CHAPTER V.

Bermuda to the Azores—The Ophiuroidea—The Azores—The Azores to Madeira—Madeira to the Cape Verde Islands —Saint Vincent and San Iago.

Bermuda to the Azores.

The second visit of the Challenger to Bermuda lasted from the 31st May till the 13th June, and during this time as well as during the visit in April, the Members of the Expedition were hospitably received by the Governor, Sir Henry Lefroy, the naval and military officers stationed on the island, and the inhabitants; every one being interested in the objects of the Expedition, and anxious to render assistance.

The ship left Bermuda for the Azores at 6 A.M. on the 13th June, obtaining the usual observations on the passage across, and maintaining as nearly as practicable the great circle route. On the 1st July at daylight the summit of Pico Island was seen, and at 9 A.M. Fayal. At 4.45 P.M. the ship anchored in Horta Bay.

On this section sixteen soundings, twelve serial temperature soundings, two dredgings, and seven trawlings were obtained (see Sheet 6).

The wind during the passage was from the southward nearly the whole time, with moderately smooth water, and on no occasion did it exceed a force of 7. The weather was on the whole fine, with occasional passing showers; but the atmosphere was very damp and oppressive, the mean daily relative humidity being seldom under 95.

No accident occurred either in taking soundings or temperatures, nor was any dredging rope lost, but the trawl came up fouled twice. On the 16th June, at Station 60, the trawl had evidently not reached the bottom, as it had no mud in the cod or on the leaden weights attached to the trawl irons; and on the 27th, at Station 71, the trawl-net and 25 fathoms of rope were twisted round the beam when it arrived at the surface.

The soundings in this section show that all indications of the existence of the Bermuda peak cease in a northeasterly direction at a distance of 90 miles from its summit; that the Azores stand on a bank which rises gradually, though not uniformly, from the bed of the ocean, at a distance of 500 miles from Fayal; and that between the bases of the Bermuda and Azores elevations the bottom is fairly level, the mean depth being 2700 fathoms (see Diagram 3).

The temperature of the water at the bottom was again remarkably uniform, when the depth exceeded 1800 fathoms, the mean result being 36°·3 and the extremes 36°·5 and 36°·2, or a range of merely 0°·3.

The mean temperature of the surface water was 74° at Bermuda, decreasing gradually to 69° at the Azores.

The serial temperature soundings showed that the isotherm of 40° was at a uniform depth of 700 fathoms for 600 miles from Bermuda, when it gradually descended to 900 fathoms at 900 miles from Bermuda, and again rose to 700 fathoms 1200 miles from Bermuda, remaining at or about that depth until within 300 miles of Fayal, after which it again descended to 900 fathoms, thus the mean depth occupied by the isotherm of 40° in this section was 750 fathoms, and the range 210 fathoms, viz., from 690 to 900 fathoms from the surface. The isotherm of 60° occupied an average depth of 300 fathoms for 1200 miles east of Bermuda, or to within 600 miles of Fayal, ranging 70 fathoms, or from 260 to 330 fathoms; it then rose gradually to a depth of 50 fathoms 300 miles west of Fayal, and continued at or near that depth for the remaining portion of the section. The temperature of the space enclosed between the isotherms of 40° and 60° calls for no special remark, as the alteration was gradual between those isotherms. The isotherm of 65° was at a depth of 100 fathoms at Bermuda where the surface temperature was 74°, and gradually rose to 20 fathoms at the Azores where the surface temperature was 69°; its position, therefore, may be assumed to depend immediately on the surface temperature (see Diagram 3).

On the 19th, at Station 63, the surface current was tried by attaching a buoy to the sounding line before heaving in, but no appreciable movement of the water could be detected. On the 26th, at Station 70, a buoy was anchored with a valve lead of 168 lbs., and here again no appreciable movement of the surface water could be detected. Subsequently the current drag was lowered successively to depths of 50, 100, 200, and 300 fathoms; no movement of the water was apparent at any of these depths. On the 27th, at Station 71, a buoy was again anchored by a weight at the bottom, and the surface current was found running to the southwards at a rate of 0·7 mile per hour. The current drag at 50 fathoms indicated a set S. 59° E. at the rate of 0·4 mile per hour, and at 100 fathoms N. 82° E. at the rate of 0·25 mile per hour. These results were obtained between 9 and 10 A.M. Subsequently, for convenience in obtaining temperatures and other purposes, a boat was anchored by the trawl, and it was noticed that at 6 P.M., when the ship took the trawl rope from the boat, that there was no perceptible surface current. This would seem to indicate that the result obtained between 9 and 10 A.M. was due to tidal movement. On the 28th, at Station 72, the surface current appeared to be going to the southward whilst sounding was in progress, but no direct observations were made.

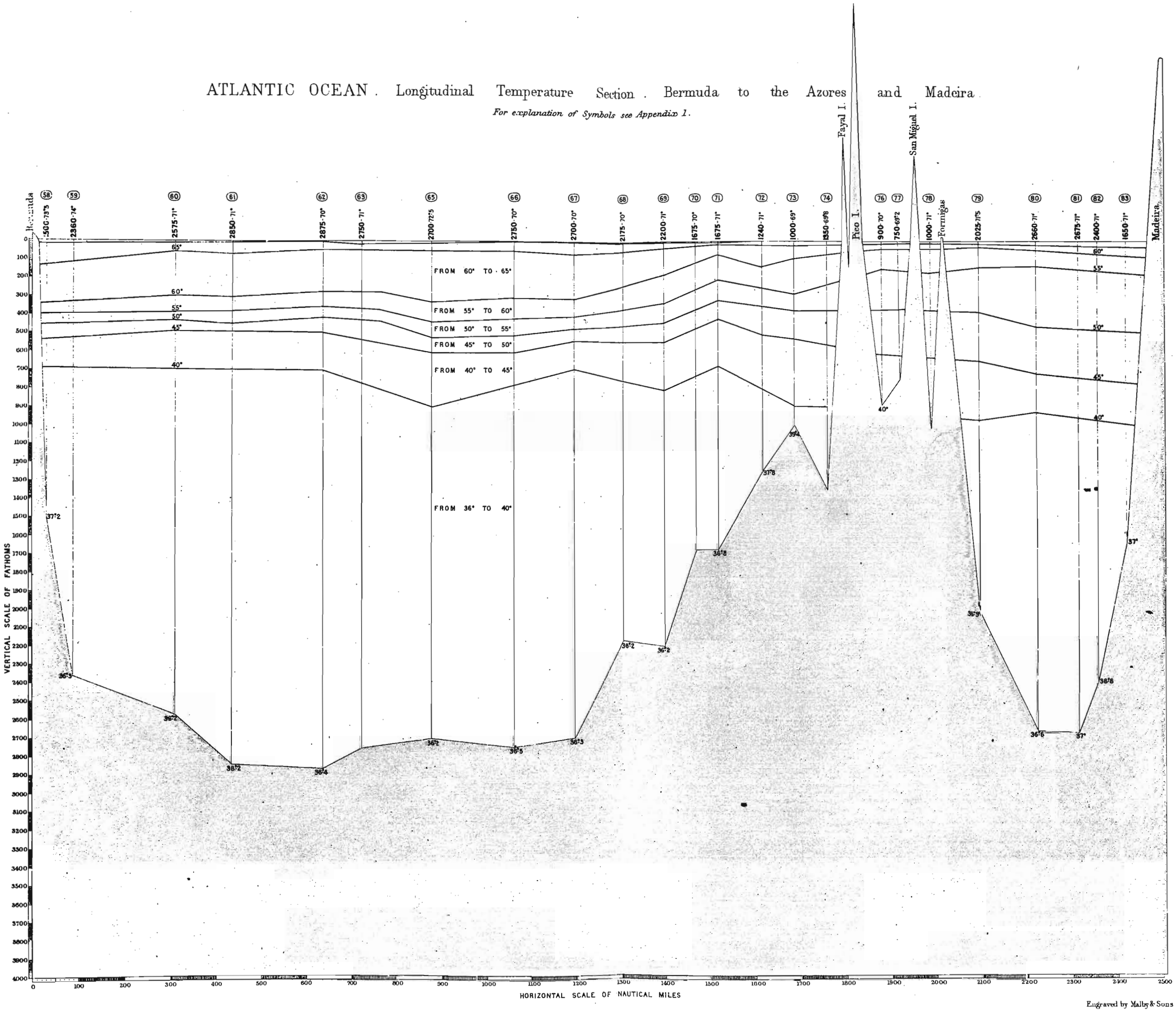
On the 18th, at Station 62, the anemometer showed the velocity of the wind to be 18 miles per hour between 3 and 6 P.M., the force registered being 4 to 5. On the 22nd, at Station 66, the velocity was 20 miles per hour from 4.30 P.M. to 6.30 P.M., and the force was registered as 6.

With the exception of the deposit from 2700 fathoms on the 23rd, which contained 54 per cent. of carbonate of lime, all the deposits in this section from depths greater

DIAGRAM 3

ATLANTIC OCEAN. Longitudinal Temperature Section. Bermuda to the Azores and Madeira.

For explanation of Symbols see Appendix 1.



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than 2400 fathoms contained less, and those from depths less than 2400 fathoms contained more, than 50 per cent. of carbonate of lime, the highest percentage being 88·30 in 1675 fathoms. In the greatest depths, 2850 and 2875 fathoms, there were only 8 and 10 per cent. In the greater depths the lime consisted chiefly of fragments of pelagic Foraminifera and Coccoliths; in depths less than 1600 fathoms, the shells of pelagic Molluscs and fragments of Echinoderms were more or less abundant, and along with pelagic and other Foraminifera made up the principal part of the carbonate of lime in the deposits. Radiolarians and Sponge spicules sometimes made up 3 or 4 per cent. of the deposit.

In the deep water, immediately to the south of the banks of Newfoundland, there were fragments of quartz, monoclinic and triclinic felspars, and fragments of mica-schist and other ancient continental rocks. These were believed to be ice-borne fragments, although apparently south of the southern limit of the ice region in the North Atlantic as shown on the charts. On approaching the Azores these fragments disappeared completely from the bottom, and the mineral fragments then consisted almost entirely of volcanic minerals and pumice. Except the pumice, the mineral particles seldom exceeded 0·25 mm. in diameter, and generally they were much smaller. A few fragments of tufa coated with peroxide of manganese were dredged.

