

## CHAPTER VIII.

Cape of Good Hope to Prince Edward and Marion Islands—The Crinoidea and Myzostomida—The Crozet Islands—  
The Petrels—Arrival at Kerguelen.

## CAPE OF GOOD HOPE TO PRINCE EDWARD AND MARION ISLANDS.

ON the 17th December 1873, the Challenger left Simon's Bay for the southern cruise, at 6.30 A.M. As the vessel steamed out to the open sea considerable differences in the temperature of the surface water were observed. In Simon's Bay it was  $64^{\circ}5$ , but at 10 A.M., when the Cape of Good Hope bore W. by N., distant 5 miles, it had fallen to  $55^{\circ}5$ , and was accompanied by a corresponding decrease in the temperature of the air, which fell  $3^{\circ}8$ . At noon, when Cape Hangklip bore N.  $78^{\circ}$  E., and Zwart Kop N.  $14^{\circ}$  E., the surface temperature had again risen to  $65^{\circ}0$ , and there was also a rise in the temperature of the air. At 1.30 P.M. a sounding and dredging in 98 fathoms, and serial temperatures at every 10 fathoms, were obtained. The dredging was very successful. The deposit consisted of a green glauconitic sand, containing 50 per cent. of carbonate of lime, which was composed chiefly of Foraminifera, fragments of Molluscs, Polyzoa, *Serpulæ*, and Echinoderms. At 6 P.M. sail was again made and a course shaped to the southward.

On the 18th, at 6 A.M., sails were furled, and the ship sounded and dredged in 150 fathoms, and at 8.30 A.M. again made all sail to the southward towards Marion Island. The deposit was nearly the same as on the preceding day. Glauconite is exceptionally abundant in these deposits on the Agulhas Bank; the grains are about one millimetre in diameter, and are isolated or agglomerated into phosphatic nodules several centimetres in diameter. Besides these grains, the Foraminifera are often filled with a pale green glauconitic substance, which only rarely shows all the typical characters of glauconite. In these deposits there was much green-coloured amorphous matter, which, when heated on platinum, burned like an organic substance, became black, then red, and gave off an organic smell.

On the 19th, at 1 A.M., the temperature of the surface water rose from  $65^{\circ}$  to  $72^{\circ}$ , and remained at from  $72^{\circ}$  to  $73^{\circ}$  all day. At 6 A.M. a sounding and dredging were obtained in 1900 fathoms, as well as serial temperatures and specimens of the water from several depths (see Sheet 18). The deposit was a Globigerina ooze, containing 90 per cent. of carbonate of lime, which consisted almost entirely of pelagic Foraminifera. In the dredge were several irregular brown-coloured phosphatic nodules, containing 49 per cent. of tricalcic phosphate. Whilst sounding and dredging, the current was found

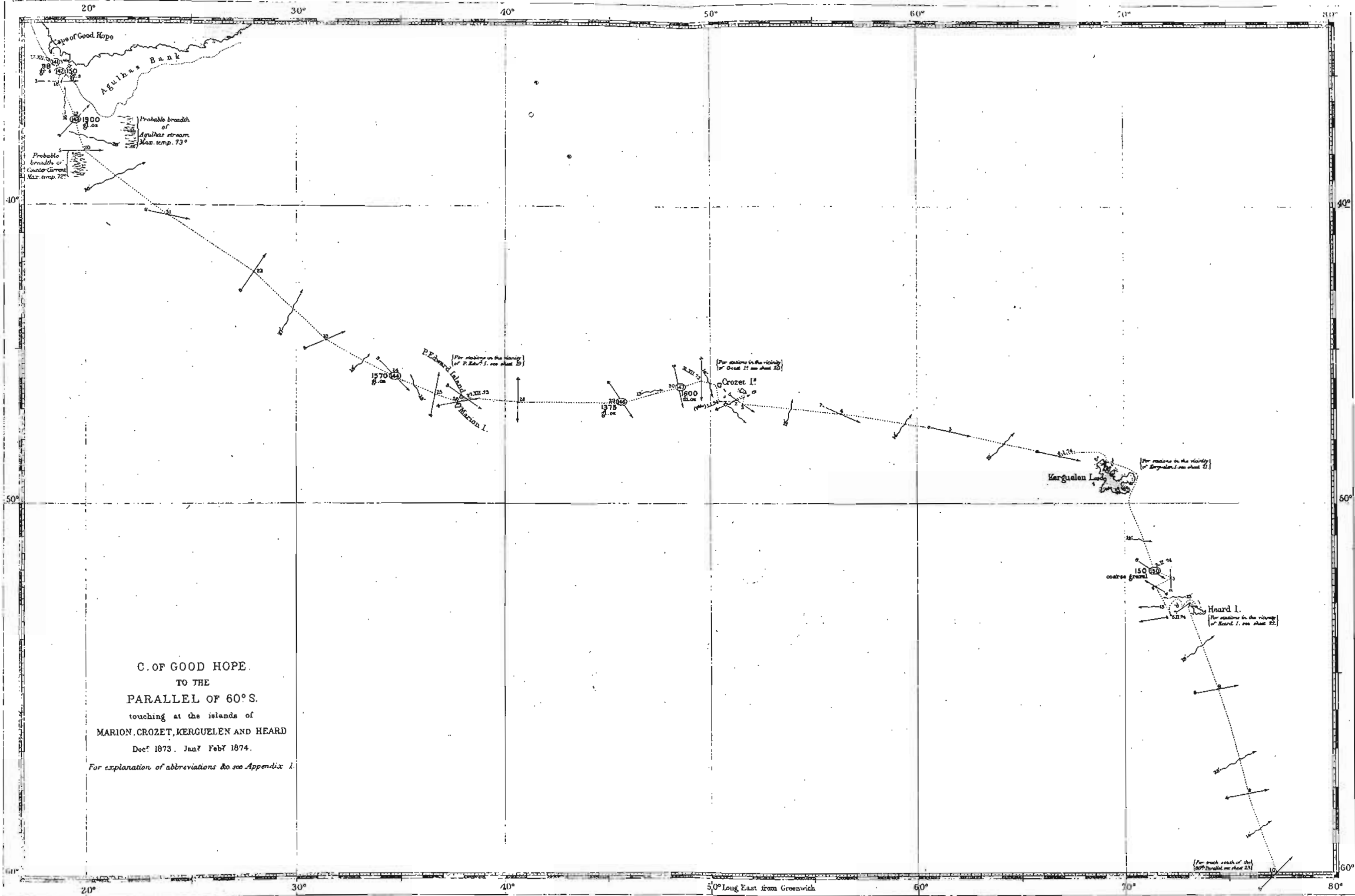
setting to the westward and northward at an average rate of 1 mile per hour, and the velocity of the wind was on an average 11 miles per hour from 7 to 9 A.M. At 4 P.M., the dredging being completed, sail was again made, and a course shaped to the southeastward.

