got four times, in depths of 350, 675, 1850, and 1900 fathoms, in the Middle and Southern Atlantic.

Decapoda Macrura were very common: nearly every haul brought up Peneids and Caridids, sometimes of large size and having often a very peculiar look; but I do not think that any thing very interesting, except a series of new forms with a more or less spiny carapax and longer or shorter legs than usual, will be found among them.

In a very successful dredging in 450 fathoms off St. Thomas we got an Astacid, which I have described and figured under the name of *A. zaleucus*, as it is totally without eyes or even a trace of eye-stalks, and is distinguished by an enormous development of the right claw. The animal has never been got since, but may perhaps, when a female shall have been found, form the type of a new genus. In the mean time I have called it *Astacus*, as it seemed to be nearer to the crayfish than to *Nephrops*, to which it would be convenient in so far to put it, as this genus contains only salt-water forms. This is a question which has to be decided by those who, after us, will be fortunate enough to dredge up some more specimens of it.

Another Decapod, of which two species were got in the Atlantic, is *Willemoesia*, a genus established by Grote, and first described by us under the name of *Deidamia*. I have shown in my paper that these crayfishes are so nearly allied to the fossil Eryonidæ (from the Solenhofener Schiefer), that it becomes doubtful whether a new genus is to be established for them at all. If, as lately has been maintained by Mr. Wood-Mason, these Crustacea have already been described by Heller under the name of *Polycheles*, from a specimen which was got in the Mediterranean near the coasts of Sicily, this will of course be the name to be adopted. I am unable for the present to compare Heller's figure with our specimens, and shall have to reconsider the question when working out the Crustacea of this expedition. There are some points in Heller's description which still make me doubtful about it; and in order not to confuse the matter more, we shall call these Crustacea *Willemoesia* until we return to Europe. Anyhow, it is very interesting that *cousins of the famous Jurassic Eryonidæ are still living in the great depths, where they are* (in the Pacific at least) *by no means rare.*

The two species found in the Atlantic are both blind: one of them, *Willemoesia leptodactyla*, has been only found in very great depths; the other one, *W. crucifer*, was brought up off St. Thomas (W. L.) from a depth of 450 fathoms. We shall below have to mention a third species, which we have very often got in the tropical parts of the Pacific.

Of Palinurids we got here only one form, a small species with eyes partly hidden under the rostrum, which I shall only describe after our return, as it might possibly be known already.

The anomurous Crustacea *Pagurus* and *Galathea* are very common in deep water, especially the former, which very often carries about a large *Polythoa*, which itself has nearly absorbed the calcareous substance of the shell on and in which both animals originally settled. The *Galathea* has been got with and without eggs; and it appears that one whitish species, which inhabits the great depths, is to be found in all the seas.

Brachyura were very rarely brought up; we had once, from 600 fathoms, a very large red crab, and from 1675 fathoms a blind spiny larva of a crab, which was in the *Megalopa*-stage, and is all the more

interesting as young stages of deep-sea animals do not often occur, owing to their small size, by which they escape through the net or are hopelessly lost in the mud.

We got once a *Lupea* and a *Gecarcinus* on the coast of Brazil from a depth of 350 fathoms; but these can scarcely be considered deep-sea animals. It is, however, remarkable to find that *Gecarcinus*, a genus which lives in holes on shore, should ever go for breeding-purposes to such a considerable depth as that, unless we here have a species before us which has taken to sea-life—a return to old habits which is neither known among the Telpusidæ nor the Gecarcinidæ, but which, of course, is not altogether out of question.