Boats were several times lowered for the use of the Naturalists. On the 26th a small Hawksbill Turtle (*Eretmochelys imbricata*) covered with barnacles and small crabs, was captured; its stomach was filled with Vellelas. A large box was observed, a few days later, and on being hoisted on board, was found to contain decaying salt meat. It was covered with Barnacles (*Lepas anatifera*) and surrounded by fish, the attempts to capture which were unsuccessful. Very little Gulf Weed was met with during the passage but some pieces of *Fucus vesiculosus* were picked up, to which were attached several specimens of *Scyllæa pelagica*. *Nautilograpsus minutus* was observed resting on every floating thing; many were found on *Ianthina* shells, and it was curious to observe that several of them had a distinctly blue tinge in imitation of the colour of these shells. Dr. v. Willemoes Suhm writes in his journal:—"*Nautilograpsus minutus*, the small crab found in all the oceans clinging to gulf weed, logs, or animals larger than itself, was obtained to-day (21st) resting on *Ianthina*. Closer examination showed that it was covered with small brown spots, which proved to be little parasitic Nemertines. This is the first known example of a Nemertine living as a parasite. The worm, a small ordinary Tremacephalid, presents no modification induced by parasitism; it appears to be a new species, and from its colour may be called *Tetrastemma fuscum*. In accordance with the character of the genus, it has two large eyes, and two very small ones, one on each side of the proboscis. The ganglia are especially large and conspicuous, and send out two nervous branches running along the sides of the body. The proboscis is very short, and distinguished from all other species I know of by having the stylet-sac placed close

behind the ganglia and just above the mouth, which, semicircular as usual, leads into a folded intestine terminated by an anus. Length 0·75 mm., breadth 0·25 mm."

On the 25th a very large colony of a new species of *Pyrosoma* was captured in the trawl; the cylinder was 4 feet 2 inches in length, and 10 inches in diameter, closed at one end, and, as in the smaller forms, the colony was spotted with red, the red spots being the visceral nuclei of the several animals. The specimen was kept in a tub of water till after dark, when it gave off brilliant phosphorescent light on being disturbed. The

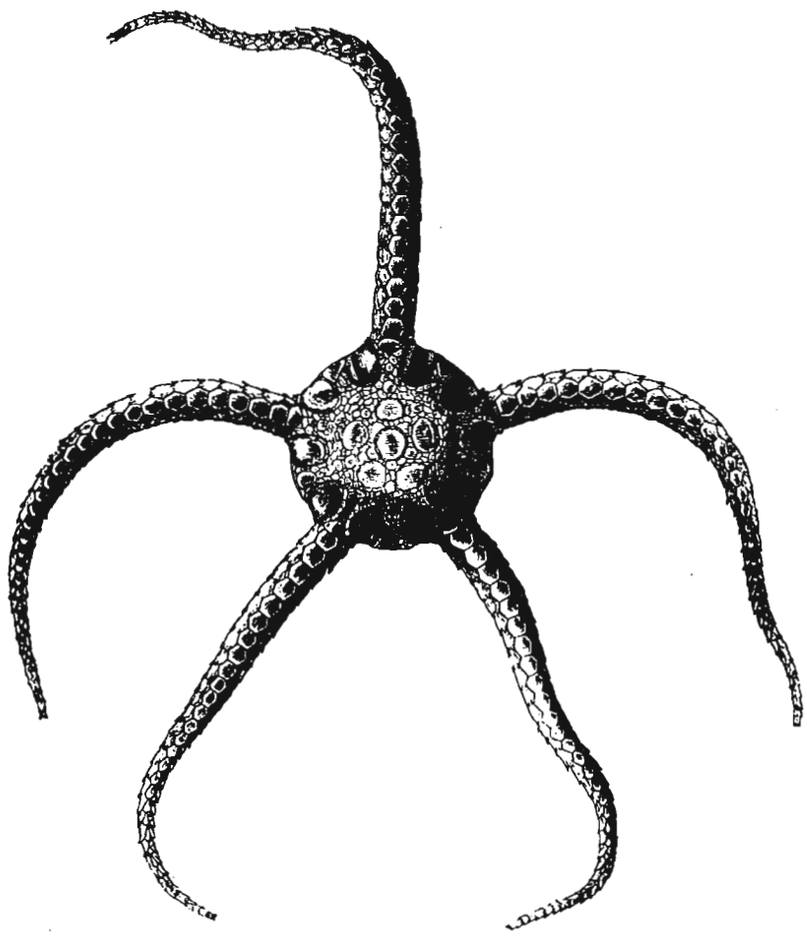


FIG. 69.—*Ophioglypha bullata*, Wyv. Thoms. Dorsal aspect; three times the natural size.

officers amused themselves by writing their names along this living cylinder with one finger, the track of which remained as a bright line of light for some seconds. *Salpæ* were the commonest animals in the surface waters; there were several kinds, and many long bands of them in the chain form were taken in the surface nets. Brilliant phosphorescence was observed at night during calm weather, and the following are some of the animals taken near the surface on these occasions:—Foraminifera, Radiolarians, *Gleba*, *Diphyes* and other Siphonophora, Medusæ, *Sagitta*, *Alciope*, Cypris-larvæ of

Cirripeds, *Hyperia*, *Phronima*, *Oxycephalus*, *Rhabdosoma*, *Mysis*, *Leucifer*, *Diacria*, *Styliola*, *Cleodora*, *Ianthina*, *Atlanta*, *Salpa*. Although pelagic Molluscs were very abundant in the surface water on that part of the section where the greatest depths were found, not a trace of their shells was found in the deposits at the bottom.

A Stormy Petrel was frequently seen following the ship, but no other sea birds were noticed till the Azores were neared.

The trawl brought up from 2850 fathoms several specimens of *Ophioglypha bullata*, two very small siliceous Sponges, two large reddish Holothurians, six specimens of *Scalpellum regium*, a few worm tubes, and a fragment of a crab. A trawl and a dredge

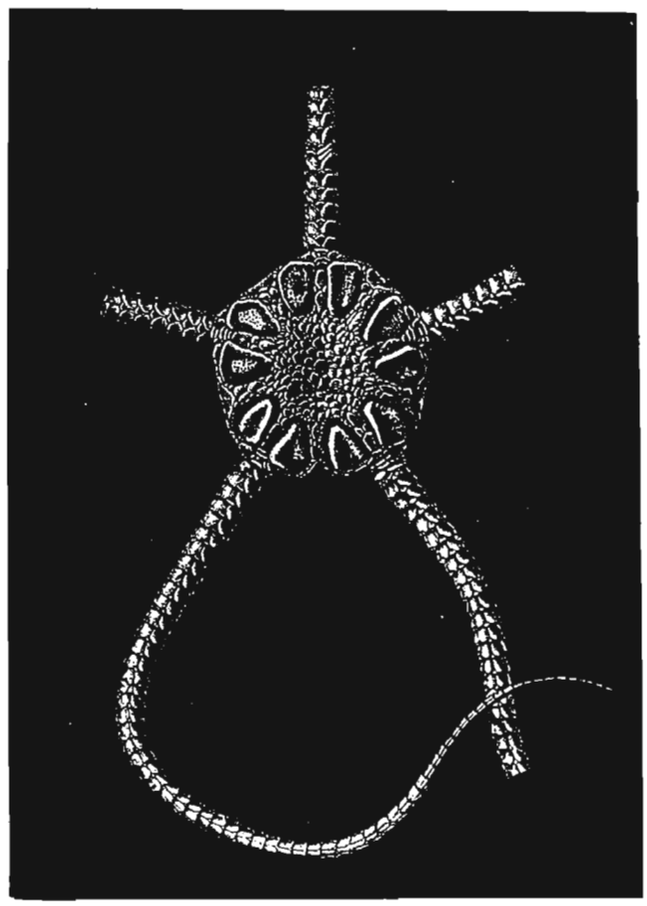


FIG. 70.—*Ophiomusium lymani*, Wyv. Thoms. Dorsal surface; natural size.

procured from 2750 fathoms, one specimen of a new genus of deep-sea fishes, *Bathyophis ferox*, Gün., and a new species, *Halosaurus rostratus*, Gün., three specimens of *Scalpellum regium*, three Annelids, one or two Annelid tubes, three Actiniaria belonging to two species, *Ophioglypha bullata*, small pieces of a Hydro-Medusoid stock on the *Scalpellum*, a Polyzoon (*Farciminaria delicatissima*, Busk), and a Priapulid. There were small Nematodes in the body wall of one of the Actiniaria. It is of course impos-

sible to say from what depth the fishes came. In the shallower dredgings, from 2175 to 1000 fathoms, on the edge of the Azores plateau, a larger number of species and individuals were found than in the deeper water, nearly all groups being represented.

The Ophiuroidea.—The Challenger collection of Ophiurans has been carefully examined and described by Mr. Theodore Lyman, who furnishes the following résumé of his Report:[1]—"In no group, perhaps, was our knowledge more extended by the explorations of the Challenger than in that of the Ophiuroidea. The number of known living species was increased from 380 to about 550, or nearly by one half, while the corresponding increase of novel groups is indicated by the addition of twenty genera. By far the

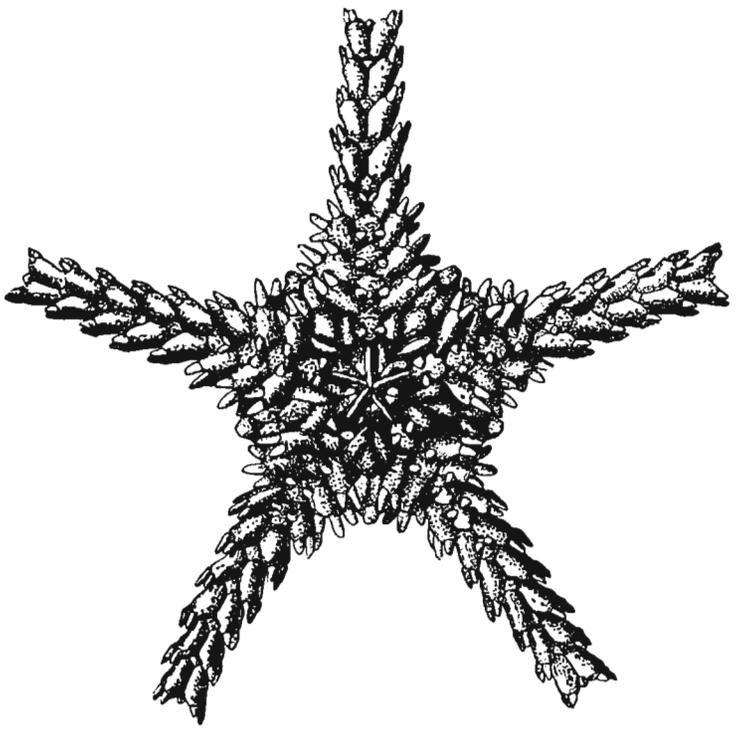


FIG. 71.—*Ophiomusium pulchellum*, Wyv. Thoms. Oral aspect of the disk; seven times the natural size.

greater number of new species are of the deep-sea fauna; that is to say, they occur below the 100 fathom line, so that this Expedition has furnished the first opportunity of comparing the littoral and the deep faunæ over a wide extent of the oceans of the world. The result is that these Echinoderms are found to be animals which live very much in defiance of temperature, light, and water pressure. Something other than environment has determined their growth; or rather, their growth is not affected by an important part of their environment. To be sure there are some genera which are confined to the profound region of cold, darkness, and crushing weight; such are *Ophiotrochus*, *Ophioplinthus*, and *Ophiernus;* but there are others, for example *Amphiura* and *Ophiacantha*, which are

[1] Zool. Chall. Exp., part xiv., 1882.

found from the littoral zone down to the lowest points reached by the dredge. In the different zones these genera may present modifications; for instance, the *Amphiuræ*, below 1000 fathoms, often have more numerous mouth papillæ, and the corresponding *Ophioglyphæ* usually have swollen arm-plates and a microscopically tuberculous surface. Such structural features, however, plainly have no connection with the conditions of life, nor have they any relation to the survival of specially favoured forms. From a depth of over 1500 fathoms are found the strongly armoured *Ophiomusium pulchellum* (see fig. 71), the delicate *Amphilepis*, and the *Ophiomitra chelys* (see fig. 72), with its thorny spines and soft disk. At that great depth the peculiar conditions, apparently so unfavourable to a rich and varied growth, have not checked the development of widely differing forms.