On the 20th the wind hauled round to the westward and gradually freshened, the surface temperature remained at about  $72^{\circ}$  until noon, and the current experienced since the previous day at 4 P.M. was 26 miles N.  $74^{\circ}$  W. At 1 P.M. the surface temperature fell to  $68^{\circ}$ , and varied between  $67^{\circ}\cdot 0$  and  $69^{\circ}\cdot 5$  till 8 P.M. At 4.40 P.M. observations showed that the current had changed to the eastward. At 10 P.M. the surface temperature again rose to  $70^{\circ}\cdot 5$ , and at midnight was  $72^{\circ}\cdot 0$ .

On the 21st a moderate gale was experienced all day with thick weather and rain squalls. The surface temperature continued at  $72^{\circ}\cdot 0$  until 4 A.M., but fell suddenly to  $61^{\circ}\cdot 0$  at 6 A.M., and then gradually to  $57^{\circ}\cdot 0$  by midnight. No astronomical observations could be obtained until the afternoon, but a double altitude at 2 and 4 P.M. showed a current of 40 miles N.  $65^{\circ}$  E. in 28 hours, or about  $1\frac{1}{2}$  miles per hour, agreeing precisely with the rate ascertained by afternoon observations yesterday. Large numbers of Terns, a few Petrels and Albatrosses in sight. The height of the waves from crest to hollow was 20 feet, the ship rolling through an arc of  $35^{\circ}$ — $4\frac{1}{2}$  rolls per minute.

On the 22nd the gale still continued, with fine cold weather, varied occasionally by rain squalls; the height of the waves 18 feet; the surface temperature gradually falling from  $57^{\circ}\cdot 0$  to  $48^{\circ}\cdot 0$ , but always warmer than that of the air. The observations showed a current of only 7 miles to the northeastward.

The current experienced on the 20th and 21st shows in a remarkable manner the recurving of the Agulhas Current, which on the 20th was running rapidly to the westward, and on the 21st just as rapidly to the eastward. The exact position of the change in direction was not ascertained, the weather being so gloomy that astronomical observations could not be obtained with sufficient frequency. From the sights that were taken it is certain, however, that the direction of the current changed between 9 A.M. and 5 P.M. on the 20th; and as a considerable change in the temperature of the surface water took place at noon, it appears highly probable that the changes in the direction of the stream coincided with this change of temperature. The width, therefore, of the west going stream is 80 miles. The width of the east going current is much more difficult to determine, as no observations were obtained until 2 P.M. on the 21st. A reference to the surface temperatures shows a sudden fall of  $10^{\circ}$  between 2 and 4 A.M., and then a gradual decrease of  $5^{\circ}$  to midnight. Now, from 4 P.M. on the 21st until 6 A.M. on the 22nd there was no current; the small amount registered on the 22nd being experienced after 6 A.M. The probability therefore is that the east going stream was entered between 2 and 4 A.M. on the 21st, when the fall of  $10^{\circ}$  in the surface temperature took place, the subsequent gradual decrease being accounted for by change of latitude; if so, the width of the east going stream must be 60 miles, and its velocity



C. OF GOOD HOPE.  
 TO THE  
 PARALLEL OF 60° S.  
 touching at the islands of  
 MARION, CROZET, KERQUELEN AND HEARD  
 Decr 1873. Jan'y Feby 1874.

For explanation of abbreviations &c see Appendix 1.

2½ miles per hour. The maximum temperature of the east going stream differed but slightly from that of the west going stream, for it attained its highest temperature after 5 P.M. on the 20th, at which time it was quite certain that the current was easterly. These remarks, of course, only refer to that part of the Agulhas Current crossed by the Challenger between the meridians of 19° and 23° E., and the parallels of 36½° and 39° S. Outside the space enclosed between those lines the direction and strength may be, and doubtless are, considerably modified<sup>1</sup> (see Diagram 8).

On the 23rd the surface temperature became lower as the ship proceeded to the southward, but was still higher than the air, owing probably to the southerly direction of the wind. The day was fine, with slight rain squalls. In the evening the barometer fell, the wind backed to the northward and became very squally.

On the 24th, at 10 A.M., the wind being light and the weather fine, a sounding and temperatures were obtained in 1570 fathoms. The deposit was a Globigerina ooze containing 92 per cent. of carbonate of lime, and a few Diatoms, Radiolarians, and mineral particles chiefly of volcanic origin. At 2 P.M. sail was again made towards Marion Island. Whilst sounding, a Penguin was seen swimming about 50 yards from the ship. The surface temperature was steady at from 42° to 43°, and about the same as that of the air. At 3 P.M. the weather became gloomy and the wind backed from N.W. to N.E. and E., a true cyclonic movement; the barometer fell rapidly, reaching its lowest point at 1 A.M. on the 25th, when there was but little wind. After 1 A.M. it rose again and the wind shifted to south and southwestward, thus retaining its cyclonic movement, and freshened to a moderate gale. At noon Marion Island was sighted bearing S. by E., and shortly after Prince Edward Island. The ship stood towards the land until 6 P.M., and then wore and stood to the northwestward until midnight. At 6 P.M. Ross Rock bore S. 68° E., right extremity of Prince Edward Island S. 52° E., Boot Rock south, and the right extremity of Marion Island S. 30° W. The peaks of the islands could not be seen, being shrouded in mist.

#### PRINCE EDWARD AND MARION ISLANDS.

At daylight (4 A.M.) on the 26th, the left extremity of Prince Edward Island being E. by S. ½ S., and the left extremity of Marion Island S.W., a course was shaped towards Boot Rock, the vessel passing about 1½ miles to the northward of it, steering careful courses, and registering the distances sailed by patent log in order to fix the relative position of the two islands, and make a running survey of them.

Marion and Prince Edward Islands were discovered on the 13th January 1772, by M. Marion du Fresne, who named the northern "Ile de la Caverne," in consequence of the large cave he observed in the cliffs of its eastern coast, and the southern "Ile de

<sup>1</sup> For the temperature observations, see Narr. Chall. Exp., vol. ii. p. 423, 1862.

*l'Esperance*," in the hope that this island would prove an outlying sentinel of the Antarctic continent, which was then being constantly sought for, and the necessity for the existence of which was firmly fixed in the minds of the geographers of that age. M. Marion tried for anchorage without success, and after remaining five days in the vicinity, abandoned his researches owing to the loss of the bowsprit and a mast of his consort "*Le Castries*," and some sails in his own ship "*Le Mascarin*."