Naturalists who have dredged much in shallow water are accustomed to consider *Nymphon* as a form which lives above the bottom, climbing up into the *Fucus* and never burrowing into the mud like *Pycnogonum*, also to find the latter in greater depths than the former; at least these were my experiences on the northern coast. But in the deep sea just the reverse is the case; *Pycnogonum* is either very rare or altogether wanting there, while *Nymphon* and the allied genera *Zetes* &c. are pretty common, and evidently walking gravely with their long legs over the muddy bottom. In the Atlantic we got *Nymphon* from 1250 and *Zetes* from 350 and 1075 fathoms, none of them being particularly remarkable, either for size or any thing else. Some of the females had the well-known larval forms, which by Claparède and others have been sufficiently described.

Brachiopoda were on the whole scarce. We had once a very large *Waldheimia* with exceedingly small animal, which was got on our way from Gibraltar to Madeira from 390 fathoms, and several times some small Brachiopoda from 850 to 1000 fathoms, the genus of which was not determined.

Also Ascidians were by no means common. Though the true genus *Ascidia* (transparent Tunicata without a stalk, taken in the wider sense) does occur in great depths, I do not remember its having been found in the Atlantic, where only a very fine species of *Boltenia* was found near the coast of North America in 1700 fathoms.

The Lamellibranchiata and Gastropoda have been duly collected and preserved; but I am not able to say much about them. "Fine shells" there are scarcely any; if they come up at all, they are small and of ordinary appearance like *Arca*, *Nacera*, *Pleuronectia*, *Trochus*, *Fusus*, &c. *Dentalium*, about the most interesting of all of them, goes to great depths, and was, either alive or dead, nearly always found when great quantities of mud were brought up by the dredge.

Of Cephalopoda I find only an *Eledone* on my list, which, coming from 350 fathoms, belongs, however, to the shore-fauna of Brazil. All the other species of the Atlantic belong to its transparent surface-forms; and I am not quite sure whether *Cirroteuthis* is not the only Cephalopod

which goes to considerable depths. This one, however, was brought up only later.

Everybody who for some time has been in the habit of visiting the fish-markets of the Mediterranean knows how great a rarity the "grenadier-fish" (*Lepidoleprus* or *Macrurus*) is considered to be by the fishermen of those shores, and how little was known as to where those curious Scopelids *Sternoptyx*, *Chauliodus*, and others might live. The latter are washed on shore from time to time, and are sure to come into the hands of naturalists, as the fishermen know their value. In the Italian fish-markets they were all the more eagerly looked after, as Professor Leuckart had described in them a sort of sense-organs running along both sides of the body, which he considered, with some doubt, to be organs of sight. But the supply was scanty, and very few zoologists who paid a visit to these places were able to get them.

Now these riddles are solved; for we know that *Macrurus* is one of the commonest inhabitants of the depths, and that with them the *Sternoptychidæ* very generally come up. Like other deep-sea animals and those specimens which from time to time were washed on the shores of Italy and Madeira, we have also found them occasionally floating about on the surface of the sea; and one species, a small, elongate, blackish fish, at least seems to belong to the pelagic fauna; but the majority, especially *Sternoptyx* and *Chauliodus*, are so rarely got on the surface, and so constantly brought up from greater depths, that I must regard them as inhabitants of that zone.

One of the Scopelids which came up from great depths (1600 and 1900 fathoms) in the Atlantic is very peculiar for its blindness and its flattened head, on the top of which there is a peculiar sense-organ of a silvery colour, 10 millims. long and 9 millims. wide. I examined this organ at that time with a lens, and it seemed to me to consist of three layers:—1, a very thin transparent epidermis; 2, a layer of hexagonal small columns resembling in miniature the lateral electrical organs of a *Torpedo*; and 3, a silvery tapetum. Without giving any opinion about the nature of these peculiar organs, I should like to point out the analogy which seems to me to exist between them and those organs which Leydig has figured from the scales of certain Reptilia in Max Schultze's 'Archiv,' 1873.

This fish was afterwards also got in the Pacific.

Of the other inhabitants of the depths (the Ophidiids, Lophioids, &c.) I have little to say, especially as, after our leaving the Atlantic, these fish were preserved in the upper-deck laboratory, where I have only seen but never studied them.