"While, however, the Ophiuroidea yield little to the dictation of light, heat, or water pressure, they show well-marked laws of growth. Certain genera take the lead, like the larger clans of a barbarous nation. The collections of the Challenger, when combined with those of the "Blake," show that the four genera *Ophioglypha*, *Amphiura*, *Ophiacantha*, and *Ophiothrix* contain more than two-fifths of the known species. There is a tendency also to elaboration and variety in structure. The naked and embryonic genera, like *Ophiomyxa* and *Ophiogeron*, have few representatives; while the finely constructed *Ophioglypha* has many species, and even the highest group, composed of the closely allied *Ophiura*, *Pectinura*, and *Ophiopeza*, is pretty strong in numbers.

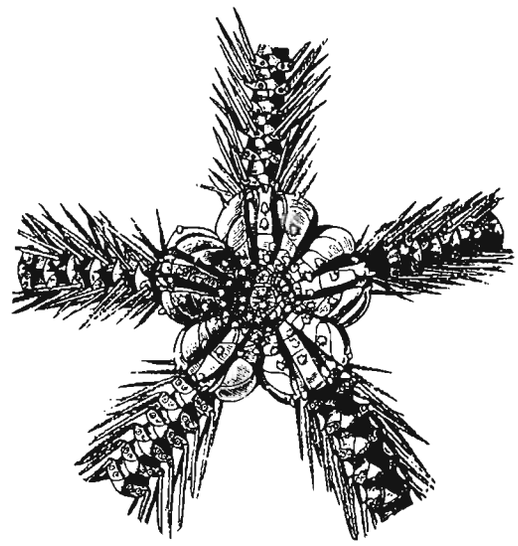


FIG. 72.—*Ophiomitra chelys* (Wyv. Thoms.). Dorsal aspect of the disk; four times the natural size.

"The dredgings of the Challenger have further taught us that we must not look exclusively in the abysses for surprising shapes, or for those that connect us closely with geological times. If the singular *Ophiotholia* (see fig. 73) must be sought in 1800 fathoms, its relative *Ophiohelus* may be found in less than 100 fathoms; and if *Ophiomastus* from the deep sea brings to mind the extinct *Aspidura*, *Pectinura* of the littoral zone recalls the so-called *Ophiura* of the Oolite. Nor must we forget that the extraordinary *Astrophiura*[1], apparently intermediate between the Brittle-stars and the Starfishes, lives in shallow water."

The "singular *Ophiotholia*," above referred to, was discovered by Mr. Murray in the

[1] Sladen, On the structure of Astrophiura, a new and aberrant genus of Echinodermata, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. iv. pp. 401–415, 1879.

contents of a tow-net attached at the weights in front of the trawl, and was mounted on a glass slide as a microscopic preparation. As the specimen shows a structural feature unknown till that time among Echinodermata, the following details from Mr. Lyman's paper[1] will be interesting :—

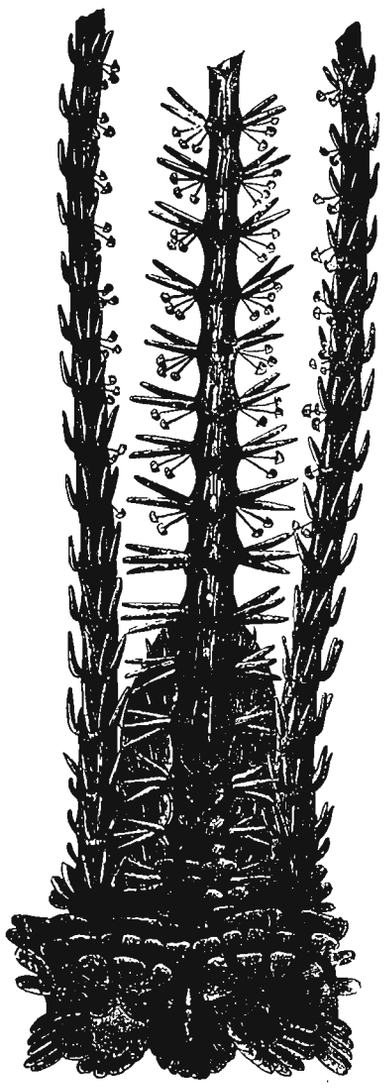


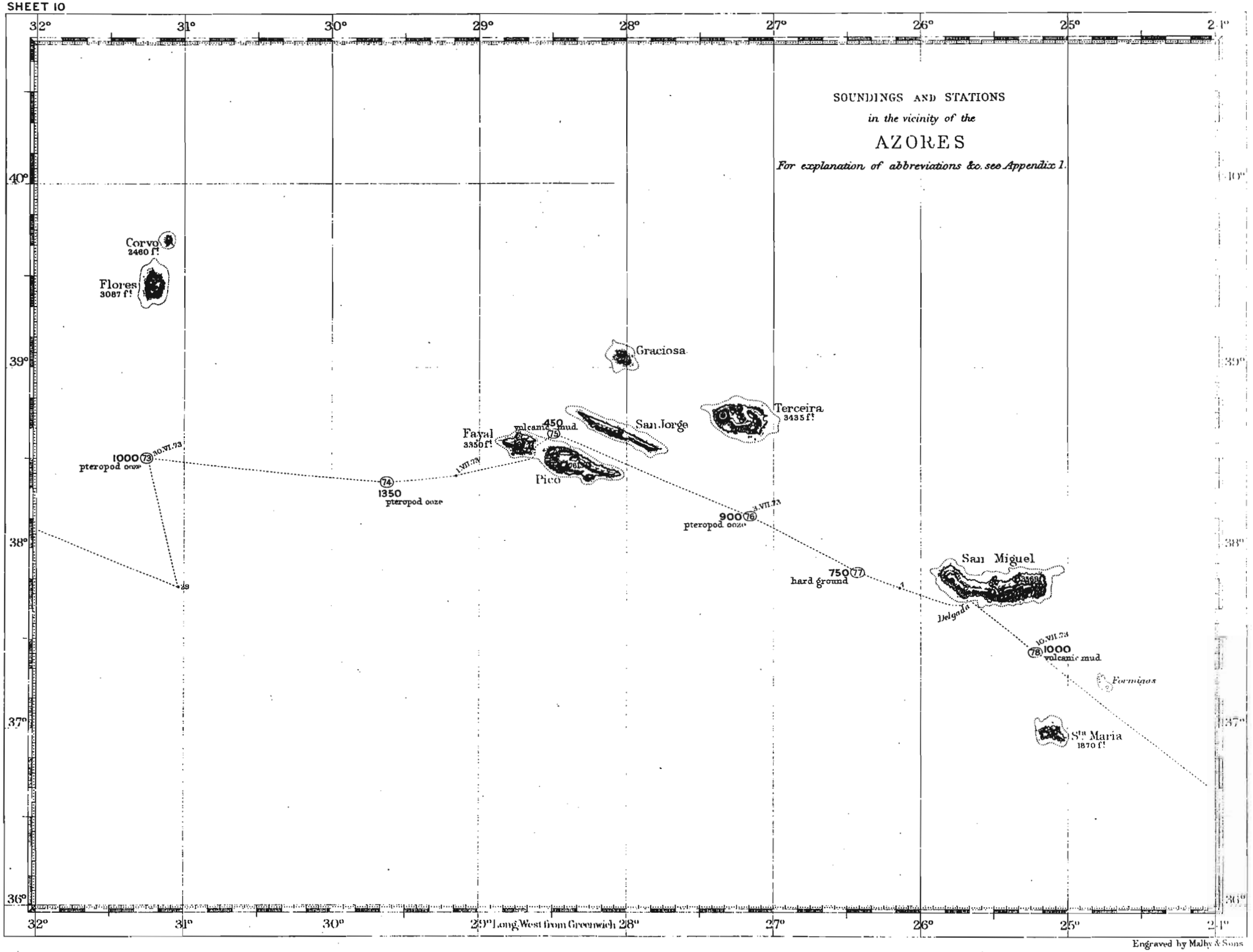
FIG. 73.—*Ophiotholia* " *supplicans*, Lym. The entire animal, ten times the natural size, seen in profile, with its arms and disk stretched upward, and its mouth angles turned downward and outward, and armed with their mouth papillæ like those of *Ophiomyces*. On the outer arm joints are the small parasol spines. Station 296, November 9, 1875, southwest of Juan Fernandez, lat. 38° 6′ S., long. 88° 2′ W.; 1825 fathoms.