These islands were next sighted on the 12th December 1776 by Captain Cook, who sailed between them, and not knowing the names given to them by M. Marion, called them the "*Prince Edward Islands*," which designation is still retained by the northern and smaller of the two.

From the year 1776 to the present time both islands have been much frequented by whalers and sealers, who as early as 1802 had establishments on shore on both islands; for Captain Fanning in the narrative of his voyages mentions them as if they were well known at that date. Sir James Ross received information to the effect that whaling vessels sometimes anchored off the east side of Prince Edward Island in 8 or 10 fathoms, with the cave W.N.W., the N.E. point N.E. by E., and the S.E. or Mary's Point S.W.  $\frac{1}{2}$  S.

From the records of M. Marion, Captain Cook, Sir J. Ross, and Captain Cecille, and the survey of the Challenger, the following account of these islands has been compiled:—

Marion Island, the southern and larger of the two, is 33 miles round; in shape an irregular parallelogram, whose sides are east and west, and N.E. by N. and S.W. by S., the sides running east and west averaging 11 miles in length, and the others 7 miles, with an area of 70 square miles, its summit rising upwards of 4200 feet above the level of the sea. Its geographical position has now been well ascertained, for good observations were obtained on shore by the Challenger's surveying officers. It lies between the parallels of  $46^{\circ} 48' S.$ , and  $46^{\circ} 56' S.$  latitude, and the meridians of  $37^{\circ} 35'$  and  $37^{\circ} 54' E.$  longitude. The observation spot close to the landing place just west of the N.E. point of the island is in lat.  $46^{\circ} 49' 30'' S.$ , long.  $37^{\circ} 49' 22'' E.$ , and Boot Rock, a remarkable islet off its north end, in lat.  $46^{\circ} 48' N.$ , long.  $37^{\circ} 43' 45'' E.$  (see Sheet 19).

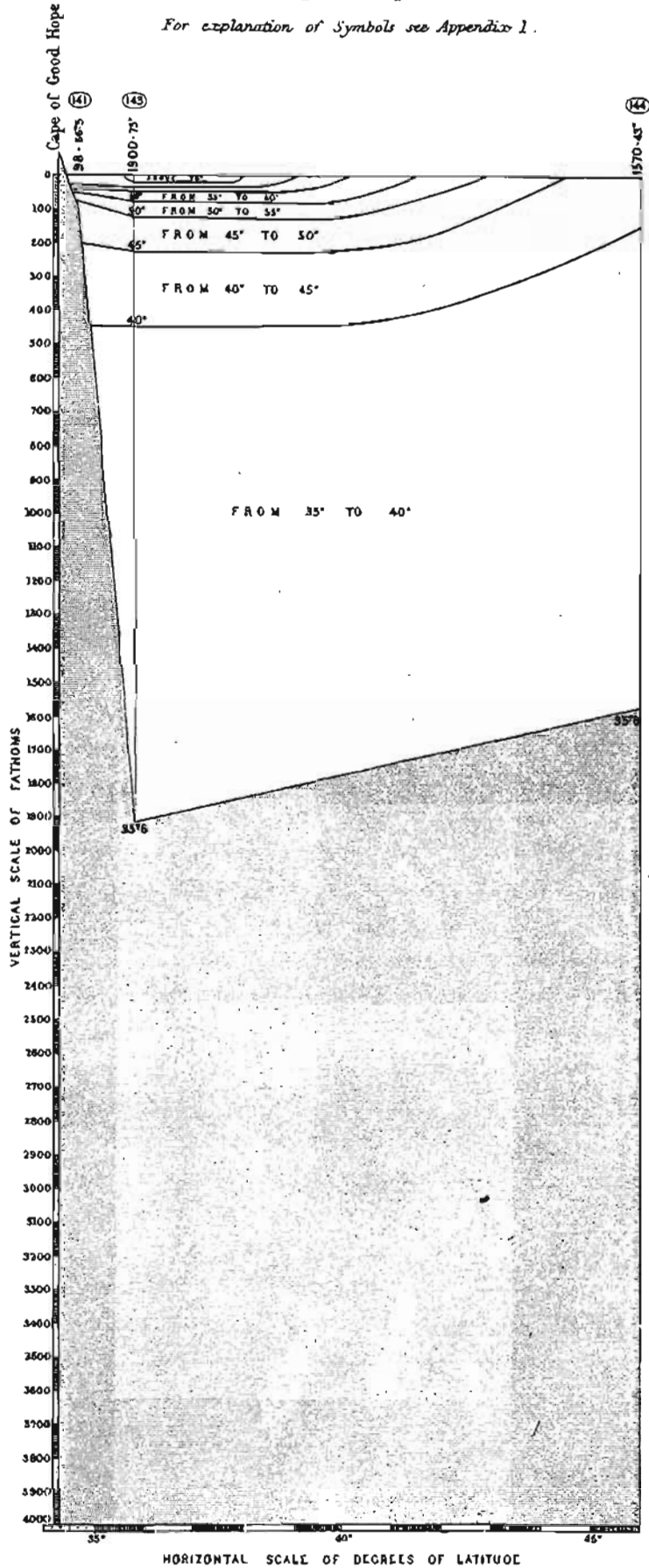
Prince Edward Island, the northern and smaller, is 15 miles round, circular in shape, with an area of 16 square miles. Its summit rises to the height of 2370 feet, and it lies between the parallels of  $46^{\circ} 34'$  and  $46^{\circ} 39' S.$  latitude, and the meridians of  $37^{\circ} 53'$  and  $38^{\circ} 1' E.$  longitude. On its northern side are three detached rocks (Ross Rocks), and on its eastern side a remarkable cave. Seen from the westward it shows a rounded summit, the land sloping gradually to the southward and terminating in a precipitous cliff about 1500 feet in height. On the north side the slope is more abrupt, and the north point is a wedge-shaped hill, which from a distance appears detached from the island; this hill is but slightly higher than the Ross Rocks which lie off it.

Both islands are surrounded by kelp, of which there is considerably more on the

# INDIAN OCEAN

## Meridional Temperature Section Cape of Good Hope to the parallel of 46° S.

*For explanation of Symbols see Appendix 1.*



eastern or leeward sides than on the western or weather coasts. In no case, however, does it extend far from the shore, nor has any been seen between the islands. The vicinity of the kelp should be carefully avoided. Between the two islands is a channel 12 miles in width perfectly free from danger, the depths in which vary from 90 to 130 fathoms.

The weather in the vicinity of the islands is seldom favourable, for owing to their height, their position in the open ocean far away from any larger tract of land, and the general prevalence of strong winds in their latitude, they are seldom free from fog or mist, and their summits are but rarely visible, whilst days may elapse before a landing can be effected on either of them. The prevalence of fog and mist not only renders the islands difficult to see, but also prevents the position of the vessel approaching them being ascertained with certainty, so that a course cannot be shaped to make them, or pass at a given distance on either side of them with any great degree of confidence, it is therefore advisable to avoid their neighbourhood unless some considerable object is to be gained by visiting them.