Surface of the Atlantic.

Only a few of the Atlantic surface-animals have been worked out by me; and about them I shall say a few words when discussing their rela-

tions of the Pacific. I do not think it advisable to fill up this report with general remarks on a fauna which is so well known as the surface of the Atlantic.

The Islands of the Atlantic.

On our first visit to the Madeira fish-market we got a number of *Mora mediterranea* specimens, a fish which we had got a few days before in deep water. We also secured a fine *Beryx*, which, being one of the oldest genera of Acanthopterygians, is especially remarkable.

In St. Thomas we spent a few days after a four weeks' cruise, but did little in the way of collecting, except catching some fish in the trammel and some dredging. The Professor secured in this place a great number of Echinoderms.

Numerous excursions were made in Bermudas, partly inland, when I tried to catch as many insects as possible on the beach, where the shallow-water animals were secured by wading. Hungary Bay was my chief place of resort. Here the forest approaches the beach, and afforded opportunities for collecting of all kinds. There mangrove-trees were growing in large swamps, crowded with a *Grapsus* which ascended these trees; and under the stones which covered the muddy ground I found plenty of land-crabs belonging to different genera of the Telphusidæ. When looking for these I discovered a land-Nemertean, being the first one found in the western hemisphere (the only animal of this kind having been found by Semper in the Philippines). This species was described and figured in the 'Annals and Magazine of Natural History' for 1874 (xiii. p. 409), under the name *Tetrastemma agricola*.

In Bermudas we also made frequent excursions in the steam-launch, which enabled me to get specimens of a *Nebalia* which I had noticed before among Crustacea collected by Mr. Murray. This species (*N. longipes*), which I have worked out and described in the 'Transactions of the Linnean Society,' is remarkable in many ways, as its legs are far less "phyllopodal" than in the other species known before, and, as in the male of this American *Nebalia*, it is the first and not the second antenna (*N. Geoffroyi*) which has been enlarged and transformed into a prehensile organ.

In the Azores we had only a few days, and in Madeira there was no landing on account of the small-pox being there. Our next collecting-places were the Cape-Verd Islands, first St. Vincent and then St. Iago.

In the barren island of St. Vincent I made a trip into the mountains, and was very much struck by the utter barrenness of the place. *Cathartes peregrinatus*, crows, and a few small birds were the only living beings we saw flying about. Under stones we got some geckos (*Platydictylus*) and a *Lycosa*, and near a water-pool a few dragonflies were seen. These were, with the exception of a few beetles, the only animals which could be found, though we looked about a good deal.

In the mean time Mr. Moseley had found out that there were certain spots in the valleys where the tamarisks grew higher than in other places and in clusters, forming a small oasis in this desert place, and that these are the places round which the insects assemble in considerable numbers. Here a *Myrmeleon*-larva eagerly watches the ants, large colonies of which are to be found. Its imago was also found, folding its wings, when settling, like a *Perla*, and when flying very much resembling an *Agrion*, a genus which was not found in these places. Some Ichneumonids (especially a large black species with yellow antennæ) and many Diptera (especially an *Osmia*) are to be seen; and of Orthoptera there are small and large *Acridia* and a *Gryllus* burrowing under the stones. Of Coleoptera we got perhaps fifteen to twenty species, most of which belong to Melasomata, a family which is so characteristic of all the countries surrounding the Mediterranean. On dead corpses of donkeys, goats, &c., which the inhabitants leave on the spot where they die, one might find a *Silpha*, on sunny places fine species of *Cicindela*, and on the leaves of the tamarisks Coccinellidæ are not uncommon. Hemiptera were scarce, only one *Cimex* having been found; and so were Lepidoptera, both perhaps partly because the season was not propitious. Myriapoda were represented by a large *Scolopendra* and a *Geophilus*.