"Long after the main collection of the Challenger Expedition had arrived, there were sent me several glass slides containing additional specimens of Ophiuridæ. One of these, hastily examined with a weak lens, I labelled *Ophiomyces*, and set aside for further study. In the very last cast made by Mr. Alexander Agassiz, during the "Blake" Expedition of 1878–79, near the Barbados, and in 82 fathoms, there came up a small soft Ophiuran, which seemed, under the microscope, to have little tufts resembling bunches of simple hydroids on the sides of the arms. More careful search, with a higher power, showed that these were bunches of minute spines, each enclosed in a thick skin-bag, and that they had a most extraordinary form, resembling long-stemmed agarics, or parasols with small shades. On going back to the Challenger *Ophiomyces*, this too exhibited the same spines, and a third species, also brought back by the Challenger, was found with similar appendages. Their form, however, was not the most curious thing. It was by their arrangement in two, or even three, parallel vertical rows, that they wholly differed from all Ophiuridæ hitherto known. For, with all the variety exhibited by the hundreds of living species, there is not one that departs from the unvarying single row of articulated spines. Not even the double rows of hook-bearing grains among the Astrophytidæ would be homologous, because these grains are not attached to the side arm-plates. In one species, these parasol-spines stood side by side with the normal arm-spines (*Ophiotholia*), while in the two others (*Ophiohelus*), they took the place of the normal spines. Among known Echinodermata I have been able to find only a single instance of a somewhat similar spine, or pedicellaria. This is in *Aceste bellidifera*, Wyv. Thoms.[2] The question whether these novel shapes are spines or pedicellariæ is not a

[1] A Structural Feature, hitherto unknown among Echinodermata, found in Deep-sea Ophiurans, *Boston Soc. Nat. Hist.* (Anniversary Memoirs), 1880.

[2] Agassiz, Zool. Chall. Exp., part ix., pl. xl. fig. 66, 1881.

SHEET 10



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very important one, since a pedicellaria is only a spine peculiarly modified. But it may be said that their supplementary character and abnormal shape give these parasol spines the position of what used to be carefully distinguished as pedicellariæ.

"*Ophiotholia* is indeed an *Ophiomyces* with this peculiar character, while *Ophiohelus* is an allied but distinct form. Both may be considered low genera, with elaborate appendages. The want of radial shields and imperfect calcification suggest their position, which is confirmed by the embryonic character of their arm-bones, which are longitudinally divided into the two halves they theoretically should have. These bones are so large and independent, even close to the tip of the arm, that it is not easy to understand how they can be spurs of the small side arm-plates, as they should be according to one theory. Unfortunately I could nowhere find a terminal joint, which would have shown how the arm-bones take their rise.

"These soft little creatures illustrate how small an influence certain kinds of the notorious 'environment' have in determining structure. Of the two species of this abnormal *Ophiohelus*, one comes from 82 fathoms, near the Barbados, and the other from 1350 fathoms, near the Fiji Islands. When we consider the differences of locality, light, pressure, and temperature (differences which are supposed to create varieties, or species so called), between these two Stations, we may well be a little sceptical as to the potency of such environment.

"These genera stand quite apart from others of the family, and call for diligent renewal of the endless search after those constantly increasing missing links."

The Azores.

The ship only remained at the anchorage in Horta Bay, Fayal, from 4.45 P.M. on the 1st July till 11 A.M. on the 2nd, as, in consequence of small-pox being prevalent in the port, it was deemed advisable not to prolong the visit.

The Naturalists made short visits to the shore in the evening of the 1st and morning of the 2nd July. Horta is beautifully situated in a nook surrounded by volcanic hills, some of which are wooded to the top; one crater close to the shore is very conspicuous, and is cut into by the waves. The town is thoroughly Portuguese, and is built along the shore of a wide bay.

The afternoon of the 2nd July was spent in dredging in 50, 90, and 450 fathoms, in the straits between Pico and Fayal; a large number of animals were procured, very many of which have turned out to be new species (see Sheet 10).

The deposit was a volcanic mud, containing pumice, fragments of volcanic rock, plagioclase, sanidine, augite, magnetite, hornblende, biotite, and pelagic and other Foraminifera, Pteropods and other Molluscs, Coccoliths, Polyzoa, *Serpula*-tubes, and a few

Radiolarians and siliceous Sponge spicules. In some instances the pumice stones were completely coated with *Serpula*, *Polytrema*, and calcareous Algæ.

The ship passed between Pico and San Jorge, and on the 3rd obtained a dredging in 900 fathoms between Pico and San Miguel. The bottom was a Pteropod ooze, containing 52 per cent. of carbonate of lime, which consisted of Pteropods, Heteropods, Foraminifera, Coccoliths, Rhabdoliths, and fragments of Molluscs and Echinoderms. The mineral particles were all of volcanic origin. The dredge contained a few Echinoderms, Annelids, Polyzoa, Hydrozoa, and Crustaceans.

It was noticed, during the time the ship was kept stationary, that the surface water ran to the westward in the forenoon and to the eastward in the afternoon. Now, on the 3rd it was high water at Fayal at 5.30 P.M., and consequently low water at 11.30 A.M., from which it would appear that the flood tide sets to the eastward and the ebb to the westward in the vicinity of the Azores.

On the 4th, at 6.40 P.M., the Challenger arrived at Ponta Delgada, the chief town of the island of San Miguel, and, there being no epidemic, remained there five days.

During the stay at San Miguel excursions were made to many parts of the island, but more especially to the Caldeira des Sette Cidades, or Cauldron of the Seven Cities, situated at the western, and the picturesque valley of the Furnas at the eastern, end of the island. The former is a marvellous hollow of enormous size, with two lakes at its bottom and a number of villages in it. One slowly climbs the mountains from the sea and suddenly looks down from the edge upon the lakes, 1500 feet below. On the flat bottom of the main crater, which is covered with verdure and cultivated fields, are several small secondary cones, the whole reminding one of the representation of a lunar volcano. One of the small craters has been so cut up by deep water-courses, that between them only a series of sharp radiating ridges is left standing, and it thus presents a very fantastic appearance.

The Furnas valley is a similar deep, nearly circular crater, in which there is a large lake, numerous boiling springs, and the Furnas village,—the fashionable watering place of San Miguel. Sir Wyville Thomson writes:—"The principal boiling springs are about half a mile from the village. Round them, over an area of perhaps a quarter of a mile square, there are scorched-looking heaps like those which one sees about an iron-work, only whitish usually, and often yellow from an incrustation of sulphur. Over the ground, among one's feet, little pools of water collect everywhere, and these are all boiling briskly. This boiling is due, however, chiefly to the escape of carbonic acid, and of vapour formed below, for the temperature, even of the hottest springs, does not seem to rise above 90° C. The largest of the springs is a well about twelve feet in diameter, enclosed within a circular wall. The water hisses up in a wide column nearly at the boiling point, bubbling in the centre to a height of a couple of feet, and sending up columns

of steam with a slight sulphurous smell. A little further on there is a smaller spring in even more violent ebullition, tossing up a column five or six feet high; and beyond this a vent opening into a kind of cavern, not inaptly called 'Bocco do Inferno,' which sends out water, loaded with grey mud, with a loud rumbling noise. The mud comes splashing out for a time almost uniformly, and with little commotion, and then, as if it had been gathering force, a jet is driven out with a kind of explosion to a distance of several yards. This spring, like all the others, is surrounded by mounds of siliceous sinter, and of lime and alumina and sulphur efflorescence. The mud is deposited from the water on the surface of the rock around in a smooth paste, which has a high character as a cure for all skin complaints. At first I could not account for the grooves running in stripes all over the face of the rocks; but I afterwards found that they were the marks of fingers collecting the mud, and I was told that such marks were more numerous on Sunday, when the country people came into the village to mass, than on any other day.

"At a short distance from the 'Caldeiros' a spring gushes out from a crack in the rock of a cool chalybeate water, charged with carbonic acid, and with a slight dash of sulphuretted hydrogen. There is a hot spring close beside it. The flavour of the aërated water is rather peculiar at first, but in the hot steamy sulphurous air one soon comes to like its coolness and freshness, and it seems to taste all the better from the green cup, extemporised out of the beautiful leaf of the *Caladium*. The warm water from all the springs finds its way by various channels to join the river Quente, which escapes out of the 'Valley of the Caves,' at its northeastern end, and, brawling down through a pretty wooded gorge, joins the sea on the north coast about six miles from Villa Franca."

FIG. 74.—*Araucaria cookii*, in the garden of Don José do Canto, San Miguel. (*From a Photograph.*)

San Miguel is well cultivated. The orange groves (see fig. 77) are surrounded by high walls or close set hedges, to protect the trees from the strong winds which prevail all the winter. The fields of maize and corn are shielded from the wind by tall hedges of Reeds (*Arundo donax*), and the appearance of the cornfields is peculiar, because a kind of

Lupine is planted in geometrical patterns amongst the corn, to be ploughed in as manure after the crop is reaped.

There are many fine flower gardens containing a large variety of Australian, New Zealand, and South American plants. On the road to Furnas numerous hills, small volcanic cones, were passed, planted with firs and various timber trees with great care. The appearance of the island has been remarkably modified by careful plantation, most of the work having been done by Mr. Brown, a gardener from Kew, who was brought to the island by Don José do Canto to superintend the laying out of his garden. Most

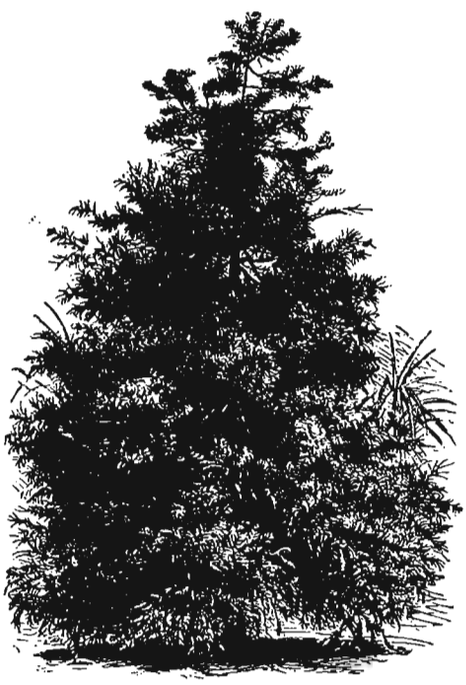


FIG. 75.—*Cryptomeria japonica*, in the garden of Don José do Canto, San Miguel. (*From a Photograph.*)