Viewed from the sea, the coast cliffs showed layers of compact and brecciated lavas of no great thickness, and were surmounted by an undulating country covered with herbage, which, as the height increases, passes into a barren mountain-cluster with many sharp and sometimes perfectly conical peaks. At the time of the Challenger's visit the highest of these were covered with snow, and for the greater part of the day enveloped in mist; the lower ones were mostly of a bright brick-red colour.

The snow commenced, as usual, on the slopes of Marion Island as patches lying unmelted in sheltered hollows, succeeded by a general thin coating or powdering over, through which the black rock showed out in all directions, and above this, again, on the highest cones and peaks, formed a continuous sheet of glistening white. The summits were enveloped in clouds, which lifted or dispersed in a partial manner from time to time. Amongst the patches of snow and below the snow line, the slopes of the island were covered with a coating of green, in striking contrast to the dark cliffs and red lower cones, which were almost destitute of verdure and had very little snow upon them. Here and there large patches of yellow showed out amidst the green, and were conspicuous even at some distance from the shore. It was found that these patches were formed of mosses. The mosses, indeed, occurring thus in patches, some dark, some nearly white, and others yellow, form the principal features in the vegetation as seen from a distance, showing out amongst the very uniform mixture of phanerogamic plants. The small rocky projections on the rough surfaces of the modern lava-flows, standing out dark above the verdure, have at a distance exactly the appearance of low bushes with dark foliage, and were at first believed to be such.

*Marion Island.*—At 6 A.M. sails were furled, and the ship proceeded under steam looking for a landing place and anchorage; the former was found at the northeast point

of Marion Island, but the deep water extended so close to the shore that it was deemed unadvisable to anchor, although it was concluded that it would be practicable to do so in case of necessity. At 9 A.M. observing and exploring parties were landed, each member of the latter being provided with a heavy stick, as it was expected that Fur Seals might be met with. The day was fine, and equal altitudes, circummeridian altitudes, true bearings, and magnetic observations for declination were obtained, whilst the ship took up stations between the two islands, and sounded and dredged; the position of the ship being fixed by bearings and masthead angles from the observing station at each sounding, at which time angles and bearings were taken from the ship to objects on shore.

On the shore near the observing station, the remains of huts with a few cooking utensils, some tubs, and iron work were found scattered about. One of these huts was built in a cave, the other on the open ground close to a Penguin rookery. They had evidently been occupied by parties landed from whaling and sealing vessels engaged in the fishery, and used in making Penguin oil. As the boat pulled on shore, cormorants flew about overhead in numbers. A gull also was common, probably the same as at Kerguelen Island (*Larus dominicanus*). The Giant Petrel or "Break-bones" (*Ossifraga gigantea*) was also wheeling about over the water, and also a few large Albatrosses. As the boat neared the beach a bird, like a small white hen, was seen eyeing the party inquisitively from the black rocks, against which a considerable swell was washing. This bird was the "Sheath-bill" (*Chionis minor*), so frequently met with afterwards in Kerguelen Island.

A female Elephant Seal was met with on the shore, which was killed forthwith, under the impression that it was a Fur Seal. The ruthless manner in which Fur and Elephant Seals were destroyed by the sealing parties in the early part of this century has had the effect of almost exterminating the colony that used these desolate islands for breeding purposes.

The walking on shore was extremely tiring; the bank was steep and the soil saturated with moisture, consisting of a black slimy mud with holes everywhere full of water. The thick rank herbage concealed these treacherous places, and the ground was covered with *Azorella* tufts, which gave way under the feet and rendered progression excessively wearying. Further, the sun coming out bright and hot every now and then made the party, who had gone on shore thickly clad, perspire very freely.

The large White Albatross or "Goney" (*Diomedea exulans*) had been seen from the ship as she steamed in towards the landing place, but now they could be examined more closely, for there were many of them all around. They were scattered irregularly all over the green in pairs, looking in the distance not unlike geese on a common (see Pl. XIV.). Their nests are in the style of those of the Mollymauks (see pp. 265, 266), but much larger, raised from the ground, and a foot and a half at least in diameter at the top. They are made of tufts of grass and moss, with





HOWLAND, EDINBURGH

PERMANENT PHOTOTYPE.

NESTS OF THE WANDERING ALBATROSS,  
MARION ISLAND.

SCOTT'S EXPEDITION  
1901-1904

plenty of adhering earth beaten and packed together, and are not so straight in the sides as those of the Mollymauks, but more conical, with broad bases. The female Albatross is sprinkled with grey on the back, and is thus darker than the male, which is of a splendid snow-white colour, with the least possible grey speckling, and was now, of course, seen in his full glory and best breeding plumage; the tails and the wings of both birds are dark. The Albatrosses met with at sea are most frequently birds in young plumage or bad condition, and have a rather dirty draggled look. The brooding birds are very striking objects, sitting raised up on the nest, commonly with the male birds beside them. They sit close on the nest when approached, and snap their bills savagely together, thus making a rather loud noise, and will lay hold of a stick with their bills when it is pushed against them, but need a good deal of bullying with the stick before they stand up in the nest and let the intruder see whether they have an egg there or not. Then the egg is seen to appear slowly out of a sort of feather pouch, in which it is held during incubation. Only one egg is laid, which is about five inches long, as big as a swan's, and white with specks of red at the large end. In most of the nests there were fresh eggs; in some, however, nearly full grown young birds. The old birds never attempted to fly, though persistently ill-treated, but merely waddled heavily over the ground; the old males tried to run away when frightened, but never even raised their wings. It is amusing to watch the process of courtship: the male standing by the female on the nest raises his wings, spreads his tail and raises it, throws up his head with the bill in the air, or stretches it straight out forwards as far as he can, and then utters a curious cry, like that of the Mollymauk, but in a much lower key, as would be expected from his larger larynx. Whilst uttering the cry, the bird sways his neck up and down; the female responds with a similar note, and they bring the tips of their bills lovingly together. This sort of thing goes on for half an hour or so at a time. Occasionally an Albatross sailed round and alighted upon the grass, but none were seen to take wing.

There were numerous nests of the Skua about amongst the herbage in dry places. The nests of these birds are never built near together; thus they always have a wide range of hunting ground round their nest. The Skuas in Marion Island were extremely bold and savage, as they were also in Kerguelen Island.