The Araneidæ are comparatively very abundant (no Scorpions found), a magnificent large yellow species of *Epeira* extending its net between the branches of the tamarisks, and a yellow crab spider, as well as a *Salticus*, living commonly on the ground. Under small labiaceous plants a very fine green spider, not unlike a *Theridium*, occurs, numerous specimens of which will be found in our bottle. It makes an irregular web in the middle of the shrub, and comes out only when you lift the plant and shake it, then running away with the utmost speed.

On the beach two Crustacea are to be found; both are rather interesting. One of them is a *Remipes*, which may be seen half-burrowed in the sand, only its head sticking out and watching for its prey. The boys in the place catch it by throwing a piece of meat on the ground immediately after the waves have gone back, when the *Remipes* will come out and try to seize it. The other crustacean, which makes holes on the beach in the dry sand, is *Ocyropa ippeus*, known from Egypt, Syria, and these islands. It is one of the species which have the eyes on the sides of the stalk, which itself surpasses the eye in length, and is terminated by a tuft of hairs. On the rocks of the beach a *Grapsus* is very common, hiding itself everywhere in the holes between them; and at low water *Palaemon*, *Pagurus*, *Eunice*, *Aplysia*, and many shells were easily picked up. A large *Calappa* was caught in the trammel, together with a *Scarus*, *Dactylopterus*, and a fine specimen of *Zygæna malleus*, caught by Mr. Balfour.

In St. Iago I frequently visited the palm-groves close to the town, where I caught many insects and watched the land-crabs (Gecarcinidæ),

which had undermined the whole of the place with large holes. In the evening one of them, a *Cardisoma*, was caught by the seeking party, and on closer inspection was found to have eggs and young ones just come out of them under its abdomen. This was of considerable interest, because we knew that the West-Indian *Gecarcinus* undergoes no metamorphosis, but that another species was said to do so by V. Thompson, who had seen dead *Zoëas* in its eggs. This *Zoëa*, however, had not been drawn (as far as could be made out), and the whole thing had been doubted, according to statements given by Fritz Müller. We were therefore very much satisfied not only by ascertaining that the young ones also of this species were *Zoëas*, but by being able to make an accurate sketch of those which had already left the egg. No doubt these would have left the mother on her nocturnal excursions to the sea, and undergone there the ordinary metamorphoses.

On the 28th of August we landed on the rocks of St. Paul, where nobody is known to have made collections since Darwin's well-known visit to the place. On the barren rocks there are hardly any insects to be found, and nearly all there is of animal life is more or less dependent on the bodies or nests of the two birds which cover these rocks, *Anous stolidus* and *Sula fusca*. These nests were carefully searched not only in the island, but also afterwards in the laboratory, where I had taken a box full of them in order to secure as many specimens of the insects as possible. The following animals were thus procured:—(1) a *Chelifer*, several specimens from the nest of *Anous stolidus* (the best places to find our European *Chelifer* are the nests of *Hirundo urbica*); (2) three species of spiders; (3) a tick, very common; (4) a small dipter; (5) pupæ of *Olfersia*, the pupiparous parasitical fly; (6) a microlepidopter; (7) a lepidopterous larva.

Darwin does not mention the *Chelifer* in his list, but has, on the other hand, a *Quedius* (beetle) and a wood-louse, which I have not been able to find.

All over the island a large *Grapsus* is very common, preying on the eggs and young ones of the birds. In pools large black *Actinie* may be seen, and many small fish which come and go by high water. In the lobster-pots we got several small specimens of a *Palinurus*.

On the main island of Fernando Noronha we only took a short walk, as we then thought, in order to look over the place and see where collecting might be most profitably done, but, as it proved afterwards, never to return. Large quantities of pigeons were seen in the woods, lizards in quantities everywhere (*Euprepes punctatus*), and under the stones a small *Gryllus* was to be seen by thousands. Besides these I only noticed a centipede.