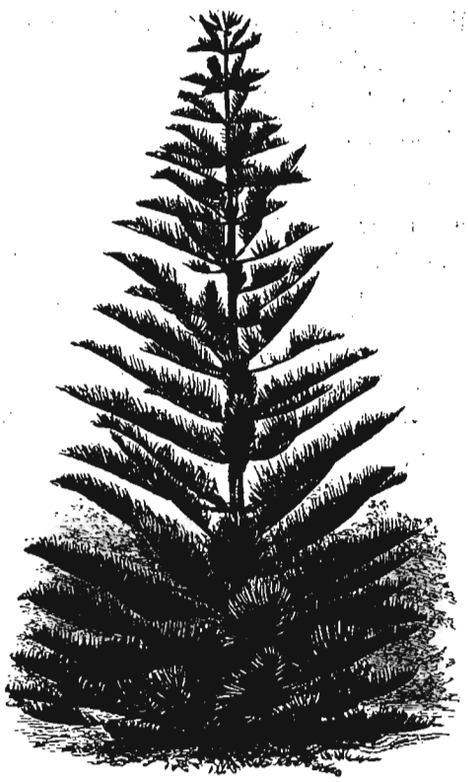


FIG. 76.—*Araucaria excelsa*, in the garden of Don José do Canto, San Miguel. (*From a Photograph.*)

curious is the markedly Australian feature which the general aspect of the vegetation has assumed in many places. Clumps of blue Gum Trees (*Eucalyptus*) abound, and the gardens by the roadside are full of Banksias and Melaleucas; but when once the higher plateaus of the island are reached, the foreign element disappears, and the moorland is covered with Bog Myrtle (*Myrica faya*), Heath (*Erica azorica*), and the splendid Fern *Dicksonia culcita*, which almost forms a tree. The beautiful golden brown silky substance covering its shoots is gathered, as elsewhere from tree ferns, for stuffing cushions. The moor looks very much like a Scotch moor, and stretches far and wide over the flat hill tops. In

the narrow glens of the Furnas valley, in the warm streams of mineral water flowing from the hot springs, the edible Arum (*Caladium esculentum*), the staple food ("taro") of the Polynesians, thrives exceedingly well, and is cultivated all over the Azores. In the excessively hot water of the hot springs, close to their points of issue, bright green lowly organised Algæ (*Botryococcus*) grow, and in places form a thick crust upon the rock surface on the sides of the fissures from which the hot water escapes. Similar growths of lowly organised plants, thus growing in the water of hot springs, have been observed in various parts of the world.[1]

FIG. 77.—Orange Groves near Ponta Delgada. (*From a Photograph.*)

A fine breakwater was in course of construction at Ponta Delgada, which, when completed, would form a well-sheltered port—a great desideratum, as the southwest gales send in a very heavy sea. This breakwater was partially washed away in 1867, during a violent storm, in consequence of its outer slope not having a sufficient angle; this defect, however, was remedied, and it was believed no other accident would occur. Some idea of the violence of the sea in the Atlantic may be gathered from the fact that the swell, dashing against the breakwater, has been known to wash up a block of stone, 6½ tons in weight, from the water's edge to the top of the breakwater, a distance of over 30 feet.

THE AZORES TO MADEIRA.

The ship left San Miguel on the 9th July for Madeira, and anchored in Funchal Bay on the 16th at 7 A.M., fine weather being experienced on the passage.

[1] For further account of the vegetable growths in the hot springs of Furnas, see H. N. Moseley, *Journ. Linn. Soc. Lond.* (Botany), vol. xiv. p. 321, 1875. Also papers on the same subject by Mr. W. T. Thiselton Dyer and Mr. W Archer, *Ibid.*, pp. 326, 328.

Six soundings, three dredgings, and four serial temperature soundings were obtained during the passage (see Sheet 6).

No accident occurred whilst the observations were being obtained, except that on the 11th July the thermometer sent to the bottom came up with the quicksilver separated, so that the result, which was considerably lower than usual, was rejected.

A sounding of 1000 fathoms was obtained midway between San Miguel and Santa Maria, another of the Azores. Between the Azores and Madeira there is a gradual descent to 2700 fathoms, and then as gradual a rise to Madeira, so that the summit of that island really stands 22,000 feet above the valley which separates it from the plateau of the Azores.

The mean temperature of the bottom water, at depths exceeding 1800 fathoms, was 36°·7, ranging from 36°·6 to 37°. It will be noticed that this bottom temperature is 0°·4 higher than the mean result obtained between Bermuda and the Azores, and that the lowest temperature obtained was higher than the highest registered between those two places. This is precisely the same result as that obtained on the east side of the Dolphin Ridge in the Tenerife–Sombrero section, whilst the mean temperature at the bottom in the Bermuda–Azores section, viz., 36°·3, is 0°·3 higher than that obtained west of the Dolphin Ridge in the Tenerife–Sombrero section.

The serial temperatures showed that the isotherm of 40° was at a uniform depth of 980 fathoms throughout the section, and that the isotherm of 50° was at a mean depth of 420 fathoms, a little deeper at Madeira, but the isotherm of 45°, which was at a depth of 580 fathoms at Fayal, descended to 800 fathoms at Madeira. The isotherm of 55° was at a mean depth of 150 fathoms (see Diagram 3).

On the 14th July, at Station 82, the current buoy moored by the lead line indicated a southerly movement of the surface water at an average rate of a quarter of a mile per hour.

The deposits in this section were remarkable for the large quantity of pumice which they contained; no fragments of quartz or continental rocks could be detected. At 1000 fathoms, between San Miguel and Santa Maria, the deposit was chiefly made up of pumice and volcanic minerals. Pteropod shells were present in the shallower deposits, but quite absent in depths greater than 2400 fathoms. The relatively high percentage of carbonate of lime at 2660 and 2675 fathoms, viz., 62 and 66 per cent., is worthy of note; the carbonate of lime here consisted almost wholly of the broken shells of pelagic Foraminifera. The fragments of siliceous organisms did not exceed 1 per cent. in any of the deposits.

The dredging in 1000 fathoms was very productive, yielding many new species, over twenty being described in the Reports already published. In 2025 fathoms two specimens of *Archaster*, and in 1650 fathoms two more specimens belonging to the same genus, and a species of *Antipathes*, were dredged.

Madeira to Saint Vincent, Cape Verde Islands.

The intention of remaining a few days at Madeira was abandoned, in consequence of the prevalence of small-pox in Funchal: the ship consequently left the island for the Cape Verde Islands at 8 P.M. on the 17th July. A steamer which arrived at Funchal from the west coast of Africa at this time, was visited by Mr. Moseley and Dr. v. Suhm, who found a large number of monkeys, birds, and other animals on board, and purchased two of the common Grey Parrots (*Psittacus erithacus*), one of which accompanied the Challenger throughout the rest of the cruise, and became a great pet in the wardroom. It is still living, and is in the possession of the relatives of the late Dr. R. v. Willemoes Suhm.

The soundings in Funchal roads being rather sparse on the chart, boats were employed during the 16th and 17th in completing the survey of the anchorage.

The trade wind prevailed during the whole passage from Madeira to St. Vincent, and in the vicinity of the former island, and between it and the Canary group, was very strong; so much so, that in standing in under the lee of Palma Island on the 19th, to dredge off its shores, it was necessary to take two reefs in the topsails. To leeward of the islands this strong trade wind is not felt, and in Funchal Bay, Madeira, where, from the curling sea, it is evident that it exists outside, the weather is either quite calm or such light variable breezes prevail that it may be said to be calm; nor, apparently, does this strong trade wind extend to any great height, as at Madeira there was no appearance of wind on the hills. The force of the trade wind gradually decreased as the Cape Verde Islands were approached.

The weather experienced on the passage was fine, but generally misty; and farther southward these mists thickened into fogs. However, the morning after leaving Madeira was remarkably clear, that island being distinctly seen at sunrise, though then distant 70 miles.

The course pursued on this passage was varied in order to run under the lee of Palma Island to dredge and sound at Station 85 on the 19th July, and again to obtain another dredging on the submarine peak, which was discovered southeast of the Canary group on the passage to Sombrero.

On the 23rd and 24th July the sea had a greenish tinge, quite unlike its usual deep blue colour. Green coloured patches of water were also observed off the African coast during the return voyage of the Challenger in 1876. They have been referred to by other voyagers, and are well worthy of further investigation.

On the Madeira–St. Vincent section nine soundings, seven serial temperature soundings, and three dredgings and one trawling were obtained; the bed of the ocean was somewhat irregular, the greatest depth obtained being 2400 fathoms (see Sheet 6 and Diagram 7).

The surface temperature, which was 70° at Madeira, rose gradually to 75° at St. Vincent.

The bottom temperature at depths exceeding 1800 fathoms was again remarkably uniform, varying only 0°·2, the mean being 36°·5 and the extremes 36°·4 and 36°·6.

The serial temperatures of this section showed some peculiarities, which, from previous experience, had not been expected. Up to this time the isothermal lines had run fairly parallel with the surface, no matter whether proceeding in an east and west, or north and south direction, unless some disturbing cause, such as the Labrador Current, interfered to prevent their doing so; but, in this section, the lower isotherms all rose towards the south. Thus, the isotherm of 40° maintained an average depth of 950 fathoms for 450 miles from Madeira, and then rose gradually, though somewhat irregularly, to 800 fathoms at St. Vincent. The isotherm of 45° rose irregularly from a depth of 700 fathoms at Madeira to 380 fathoms at St. Vincent; and the isotherm of 50° rose from 420 fathoms at Madeira to 200 fathoms at St. Vincent. The isotherms above 50° were nearly parallel with the surface.