Three kinds of Penguins were abundant on the island. One kind (*Aptenodytes* [*Pygosceles*] *tæniatus*), called by the sealers the "Johnny," the "Gentoo" of the Falkland Islands, is much larger than the Crested Penguin, in fact, nearly as big as the King Penguin. The beak is bright red, long and sharp-pointed, the back dark, the breast white; the colour of the back is continued on to the head, but a white patch on the top of the head in contrast with the dark colouring is the marked feature about the bird. These Penguins were nowhere met with nesting, but were often associated with the King Penguins. They were usually to be met with here and in Kerguelen Island in parties of a dozen or twenty or thirty on the grass, close to the shore, and were

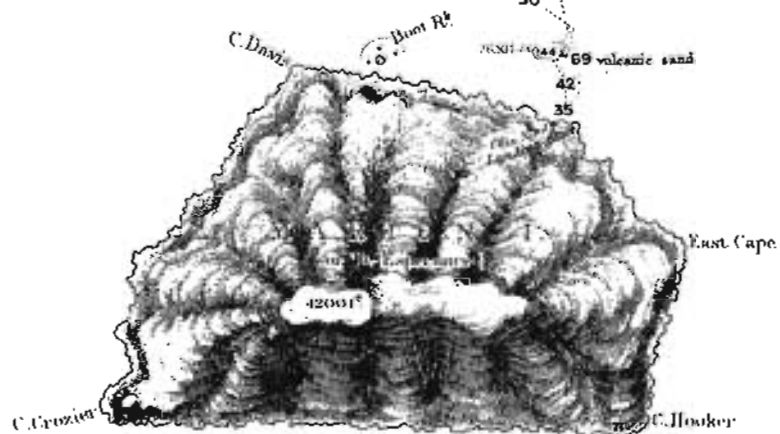
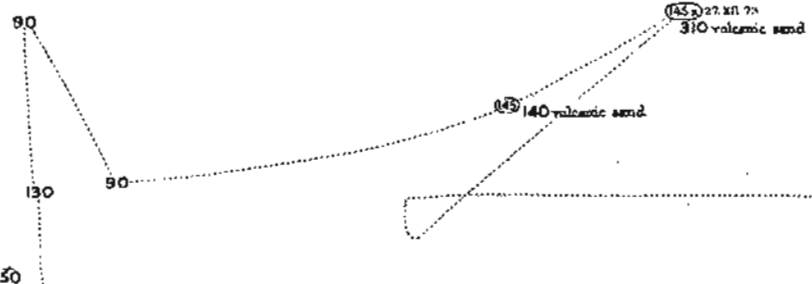
apparently moulting at the time of the visit. At Christmas Harbour, Kerguelen Island, small droves of them "camped" as the sealers term it, at 100 feet at least, up the steep but green hillside at the end of the harbour. These Penguins do not hop, but run, and when closely pursued throw themselves on their bellies on the ground, and struggle along, rowing themselves with violent blows of their wings on the sand or mud, dashing the mud into the eyes of their pursuers. When in the water, as they come to the surface, they make a sort of very feeble imitation of the leap of the Crested Penguins, never throwing the whole of the body out of the water, but only the back. They are also to be seen swimming about when undisturbed with their head and back out of the water, and the body horizontal.

Another Penguin, the "Rockhopper" (*Eudyptes chrysocome*), the same species that occurs at Tristan da Cunha, was nesting about the low cliffs on the shore. The ground on which the nests were made was very wet and filthy, and the nests were like those of the Jackass Penguins at the Cape of Good Hope, made of small stones, raising the egg about an inch from the mud. These Penguins were exactly like the Tristan ones in their cry, and quite as savage, but they were in full sight, and not amongst grass; for though there was plenty of grass just over them, nearly a foot in height, they prefer to build where the ground is quite bare. The birds therefore for some reason have adopted slightly different habits from those of the representatives of the species at Tristan da Cunha.

Most interesting, however, by far, amongst all the rookeries was one of King Penguins (*Aptenodytes longirostris*), met with a little further along the shore. The rookery was on a space of perfectly flat ground about an acre in extent, and was divided into two irregular portions, a larger and smaller, by some grassy mounds. The flat space itself had a filthy black slimy surface; but the soil was trodden hard and smooth. About two-thirds of the space of the larger portion of the rookery was occupied by King Penguins, standing bolt upright, with their beaks upturned, side by side, as thick as they could pack, and jostling one another when disturbed. The King Penguins stand about 3 feet high, and are distinguished at once not only by their size, but by two narrow streaks of bright orange yellow, one on each side of the glistening white throat. These Penguins were to be seen coming from and going to the sea from the rookery, but singly, and not in companies like the Crested Penguins. The King Penguins, when disturbed, made a loud sound like "urr-urr-urr." They run with their bodies held perfectly upright, getting over the ground pretty fast, and do not hop at all. A good many were in bad plumage, moulting, but there were plenty also in the finest plumage. The smaller area of the rookery, which consisted of a flat space sheltered all round by grassy slopes, forming a sort of bay amongst these, and communicating with the larger area by two comparatively narrow passages, was the breeding establishment.

These Penguins are said by some observers to set apart different spaces in their

SOUNDINGS AND STATIONS  
 in the vicinity of  
**P. EDWARD AND MARION I<sup>DS</sup>**  
*For explanation of abbreviations &c. see Appendix 1*



38° Long East from Greenwich

rookeries for moulting birds, for birds in clean plumage not breeding, and again for breeding birds. Here the breeding ground was quite separate and the young and breeding pairs were confined to this smaller sheltered area. This was the only King Penguin rookery seen in full activity during the entire voyage; at Kerguelen Island the King Penguins were only met with in scattered groups of a dozen or twenty, and they were not breeding, but moulting. On this breeding ground, at its lower portion, numbers of Penguins were reclining on their bellies, and it was thought at first they might be covering eggs, but on driving them up, they were seen to be only resting. There was a drove of about a hundred Penguins with young birds amongst them. The young were most absurd objects; they were as tall as their parents, and moved about bolt upright with their beaks in the air in the same manner. They were covered with a thick coating of a light chocolate down, looking like very fine brown fur, which was at least two inches deep on the birds' bodies, and gave them a curious inflated appearance. They had a most comical appearance, as they ran off to jostle their way in amongst the old ones; they seemed to run rather better than the adults. Absurd in appearance as were these young, those that were just dropping the down and assuming the white plumage of the adults were far more so. Some were to be seen with the brown down in large irregular patches, and the white feathers showing out between these. In others the down remained only about the neck and head, and in the last stage a sort of ruff or collar of brown remained sticking out round the bird's neck, and then, when it cocked-up its head, it looked like a small boy in stick-up collars. The birds in this stage of moulting had a peculiar expression of vanity, and as they ran off on their short stumpy legs, it was impossible to resist laughing outright. At the farthest corner of the breeding space, in the most sheltered spot, was a clump of birds, a hundred or more, most of them in a slightly stooping posture, and with the lower part of their bodies bulged out in a fold in front. When these birds were approached and bullied with a stick they shifted their ground a bit, with an awkward sort of hopping motion, with the feet held close together. The idea immediately suggested itself that they were carrying eggs with them, in accordance with the peculiar habit of this species as described in works on natural history. Their gait was quite peculiar, and different from the ordinary one, and evidently laboured and difficult. One of them was struck with a stick, and after some little provocation she let her egg drop from her pouch, and then at once assumed the running motion. These birds carry their egg in a pouch between their legs, and hold it in by keeping their broad webbed feet tucked close together under it. They make absolutely no nest, or even mark from habitually sitting in one place, but simply stand on the rookery floor in the stooping position above described, and shift their ground a little from time to time, as occasion requires. The egg is probably not dropped till the young one begins to break the shell. Charles Goodridge, who was one of a searching party on the island