On the second day we paid, with Captain Nares, a visit to Mount St. Michael, Rat Island, and Platform Island. The rather steep rocks of the former are the resting- and breeding-places of *Anous stolidus*, *Sula*

fusca, *Tachypterus aquila*, and *Phœnicurus æthereus*, great numbers of which may be seen flying about.

Among the creepers which cover the stony ground I found several green *Cicadae*, a *Locusta*, and very large yellow spiders, which are also very common on the mainland.

On the beach I found a large *Nerita* and the *Grapsus* (c. f. *strigosus*) from the rocks of St. Paul.

Rat Island.—Among the white *Convolvulus* we saw and caught some specimens of a *Polygonmatus*, the only butterfly which was seen, with the exception of a few small Microlepidoptera. Pigeons are common here.

Platform Island.—The rocks on the beach are covered with a small *Mytilus*; and among these mussels specimens of a *Patella* were found.

In each island our stay was extremely short. Every thing, however, that came in our way was eagerly collected; nevertheless the result will not give an idea of the Fernando fauna, as no collecting could be done on the mainland.

15th October, 1873.—Landed on the lower ground of Tristan d'Acunha, and remained six hours on shore collecting every thing I could find. On the beach I saw underneath the seaweeds many Diptera, all of one species, and under the stones *Oniscus*, *Iulus*, and a *Lumbricus*. Besides these there was a small *Scolopendra*, but scarcer than the former. Here I also found a small *Limax* in great quantities, which was just laying eggs (the corresponding species in northern Europe does so in April). In a pool near the beach, the water of which was brackish, I saw a small whitish Oligochaet.

Of land-mollusca I found a small species resembling in shape our genus *Zonites*, and secured a good many specimens of them.

Several small spiders were gathered among the grasses and under stones.

Proceeding then towards the settlement, I examined in many places the dung of cows and sheep, but could find no trace of the *Aphodii*, *Geotrupes*, and other beetles which, with us, are invariably to be found underneath it. All I got was a small *Staphylinus*. Going into the houses, and asking for any objects of natural history which might have been collected and kept by the inhabitants, I got quantities of a *Buccinum* found on the beach, with *Patella*, *Chiton*, and others, also a dried sea-urchin and a living *Procellaria glacialisoides*. This bird, which is common on the antarctic coast of South America, seems to be unknown to the fishermen of Tristan. Of course we also made inquiries about the butterflies, none of which had been seen flying about, asking especially if they had not a dried specimen of them in a book or on a pin. They, however, had none, said it was not the proper time of the year for it, and described it minutely—very likely *Vanessa urticae*, a species common all over the world.

There are no wild mammals on the island except rats and mice, no

reptiles, and no amphibia. Of the three species of land-birds we only saw the Thrush (*Nesocichla eremita*, Gould), which seems to be common and very tame into all the three islands of the group. The yellow *Emberiza brasiliensis*, so common in the other islands, seems to have become extinct in Tristan Island, or never to have been there; for the two destitute Germans on Inaccessible Island told me that the Tristan people had tried to introduce the bird into their island, but they did not know whether they had succeeded. *Gallinula nesiotis* is still to be found high up in the hills. Several specimens of it had been sent to Capetown, and one of them had been sold last year to a merchant-ship.

16th October.—Landed in the morning on the lower ground of Inaccessible Island, and collected a good deal among the *Phyllica*-shrubberies on the small hill. Here we got several *Curculiones*, an Hemipter, a moth, and many caterpillars, besides the insects already mentioned from Tristan Island. The two Germans gave me their popular names for the butterflies, of which they distinguish two species (a "Fuchs" and a "Perlmutterfalter"—*Vanessa* and *Argynnis*).

In the pond at the foot of the waterfall we got several specimens of an *Hydrobius*.

The *Nesocichla* and *Emberiza* were very common. Of *Nesiotis*, which the Germans declared to be a smaller bird than the Tristan one (?), some pairs had been seen previously on the lower ground, but they were commoner on the top of the hills.