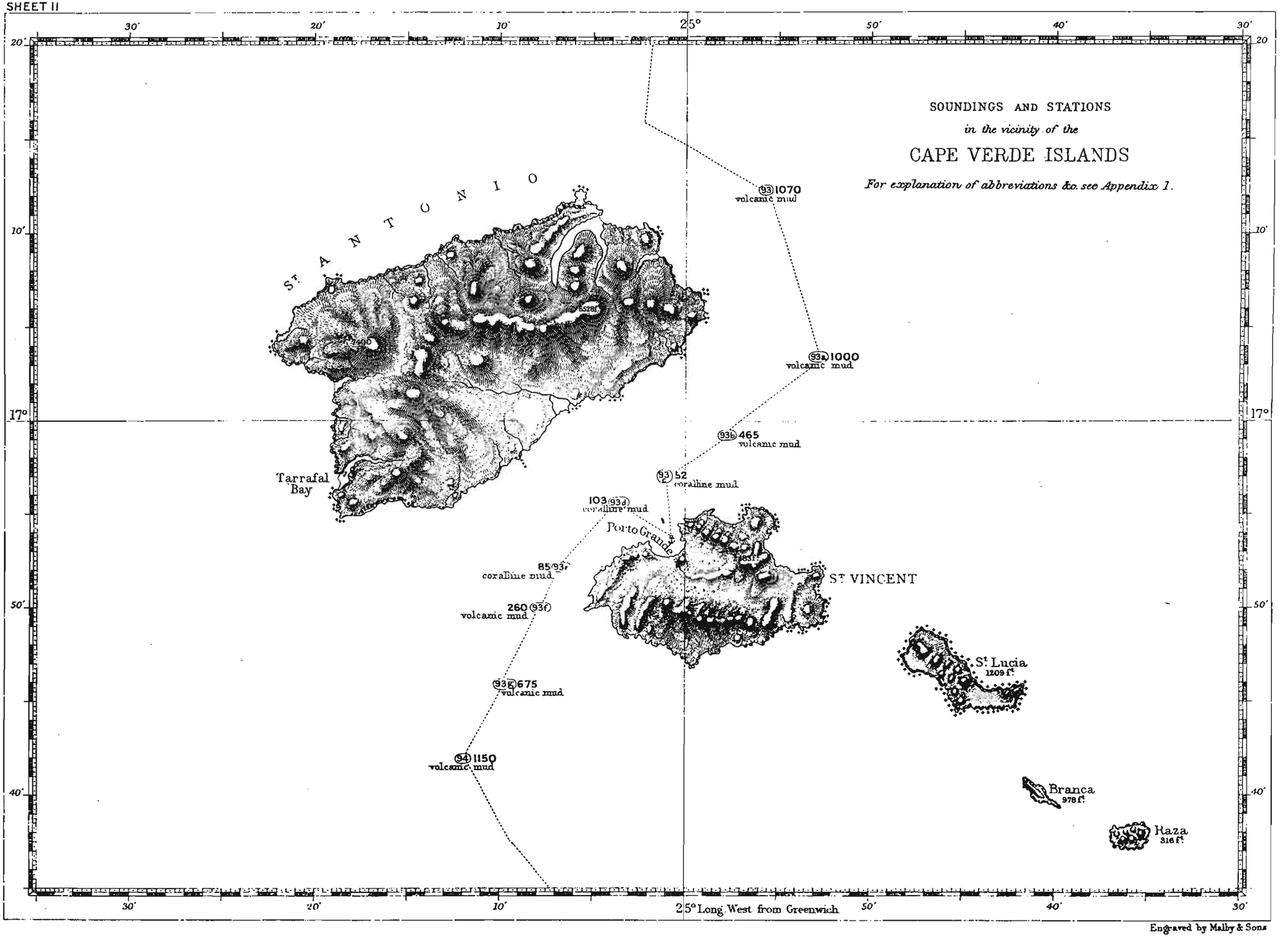
No regular current observations were taken on the passage to St. Vincent, but it was noticed, whilst dredging under the lee of Palma Island, that the surface water was running to the northward, at an estimated rate of one mile per hour, and on the 26th July, at Station 92, it again had a northerly tendency.

On the 18th July, at Station 84, the velocity of the wind was 22 miles per hour by the anemometer, its force being registered as from 5 to 6.

At 11 P.M. on the 26th July the island of San Antonio was sighted, and the ship stood off for the night. On the 27th, as soon as the fog cleared off the land, a line of soundings was carried into the channel between the islands of St. Vincent and San Antonio (see Sheet 11), and the ship anchored in Porto Grande at 4.30 P.M.

The deposit to the west of the island of Palma in 1125 fathoms was a brown volcanic mud, containing about 6 per cent. of carbonate of lime. The size of the mineral particles rarely exceeded 0·25 mm. When the mud was passed through sieves the washings which remained were almost wholly made up of dead shells of Pteropods and Heteropods. In the dredge there were a few animals and several large fragments of a dead Gorgonoid Coral (*Corallium*), coated with manganese peroxide, similar to that obtained in 1525 fathoms about 200 miles further south on the Tenerife–Sombrero section (see page 125). The next sounding was in 2300 fathoms, a little to the west of the position where the depth of 1525 fathoms just referred to was observed in February. Here the deposit was a Globigerina ooze, containing 57 per cent. of carbonate of lime. Later on the same day, 21st July, a sounding and dredging were obtained in 1675 fathoms, on the same hard ground with dead coral, and in nearly the same position as in February, when the dredge brought up more of the black coral, fragments of a Polyzoon (*Nellia simplex*), one specimen of *Ophiomusium pulchellum*, one of *Ophiomitra carduus*, and two Peneid Shrimps. In 2300 and 2400 fathoms farther south a Globigerina ooze with 64 and 58 per cent. of carbonate of lime was obtained, containing no Pteropod or Heteropod shells. The mineral particles were

SHEET II



Engraved by Malby & Sons

chiefly volcanic, with a mean diameter of 0·07 mm., but here also small rounded grains of quartz were found for the first time since leaving the coasts of America. These appear to be wind-borne fragments, carried from Africa by the Harmattan winds (see p. 126). A trawling in 2400 fathoms gave a fragment of a Pennatulid, a red Holothurian with *Stylifer* in the cloaca, two Starfish, one belonging to a new genus (*Thoracaster cylindratus*, Sladen), several Polyzoa (*Bugula mirabilis*, *Farciminaria delicatissima*), *Scalpellum velutinum*, and a Lophioid fish (*Ceratias holbölli*), the last with a parasitic Copepod (*Lernæa abyssicola*) attached to it. Soundings in 2075 and 1975 fathoms gave a Globigerina ooze with 60 and 75 per cent. of carbonate of lime. About 2 per cent. of these deposits was made up of Radiolarians and fragments of other siliceous organisms, the remainder being composed of volcanic minerals, a few grains of quartz, and clayey matter.

Cape Verde Islands.

Saint Vincent.—The island of St. Vincent is about twelve miles long by six broad, and has an irregularly oval form, consisting of a flat central tract more or less broken by low hills, surrounded by a range of high land. The low central district is evidently the bottom of an ancient crater, of the wall of which the high surrounding range is the remains. The range is composed of strata dipping outwards from the ancient centre of eruption, and is cut up by a series of deep valleys, having a general radiate arrangement, into ridges of various heights, some of them of considerable altitude, which are again cut up by secondary transverse valleys so as to culminate in a series of irregular peaks. The Green Mountain is 2483 feet in height, and one other mountain, to the extreme south of the island, 2218 feet. A break in the encircling range to the northwest forms the harbour of Porto Grande, in the entrance to which lies a small island, called Bird Rock, a fragment of the range, once continuous in that direction.

More barren and desolate-looking spots than San Antonio and St. Vincent appear, as approached from seawards, after they have been suffering from their usual prolonged droughts, it is impossible to conceive. Their general aspect recalls Aden or some of the volcanic islands in the Red Sea. At the time of the Expedition's visit, no rain had fallen for a year at St. Vincent; sometimes it does not rain for three years.

The mountains are of black volcanic rock terminating seawards in precipices, in which the numerous dikes traversing them in all directions, stand out conspicuously owing to the weathering of the surrounding rock. Between the mountain ranges stretches a flat sandy plain, covered with sand dunes and with ranges of low rounded hills of a bright red ochre tint. The white plain terminates at the head of the harbour in a shore, where there is a miserable town. The whole glares in a fierce sun, and appears almost devoid of vegetation; but from the anchorage some black tufts can be made out with a telescope, which consist of small bushes of Lavender (*Lavandula rotundifolia*), the most

abundant plant in the island, and on the summits of the higher hills a few *Euphorbia* bushes (*Euphorbia tuckeyana*) can be made out in the same way. On the sandy plain at one spot a thick growth of low Tamarisk bushes stretches from the shore inland, and amongst these, about half a mile from the shore, there is a group of half a dozen small Tamarind trees (*Tamarindus indica*). Some thorny Acacias (*Acacia albida*), and *Terminalia catappa*, which stand in an old enclosure in front of the ruins of a house, and are green and flourishing, show that much might be done by cultivation, even in St. Vincent. The plains were found to be covered all over with the spiny fruit of a small creeping plant (*Tribulus cistoides*). Almost the only plants retaining any living and green leaves were the lavenders, on the bushes of which were to be found here and there a green sprout, put forth apparently in anticipation of the wet season.

On June 30th a small party made an excursion up Green Mountain. The road led over the bottom of the old crater, and then up the steeper end of the mountain by a zigzag path, in places built up in steps and in others hewn out of the rock. The soft friable soil of the plain was in many places already converted into tenacious mud by the rain, which was then falling, one of the rarest events of the year. As the hillslopes were ascended from the plains, the plants became greener and more abundant. In a narrow gorge at the commencement of the ascent of the mountain, some small gardens were passed, at an elevation of about 200 feet above the sea level. They contained sugar cane, pumpkins, and a small date palm; and maize was just being planted in them. There were a few cotton bushes growing near. At 700 feet, Euphorbias and woody Composites commenced, and the hillside was covered with coarse dry grass. At 1000 feet, small Boraginaceous bushes with pink flowers (*Echium stenosiphon*) commenced, and at 1300 feet the first patches of moss and *Marchantia* were found, with a fern and a live snail. At 1700 feet a *Statice* (*Statice jovibarba*) was abundant on the cliff. The lavender grew right up to the top of the mountain, but there it was entirely fresh and green instead of black and withered as below. A leafless trailing Asclepiad (*Sarcostemma daltoni*) commenced at 900 feet. All the plants on Green Mountain appeared to extend their range of growth to the summit. On the summit there were several cottages, and the land was all more or less under cultivation; maize, potatoes, tomatos, and pumpkins were growing there.

On Bird Island, the rocks about tide mark are covered with a broad band of a dense incrustation composed of Corallinaceæ, which forms a striking feature in the appearance of the island as seen from the sea, and is more marked here than on the main island. The Corallinaceæ are seaweeds which secrete a dense skeleton of carbonate of lime. The incrustation on Bird Island is of several colours, white, bright pink, or cream colour, and is mainly composed of two species of calcareous Algæ (*Lithothamnion polymorphum* and *Lithothamnion mamillare*). This incrustation assumes very varied forms, being quite thin, and following the form of the rock surface on which it rests, or forming smooth rounded convex masses, or being covered with a closely set series of projections, sometimes of con-

siderable length, and with a sinuous arrangement. On the whole, plant-life seems to play a much more important rôle than corals in accumulating carbonate of lime around the Cape Verde Islands; but the larger Foraminifera are of far greater importance than either in some places, the calcareous sand of the harbour of St. Vincent being mainly composed of them.

Notwithstanding the desolate nature of the island, St. Vincent is rising into importance, for it possesses the only safe and convenient anchorage in the Cape Verde group, or, in fact, anywhere between that group and the south coast of Spain; its situation also renders it a most suitable halting place for the mail steamers running between England and the ports in South America, or the Cape of Good Hope. Spacious coal stores have been constructed on shore, and piers have been run out into the bay to admit of loading boats rapidly. The coal, kept in bags, is conveyed to the ships in barges, and labourers can be hired from the shore to assist in passing the bags on board, so that vessels requiring to replenish their fuel here can do so without difficulty or delay. A submarine cable connects St. Vincent with Madeira and Pernambuco.

The town is well laid out, and there are a few respectable buildings in it, especially the custom house and the residence of the governor, but the great want of the place is water, which can only be obtained in small quantities from a few wells at the back of the settlement. The supply of provisions is extremely bad; no vegetables of any kind could be procured during the stay, nor, in fact, supplies of any kind, except coal and bread; the beef was so bad that the ship's company refused to eat it.