in 1820, and spent two years on the Crozets,<sup>1</sup> says that the period of incubation is seven weeks, and that they commenced laying in the Crozets in November, and continued to lay, if deprived of their eggs, till March. Unfortunately no close examination of the exact structure of the pouch was made, and as it was not in the least suspected that this was to be the only opportunity of observing the breeding habits of this bird during the voyage, no brooding females were specially prepared to show it. Goodridge compares it to the pouch of a kangaroo. Probably the larger species of the genus, the Giant Penguin (*Aptenodytes forsteri*) of the far south, which has to hatch its egg on the ice, secures it from being killed by the cold in a similar manner. The birds with eggs were sitting close together, and when frightened so that some were driven against the others, savage fights ensued, and blood was drawn freely; the birds whose ground was invaded striking out furiously with their beaks. Round about the brooding birds were others, apparently males, in considerable numbers, who probably feed the females with which they are paired. There were also some young downy birds, and if one of these latter were driven in amongst the brooders it was at once pecked almost to death. The young ones utter a curious whistling cry, of a high pitch and running through several notes, quite different from the simple bass note of the adults. The rookery was only inhabited to about a quarter of its extent, but it was strewn everywhere with the bones of the Penguins in heaps, and on the verge of the rookery was a small ruined hut, without a roof, and overgrown with weeds, containing an iron pot and several broken casks, and some hoop iron, evidently an old sealer's hut. The sealers had probably employed their spare time in making penguin oil, and perhaps taking skins, which are made up into rugs and mats at the Cape of Good Hope, often only the yellow streaked part about the neck being used. Hence the many bones and emptiness of the rookery. The egg of the King Penguin is more than ordinarily pointed at the small end; it is greenish-white, like other penguin eggs.

Living also about the rookery was a flock of about thirty Sheath-bills (*Chionis minor*). The instant they saw the party approaching they came running in a body over the floor of the rookery in the utmost excitement of curiosity, up to within reach of a stick, uttering a "cluck, cluck," which with them is a sort of half-inquisitive, half-defiant note. Several were knocked over with big stones and sticks; but the remainder did not become in the least alarmed. They just fluttered up off the ground to avoid a stone as it was sent dashing through the thick of them, but immediately pitched again, and ran up, as if to see how the stone was thrown. At the rookery they were living on all sorts of filth dropped by the Penguins, and were the scavengers of the place, and when some of the brooders were driven off their eggs, and an egg or two got broken, the Sheath-bills, who had followed closely, notwithstanding the slaughter done amongst them, came and pecked at the eggs almost between the explorer's legs.

<sup>1</sup> Narrative of a Voyage to the South Seas, &c., by C. M. Goodridge, pp. 22, 23. London, Hamilton & Adams, 1833.



Нижняя часть

Верхняя часть

VIEW IN KERQUELEN ISLAND,  
WITH HUMMOCKS OF (*Loretta selago*)

Near this rookery was a shallow freshwater lake, on which some young Albatrosses were swimming. There were numerous White Albatross's nests scattered about, but they did not extend more than 100 feet above sea level, and hardly anywhere as high up as that. High up, at about 500 feet elevation, were some four or five Sooty Albatrosses (*Diomedea* [*Phaebetria*] *fuliginosa*, the "Piew" or "Pio" of sealers), soaring about the tops of the cliffs; probably they nest there. This bird is continually to be seen flying about cliffs and higher mountain slopes, and never seems to nest low down like the Mollymawk and Goney.

In holes in the banks at this elevation, a Prion (*Prion banksi*) was extremely abundant, but it was also pretty common down about sea level. Its peculiar angry cry, somewhat like the snarling of a puppy, uttered as it hears footsteps about its hole, is very puzzling at first as listened to coming up from the ground at one's feet.

The rocks, about high-water mark, are covered with a dense growth of the large brown seaweed (*Durvillea utilis*), which is of great assistance in breaking the surf. The plant has stout stems, as thick as the wrist, attached to the rock by large conical boss-like suckers, and with large spreading leaves on the stalks, provided with floats composed of a series of honeycomb-like air-cells within a thickened frond. Beyond the ordinary reach of the sea, but still within the beach-line, the rocks are covered with a Crassulaceous plant (*Tillæa moschata*), which occurs also in Kerguelen Island. Above the beach is a thick growth of herbage investing a swampy black peaty soil, which covers the underlying rock more or less thickly everywhere on the lower ground, and extends up with the herbage almost to the snow. The principal plants forming the thick growth are *Acæna adscendens*, by far the most abundant plant on the island, *Azorella selago*, forming bright green patches in intervals between the *Acæna* or cake-like masses at its roots, and a grass *Poa cookii*. *Azorella selago* is a characteristic plant of the southern islands, and will be frequently referred to in the sequel (see Pl. XV.). It belongs to the Umbelliferæ, and forms large convex masses often several feet in diameter, which are compact and firm, and when on solid ground yield little to the tread. The masses are made up of the stems and shoots of the plants closely packed together side by side, with their flowering tips and small stiff and tough leaves forming an even rounded surface at the exterior, being all of the same length; the interior of the masses is full of dead leaves and stems. The whole, where growing in abundance, formed sheets and hummocks which invest the soil, sometimes for acres in extent at Kerguelen Island, with a continuous elastic green coating. An allied plant, *Bolax glebaria*, forms similar masses at the Falkland Islands, and there is a tendency in many Antarctic plants to assume a similar habit, as in the case, e.g., of *Lyallia kerguelensis*.