17th October.—Collected some beetles and other animals among the *Phyllica* trees and on the corpses of dead puffins, as well as in the nests of the albatrosses. *Nesocichla* and *Emberiza* were very common; no *Nesiotis* was seen.

List of the land-animals collected in the Tristan d'Acunha group.

AVES.—1. *Nesocichla eremita*, all three islands; 2. *Emberiza brasiliensis*, Inaccessible and Nightingale Islands.

MOLLUSCA.—1. *C. f. Zonites*; 2. *Pupa*; 3. *Limax*.

ARACHNIDA.—1. *Drassus*, sp.?, common in Tristan Island, rarer in Inaccessible Island, not seen in Nightingale Island; 2. Several other small spiders; 3. A tick, parasitic on *Diomedea chlororhynchus*.

MYRIAPODA.—1. *Iulus*, common everywhere; 2. *Scolopendra*, common everywhere.

COLEOPTERA.—1. *Curculio*, three to four species in all the islands; 2. *Staphylinus*, everywhere; 3. Small black Chrysomelid; 4. *Hydrobius*, Inaccessible Island.

HEMIPTERA.—1. Cimicid, Inaccessible Island; 2. Small *Cicada*, Nightingale Island.

LEPIDOPTERA.—1. *Noctua*, Nightingale Island; 2. Microlepidopter, from Inaccessible Island; 3. Caterpillars, Inaccessible Island.

DIPTERA.—1. Muscid, everywhere; 2. *Pulex*, parasitic in the nests of *Diomedea* and *Eudyptes*.

PODURIDÆ.—*Thysanura*, on a dead puffin.

CRUSTACEA.—1. *Oniscus*, everywhere under stones; 2. *Gammarus*, everywhere under stones.

OLIGOCILATÆ.—*Lumbricus*, everywhere under stones.

V. "Preliminary Report to Professor WYVILLE THOMSON, F.R.S., Director of the Civilian Scientific Staff, on Crustacea observed during the cruise of H.M.S. 'Challenger' in the Southern Sea." By the late Dr. RUDOLF VON WILLEMÖES-SUHM, Naturalist to the Expedition. (Published by permission of the Lords of the Admiralty.) Received February 14, 1876. Read March 16.

In the following paper it is intended to give a short account of the Crustacea found at the bottom as well as on the surface of the sea during the antarctic cruise of H.M.S. 'Challenger.' Our expedition, as is probably well-known to most readers, left the Cape on December 17, proceeded towards the Prince-Edward Islands, and landed on one of them. Between these islands and the Crozets, on which landing was impossible, we had several successful deep-sea dredgings. From the Crozets we sailed to Kerguelen, where we stayed nearly a month, and where a great deal of shallow-water dredging was done. Proceeding from this large island to the south, we penetrated beyond the antarctic circle, and had four successful deep-sea dredgings near the ice-barrier. On our way to Australia we were able to trawl five times.

The surface animals were generally collected by the towing-net at every station by lowering the net to a depth of 50-100 fathoms, where, as experience has shown us, nearly the same quantity of animals are found during the day which at night are to be got from the very surface. In fine nights, when the ship was gliding very slowly through the water, the net was of course always put out, and its contents were carefully preserved; but during our antarctic cruise such nights were rare, so that in most cases we had to lower the net in the daytime, during the manipulations of dredging and sounding.

In shallow water near the shores of the antarctic islands we found scarcely any of the higher Crustacea. Only on the north coast of Marion Island (Prince-Edward group, the northernmost of the islands which we visited) a small Caridid shrimp was got in considerable numbers. Besides there was a *Serolis*, different from the only species which we had met with (in 700 fathoms off the coast of Brazil). On the south coast of Prince-Edward Island there were no Decapods at all in a similar depth, only *Serolis* came up in the dredge. Near the same place, however, we