A quarantine establishment of some description is much required, as at present passengers from the fever-stricken ports of South America have to remain in an open boat in the bay until the health officer is satisfied that they are free from disease.

The climate, although warm, is, owing to its freedom from moisture, not unpleasant; the mean yearly temperature is about 74°, the mean temperature of the coldest month (February) being about 69°, and of the warmest (September) 79°. The trade wind is seldom interrupted, and frequently blows with considerable violence through the channel between the islands of St. Vincent and San Antonio.

The survey of the anchorage was not completed without some little difficulty. The trade wind was occasionally so strong, reaching on one occasion a force of 8, that the boats could not work, nor could a theodolite be set up on shore, except in a sheltered position; in fact, the squalls from the hills raised a mass of spoondrift over the whole of the bay and clouds of sand in the plains. A landing was effected and a station established on Bird Island, though not on the summit, the crumbling nature of the rock of which that islet is composed rendering it unadvisable to plant an instrument on its peak. The magnetic observations taken on shore were unsatisfactory, since a position was not found which was free from local attraction.

Observations on the current in the channel between St. Vincent and San Antonio gave the following results:—The movement of the water was tidal, the N.E.-going stream

running five hours, and the S.W.-going stream seven hours. The alteration in the direction of the stream did not coincide with the times of high and low water at St. Vincent, for the N.E.-going stream commenced three hours before high water, and the S.W.-going stream two hours after high water. The maximum speed of the surface stream was one mile per hour. The current drag at the bottom indicated an equality in the hours of the stream there, as it ran six hours in each direction, the times of change being at half flood or ebb; it would, therefore, appear that the stream at the surface is affected by the trade wind, the N.E.-going tide being retarded and the S.W.-going tide accelerated. The maximum speed of the stream at the bottom was three-quarters of a mile per hour.

In the harbour of St. Vincent the deposit in depths from 7 to 50 fathoms was a calcareous sand, with 87 to 94 per cent. of carbonate of lime, chiefly made up of Foraminifera shells and calcareous Algæ. In some places the shells of *Amphistegina lessonii* made up fully two-thirds of the whole deposit. *Polystomella*, *Discorbina*, and *Orbiculina* were also abundant. The deposits around the islands from 200 fathoms down to a depth of 1150 fathoms were volcanic sands and muds, with from 13 to 50 per cent. of carbonate of lime, in which Pteropod and Heteropod shells were abundant.

Dr. v Willemoes Suhm writes as follows in his Journal:—"The following birds only were observed near the settlement:—the Egyptian Vulture (*Cathartes percnopterus*) and the common hooded crow, carrion crow and rook. The first of these, the sacred vulture of the east, appears to breed in December and January, for at the time of our visit (July) the young ones, recognisable by their brown plumage, were just beginning to moult. Among the tamarisk trees was a small *Platydactylus*, and also a lizard. A small black beetle was found under nearly every stone, and over a pool we observed two species of dragon-fly, whilst an *Acridium* was jumping and flying over many of the stony places. Where the tamarisk trees are high enough to afford shelter, insects are in greatest abundance. An Ant-lion (*Myrmeleon*) of which we obtained both the larva and imago, lies in wait for a small colonial species of ant. It somewhat resembles *Agrion*, but can be distinguished from it by its slow flight and its habit of folding its wings when sitting. Of Hymenoptera,[1] a large black Ichneumonid with yellow antennæ, and another wasp-like one may be mentioned. Diptera abound, especially the common meat-flies; an *Osmæa* was also noticed. Some fifteen or twenty species of Coleoptera were observed, which, with few exceptions (*Cicindela*, *Coccinella*, very common among the tamarisks), belong to the Melasomidæ, a family characteristic of the shores of the Mediterranean and the west coast of North and South America. There are some Silphidæ, more of which might perhaps be found beneath dead animals. Lepidoptera and Hemiptera seem to be scarce; one species only of the latter was found. A *Scolopendra*, possibly brought by ships, was not uncommon under stones; a *Geophilus* may also be noted. We observed no

[1] Among the Hymenoptera collected were two new species, *Priocnemis atlanticus*, Kirby, and *Polistes fortunatus*, Kirby, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xiii. pp. 408–410, 1884.

Scorpions, but the Araneidæ were comparatively abundant; one magnificent yellow species (of which both the female and the very small male were captured) extends its net among the tamarisk shrubs, where dwells also a small *Epeira*.[1]

"The poverty of animal life on the beach was disappointing, but one or two forms were of some interest. A small *Blennius* and a *Mugil* are common in the shore-pools, and are used by the boys as bait to catch the Sand-crabs (*Remipes*). These hide in the sand with nothing but their heads peeping out, but as soon as one of the little fish is thrown down they jump out to obtain it, and fall a prey to the juvenile sportsmen. The crab carries its ova with it, and in several I saw the large black eyes of an embryo which would probably develop into a zoea. Walking along the beach one observes holes of different sizes which are made by another interesting Crustacean (*Ocypoda ippeus*), which may now and then be seen running along like a piece of paper blown by a strong wind. We found it no light task to dig each separate crab out of its hole, but the fishermen, who use them for bait, obviate the difficulty by digging a large hole in the evening and placing a dead animal in it, and on returning in the morning they readily capture a large number of crabs. This species is also found in Egypt and Syria; its eyes are situated, not at the summit, but at one side of their pedicles, which are terminated by a tuft of brown hairs, these, however, are wanting in young specimens. Milne-Edwards had remarked a finely polished plate, fringed with hairs, between the fourth and fifth ambulatory legs, which he regarded as an arrangement for avoiding friction. Fritz Müller, however, who observed the animal in Brazil, has shown that it is a covering for the orifice of the branchial cavity, so that the crab can open or close it at will, and thus retain water or air; but notwithstanding this provision, it can live only a comparatively short time when deprived either of air or of water. The hairs which fringe the smooth plate are curious, and appear to belong to the so-called 'Riechhaare' (olfactory hairs) of Hensen.[2] A brown Sea-Urchin, and an *Aplysia*, with *Grapsus*, *Palæmon*, and *Pagurus* were also obtained. A fragment of amber was picked up on the beach in my presence, and Moseley found there a large Eunicid.

[1] The Rev. O. P. Cambridge gives the following notes on the Spiders from the Cape Verde Islands :—

"St. Iago.—*Argiope clarkii*, Bl. (also abundant from St. Vincent), *Artema convexa*, Bl., *Hersilia caudata*, Sav., *Marpessa nigrolimbata*, Cambr., and *Sparassus* sp.?, *Trochosa* sp.? (both young and probably indeterminable), *Cyrtophora opuntiæ*, Duf. St. Vincent.—Fourteen species of which I can as yet only certainly determine three; *Gnaphosa exornata*, C. L. Koch. *Argiope clarkii*, Bl., *Artema convexa*, Bl. Of the rest one is a very handsome, and, I think, new species of *Pasithea*, four are Drassidæ (*Drassus* and *Trachelas*), two Thomisidæ (*Misumena* and *Thanatus*), one *Epeira*, one Salticida (I think an *Icius* or *Marpessa*), and two *Tarantula*. There are also a *Dysdera* and several Drassids indeterminable from immaturity. There is no departure in the above collection from the South European type excepting in *Hersilia*, which connects them with the more tropical forms. *Hersilia* is found abundantly in Egypt and Bombay, where there are also other species of the same genus; a closely allied genus occurs in Algiers and Egypt. I should observe that *Marpessa nigrolimbata*, Cambr., is identified by Dr. T. Thorell, and probably rightly, with *Icius dissimilis*, C. L. Koch, and several other more recently described species (Studi sui Ragni Maltesi e Papuani, *Ann. Mus. Civ. di Genova*, tom. xvii. p. 461). It appears to be almost cosmopolitan, having been recorded from St. Helena, Java and Amboina, St. Thomas, W. I., Columbia, Brazil, Argentine Republic, and West Africa; I have received it also from the Isle of Wight."

[2] Facts for Darwin, p. 31.

"The dredge brought up a *Calappa*, which does not seem to differ much from the Mediterranean species, together with a *Galathea*, *Cancer*, *Squilla*, &c. A large *Cidaris* seems to cover the whole bottom, along with a fine red *Oreaster* and a small white Ophiurid.

"It may be of interest to anthropologists to learn that I visited a yellowish-black family, consisting of a healthy grandmother, and a mother and father, with several children, of whom two were interesting, as one, a girl twenty years of age, was an almost complete albino, and the other presented a case of hypospadias with cryptorchy, simulating hermaphroditism; he was seventeen years of age and ill-developed, being only about 4 feet high."

Two land shells (*Helix advena*, Webb and Berth., *Helix bollei*, Albers) were obtained.[1]