*Pringlea antiscorbutica* (see Pl. XVI.), the Kerguelen Cabbage, is, at least in the part of the island explored, by no means so abundant as at Kerguelen Island. It was some



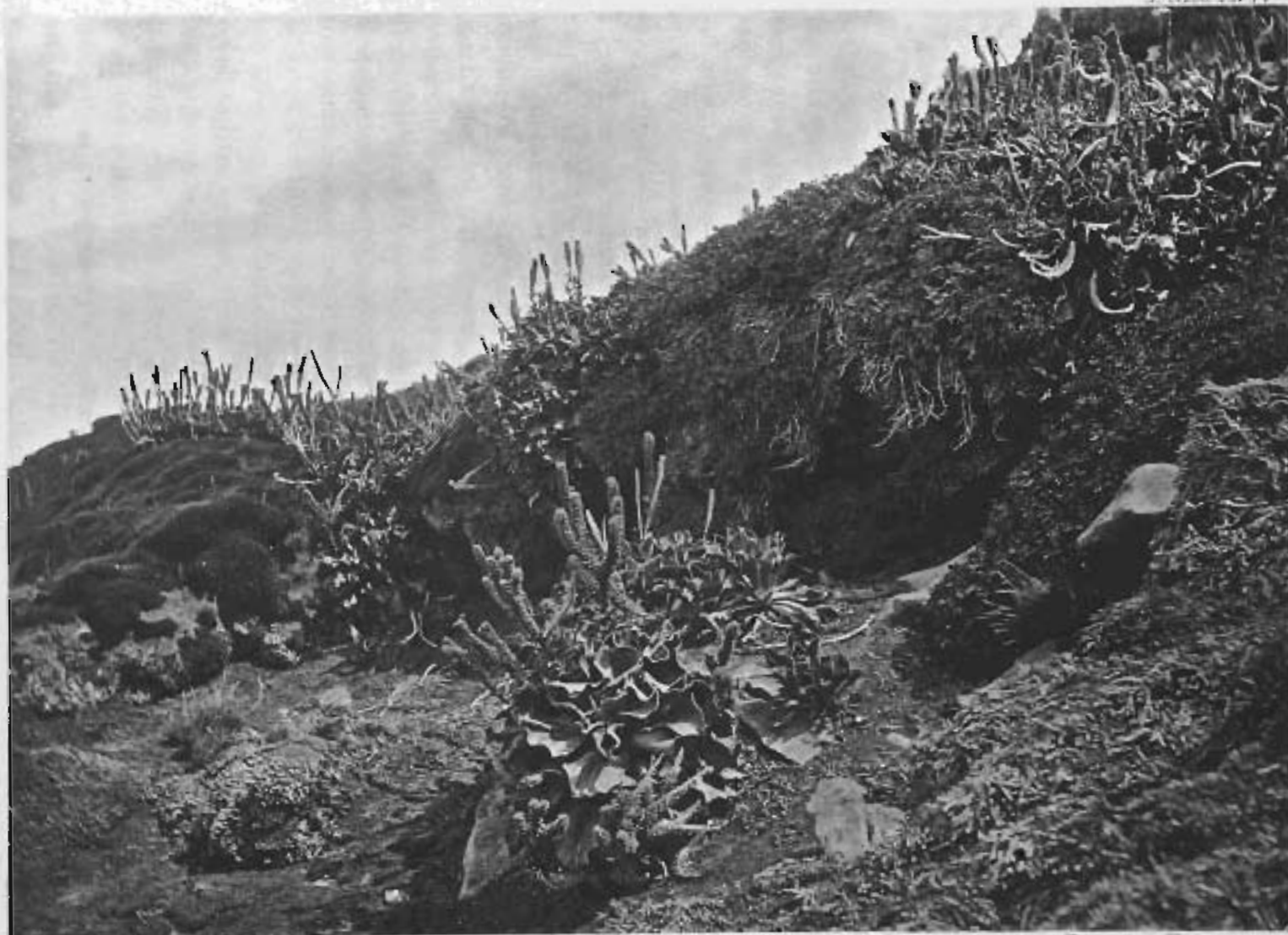
time before a plant was found; subsequently a good many were met with, but growing in groups of only four or five. Some were found on the very verge of the shore, within reach of the spray, and the rest on the banks of a small rivulet. The Cabbage was mostly in full flower and bud, with sepals and anthers complete; no plants were found with seed at all ripe, and the last year's seeds were decayed. This plant at least would appear to have a regular summer flowering-season, since Sir Joseph Hooker found only the fruit at Kerguelen Island in the winter.

*Hymenophyllum tunbridgense* var. *wilsoni*, the well known British Fern, and *Polypodium (Grammitis) australe* grow abundantly on the sheltered sides of the projecting rock-masses already mentioned, but are dwarfed and almost hidden amongst the mosses; they grow in greatest luxuriance on the damp banks of the stream.

The mosses are in most striking abundance,<sup>1</sup> and, in some very wet places, form continuous sheets over the ground many square yards in extent. Lichens are not in very great quantity, except the incrusting forms, which are tolerably abundant on the rocks.

An attempt was made to reach the actual upper limit of vegetation, but failed from being commenced too late in the day. The ascent was up the bed of the small stream already mentioned, which lay at the verge of one of the modern lava-flows, where it abutted on a low cliff exposing a more ancient flow in section. The more recent flow had a very gradual inclination of not more than 8°. When the swampy moss-covered ground, the uniformly dull green colour of which was relieved here and there by the snowy plumage of the nesting albatrosses, had been left behind, the stream was found to flow over an apparently very recent stream of black cellular lava, the ripples and eddies in which were still perfectly fresh, except in the very centre, where they had suffered some slight abrasion; there was no trace of any hollowing action on the part of the water, the windings and little waterfalls being still determined by the original inequalities of the solidifying rock. The lava was basaltic, containing much olivine. Close by the bed of the stream rose several of the above mentioned red conical hills. One of these, the highest within reach, consisted of a heap of loose scoriæ disposed in layers, dipping away on all sides at a regular and very steep angle. Few of these pieces of scoriæ were more than six inches in diameter; and had it not been for the occasional clumps of moss which alone afforded a sure footing, the ascent would have been a matter of considerable time. At the top was a perfectly conical pit, and slightly below the summit, on the north side, were three smaller and similar pits. The scoriæ of which the hill is made up consisted of a highly cellular red ground mass, with indications of augite, without, however, any perfect crystals being discernible. Besides the red scoriæ, there were some of a chocolate-brown colour, with frothy exterior and compact kernel. The form of some of them resembled the almond-shaped bombs found in many volcanic districts; but none were noticed with the dense outside and highly cellular core so characteristic of the

<sup>1</sup> Thirty-one species were collected, five of which are described by Mr. Mitten as new in Bot. Chall. Exp., part ii., 1884.



Нордгорн, Симетрон.

PERMANENT PHOTOGRAPH.