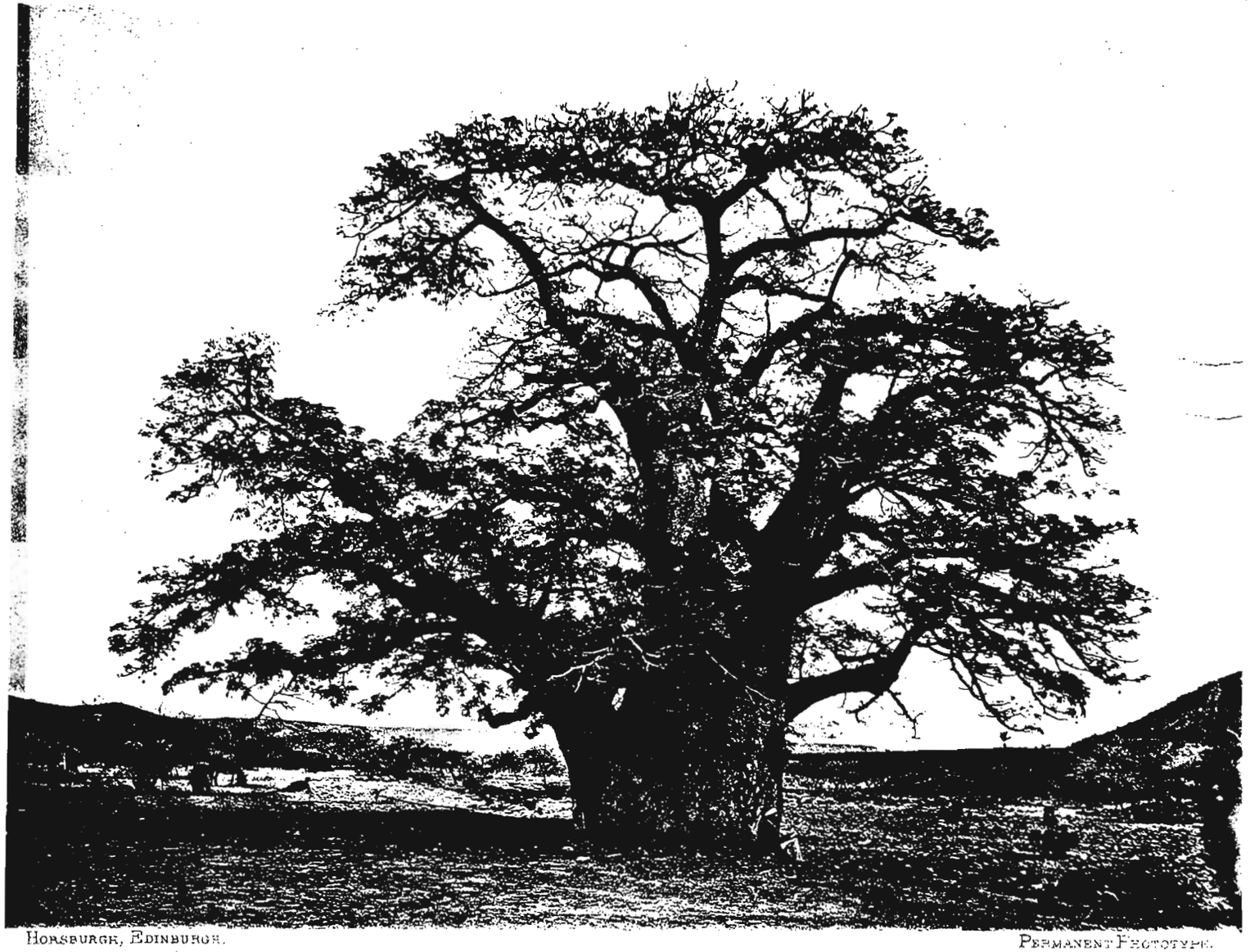
The rocks collected at St. Vincent belong to recent types, the basalts being especially prominent in them. These felspathic basalts present three types of structure,—(1) fine grained, (2) doleritic, (3) porphyritic. One rock obtained from a dike in the southwest of the island is an amphibolic andesite. Two specimens from Bird Island must be referred to the variety of basaltic rock known as pyroxenite, on account of the important part which augite plays in their formation.

A naval schoolmaster, who had come to St. Vincent to join the Challenger, was lost on one of the mountains just before the arrival of the ship, and died of exposure; his body was found only after the lapse of several months.

San Iago (*Santiago*).—On the 5th August, at 10 A.M., the ship left Porto Grande, and a course was shaped for Porto Praya, in the island of St. Iago, as it was desirable to obtain some fresh meat and vegetables for the ship's company, and also to investigate the nature of the bottom off that island, red coral being found there. In proceeding through the channel between the islands of St. Vincent and San Antonio, a line of soundings was carried to 1200 fathoms (see Sheet 11). Porto Praya was reached on the 7th August at 8 A.M., light winds and foggy weather having been experienced on the passage. The mean annual temperature at Porto Praya is 76°·1, the mean of the coldest month being 72°, and the warmest 80°.

Viewed from the sea, the island of St. Iago is almost as desolate looking as that of St. Vincent, but at an easy distance from the port there is a well-cultivated valley, in which are cocoanuts, abundance of vegetables, and a large variety of crops. Cocoanut trees also grow in small ravines on each side of the town, and artificially irrigated gardens are cultivated beneath their shade. Twelve miles N.E. of Porto Praya is the valley of San Domingo, where the scenery is green and delightful, and presents a striking contrast to the arid gravelly plains near the sea. Good beef and vegetables were procured at Porto Praya, and shooting parties brought back a few quails, pigeons, and guinea fowl. The seine was hauled in the evening with great success, notwithstanding the considerable swell breaking all along the beach. A small mole has been built to facilitate landing,

[1] E. A. Smith, *Proc. Zool. Soc. Lond.*, p. 276, 1884.



HORSBURGH, EDINBURGH. PERMANENT PHOTOTYPE.

BAOBAB TREE, SAN IAGO.

which is difficult at this season of the year, as the southwesterly monsoon sometimes reaches the island. The town is clean, and has a good supply of water, brought in by an aqueduct from the foot of the hills. Coal is stored on Quail Island, and can be procured if necessary, but it is not so cheap as at St. Vincent.

The country rises inland in a succession of terrace-like steps often remarkably flat at the top, and formed by successive flows of lava. The flat table-land nearest the sea was parched and had very little green upon it. Behind rises a succession of small conical hills and higher table-lands, which were brilliantly green.

There is a large Baobab tree (*Adansonia digitata*) near the town, which has been mentioned by travellers. Its stem is irregular in transverse section and short; it measured 42 feet in circumference at the time of the visit, when it was in full flower with no fruit as yet of any size. An excellent photograph of it was obtained (see Pl. II.).

Quails were not at all plentiful, being only migratory visitors to the island, and not having as yet arrived in numbers. The Kingfisher (*Halcyon erythrorhyncha*), mentioned by Darwin, is common; it is peculiar to the island, though very closely allied to an African species, and is a beautiful bird, brilliant blue and white with a red beak. Like many other kingfishers it is not aquatic in its habits, but feeds mainly on locusts and other small terrestrial animals; it has a terribly harsh laughing cry, a feeble imitation of that of its congener of Australia the Laughing Jackass. Birds of prey are very abundant in St. Iago; large falcons and hawks were very common, and eagles were seen in San Domingo valley. Ravens and crows were also very plentiful. It is difficult to understand on what so many predaceous birds can feed; possibly the falcons and hawks frequent the island in numbers only in the quail season. The Gecko, *Tarentola delalandii*, which had been found in Tenerife, was obtained here, as also a Skink (*Euprepes*).

An excursion was made by Mr. Moseley to the San Domingo valley, in the hopes that it would be found possible to ascend the highest mountain of the island, called San Antonio, 7400 feet in altitude, in search of the plants growing on its summit. The journey to the base, ascent, and return to the harbour in twenty-four hours was stated to be feasible by the townspeople, but it proved that such is by no means the case. The road led directly inland, and as the successive terraces were ascended the hills became greener and greener, being covered by a continuous carpet of seedling grass and other herbs as yet only two or three inches in height. The guide said that it would be a foot or eighteen inches high later on, and that then the quails would abound and the guinea fowl breed, so that the breeding season of these birds here appears to be in the autumn, and determined by the rainy season.

The valley of San Domingo into which the road at length led is deep, with precipitous cliffs and steep mountains on either side, rising 1000 to 2500 feet above sea level. The valley is broken here and there by lateral offsets and backed towards its head by irregular mountain masses. The view up the valley is very beautiful. Beneath the

cliffs, which are encrusted with lichens and stained of various colours, often of a deep black, are steep talus slopes covered with oil trees with a few other shrubs sparingly intermingled. At the bottom of the valley is a strip of comparatively level land, on which are cultivated all sorts of tropical fruits, pineapples, bananas, oranges, lemons, guavas, cocoanuts, and coffee; with cassava, sweet potatoes, and sugar cane as field crops. All along the valley a little way up the slopes are small huts, where boys are stationed whose duty it is to keep off the monkeys which abound amongst the rocks, and the wild Blue Rock Pigeons (*Columba livea*), which are very numerous, and were seen flying about in flocks and alighting in the road. The fact of the existence of monkeys in the island is not mentioned in any published account of the place. They must be of some African species imported and run wild, but it would be important to determine what the species is, and future explorers would do well to try and procure a skin. The guide said that the monkeys never came out in wet weather, and so not one of them was seen. The boys kept up a constant shouting, which resounded through the valley.

At the bottom of the valley is a small stream running rapidly over the stones, like a trout stream, and everywhere very shallow, in which grow water cresses and several familiar English water plants; two ferns also were noticed on the banks. Two kinds of freshwater shrimps live in the stream under the stones, and are very abundant, notwithstanding the shallowness of the water. One is a *Palæmon*, a large prawn, as big as the largest specimens of our common river crayfish, and with long and slender biting claws. The other is a very different animal, somewhat smaller, and of the genus *Atya*, distinguished by having no nippers on the larger pairs of walking legs, but only simple spine-like ends to them, and by several very remarkable and characteristic features of structure. The genus is very widely spread, occurring in the West Indies, Philippines, Samoa, and Mexico. After the village of San Domingo, which consists of a few scattered thatched stone houses, had been passed, the road became very much worse and the ponies soon became completely tired out, so much so that a retreat had to be made on foot. Five hours had already been spent in the saddle and the place from which the ascent of the mountain commences was still a very long way off. A Portuguese inhabitant of the valley said that it was impossible to ascend the mountain in the rainy season, because of the falls of stones or stone avalanches which were common and dangerous. It is evident that an excursion to the summit of San Antonio, from the harbour of St. Iago, is possible only in three or four days; a good supply of provisions should be taken by any party attempting it. San Domingo valley, with its succession of mountain ridges and peaks becoming bluer and bluer in the distance, is one of the finest of mountain valleys, and the tropical vegetation with which it is clothed gives it an especial charm. The sight of such a place is particularly delightful to a traveller who has for weeks been trudging the arid hills and plains of St. Vincent, or one who has just ascended to it from the almost equally sterile plains about the coast of St. Iago.

Red, or precious, Coral occurs at St. Iago and also at St. Vincent, the fishery being carried on by Italians, Spaniards, and Americans. One ship, which was employed during the season with seven boats, is said to have taken thirty barrels of the Coral in the rough state. Professor Thomson and Mr. Murray dredged over the ground in the steam pinnace during the whole of the 8th August and were very successful. The Coral occurs in 80 to 120 fathoms, and is dragged for by rough nets and swabs, and a duty of a dollar per kilogramme is paid to the Government.

The insect fauna at St. Iago, so far as cursorily examined, was found to be the same as that at St. Vincent, though much richer.

The rocks collected at St. Iago are felspathic basalts and phonolite. The raised beach described by Darwin[1] appears as a conspicuous white streak underneath the cliffs surrounding the harbour. Immediately below the lava bed is a crystalline limestone cementing volcanic debris, in which appear small fragments of palagonite, and clastic grains of shells. Under the microscope it is seen that the organic structure of these shells has not entirely been lost. The fragments of volcanic origin enclosed in the limestone are small splinters of basalt, fragments of crystals of augite, olivine, hornblende, black mica, and magnetite. Some specimens of incrustation on the lava are almost entirely made up of carbonate of lime, present all the characters of a stalactitic deposit, and do not contain organic remains discernible under the microscope. The organisms found in the limestone are, as pointed out by Darwin, the same as those now living in the harbour.

[1] Darwin, Journal of Researches during the Voyage of H.M.S. "Beagle," pp. 4–6, ed. 1871.