VEGETATION KERGUELEN ISLAND.  
(*Pringlea antiscorbutica*).

true volcanic bomb. Besides this hill, there were five or six others precisely similar in appearance, and rising out of the same valley or depression in the ground. From the top of the hill this depression could be seen to be bounded, towards the interior, by a semi-circular cliff of rock, in some parts columnar, and open towards the sea. Above this cliff rose the snow-covered cones and peaks of the interior, which, wherever the snow had been removed, showed the same red colour and steep sides, so that there can be little doubt of their being similarly formed to those on the lower ground. On leaving the stream bed and returning to the eastward over the spur of the mountain, the cliff had to be skirted, and it was found to consist of a light grey compact doleritic rock.

From these few observations it may be concluded that the island consists of a foundation of older lava ruptured and surmounted by recent volcanoes. That these have been active at no very ancient date is rendered probable by the perfect preservation of the forms of the cones with their summit craters, and by the fact that the mossy vegetation, so luxuriant at their base, and retaining this luxuriance on the certainly older mountain spurs to an elevation at least equal to that of the top of the cone ascended, has as yet spread up their sides only in straggling isolated patches. The evidence afforded by the want of erosion deserves all the more weight when the position of the island is remembered, where of necessity the rainfall must be considerable.

The first scattered patches of snow were encountered at about an elevation of 800 feet. A patch of the Cabbage was met with at 1000 feet. The highest point reached was at an elevation of about 1500 feet, where patches of snow were frequent. Here *Ranunculus biternatus* had disappeared, and where growing a little lower down was very much dwarfed. The *Azorella*, with a few mosses, formed the principal vegetation; but the green was merely dotted over the bare rock and stones. The *Azorella* appeared from this point to continue on for about 300 feet more, becoming scantier and scantier. The absolute limit of vegetation may probably be placed at about 2000 feet. The part explored was somewhat sheltered. A red cone of scoriæ more exposed was quite bare of green from about 1000 feet elevation upwards.

At about 1400 feet elevation, the water in a shallow pool exposed to the sun was found to have a temperature of 65° F., the temperature of the air in the shade being 44°. At 900 feet a similar pool, but one which had a small stream of colder water running into it from the cliff, had a temperature of 55°, the air there being 45°, while the thermometer when plunged into the midst of a rounded mass of *Azorella*, rose to 50°. It is therefore evident that these mounds retain and store up a considerable quantity of the sun's heat; and this fact probably yields a partial explanation of their peculiar form, which is that of so many otherwise widely different Antarctic plants, and of some Swiss and New Zealand Alpine plants (*Raoulia*, *Haastia*). No doubt power of resistance to wind is also gained by the assumption of this form.

At 6 P.M. the surveying and exploring parties returned, and the ship worked to windward under easy sail between the two islands during the night.

On the 27th the weather in the morning was thick and cloudy, so that it was unadvisable to proceed towards the land or to send exploring parties on shore; the day was therefore devoted to dredging, which proved very satisfactory. The islands were occasionally seen through the mist, thus enabling the position of the soundings to be fixed. In the afternoon they were both seen for a short time. The dredgings between the island showed that the bottom, in depths less than 100 fathoms, was covered with great masses of Polyzoa, the dredges and swabs being filled and covered with them; Mr. George Busk records sixteen species from this locality, eight of which are new. There were also numerous animals belonging to all the marine invertebrate groups. In 130 and 310 fathoms there was a volcanic mud containing 15 to 20 per cent. of carbonate of lime, shells, many Diatoms, and many volcanic minerals and lapilli of vitreous basaltic rocks.

#### MARION ISLAND TO THE CROZET ISLANDS.

At 6 P.M. on the 27th December, sail was made for the Crozet Islands, and the 28th December, the day after leaving Marion Island, was bright and sunny, with a smooth sea, moderate northerly wind, and a high and steady barometer.

On the 29th the weather still continued fine, but was misty, the mist at times amounting to a light fog. Advantage was taken of this fine weather to sound and trawl in 1375 fathoms; serial temperature soundings were also obtained (see Sheet 18). Four Penguins appeared on the water close to the ship while dredging was going on, and stopped in the vicinity for some time.

On the 30th, the weather still continuing fine, a sounding and trawling were obtained in 1600 fathoms with excellent results (see Sheet 18). At 10 P.M. Hog Island of the Crozet group was seen. During the night a large cetacean came close to the ship but soon disappeared.

The trawlings at the two Stations on this section, in depths of 1375 and 1600 fathoms, were probably the most productive of the cruise; between one and two hundred animals, belonging to nearly all the marine groups, were taken at each of the hauls, and with few exceptions they belonged to genera and species discovered for the first time by the Expedition. In the memoirs already published, 7 new genera and 35 new species are described from the trawling in 1375 fathoms, and 9 new genera and 29 new species from 1600 fathoms; among these, 12 species are common to both Stations. It is probable that these new species do not represent more than one-third of the whole number discovered, but this cannot be said with certainty till all the specialists have completed their reports.

The deposit at 1375 fathoms was a Globigerina ooze, containing 81 per cent. of carbonate of lime, the residue being almost wholly remains of Diatoms and Radiolarians. At 1600 fathoms there was only 35 per cent. of carbonate of lime, 40 per cent. of Diatom

and Radiolarian remains, and 25 per cent. of minerals and argillaceous matter. There were a few rounded quartz particles in each of the deposits, but the great majority of the mineral particles were of volcanic origin. The carbonate of lime in these deposits consisted chiefly of Globigerinas and Coccoliths. Neither Orbulinas nor Rhabdoliths were observed in the deposits, nor at the surface, so that these Stations are probably beyond the southern limit of these organisms.

Dr. P. H. Carpenter and Professor L. v. Graff, of Graz, refer to some of the Crinoidea and Myzostomida, found at these Stations, in the following summaries of their Reports on these groups<sup>1</sup> :—

*The Crinoidea.*—“ Twelve genera of recent Crinoids are now known to science, six of which are usually classed as ‘ Stalked Crinoids,’ while the other six belong to the group of Feather-stars, or Comatulæ. Species of every genus, with the exception of *Holopus* (see p. 153), were obtained by the Challenger, while the number of existing genera was increased by one half, four being added to the eight previously known. The most familiar of these is the beautiful *Pentacrinus*, a type closely allied to the well-known Liassic fossils *Extracrinus briareus* and *Extracrinus subangularis*, specimens of which have been found with stems from 50 to 70 feet in length. There are several Jurassic and Cretaceous species of *Pentacrinus*, but only eight living ones are known. Four of these have not been met with out of the Caribbean Sea, while two inhabit the Atlantic and two the Pacific. The surveys of the U.S.C.S. steamer ‘ Blake’ have discovered *Pentacrinus* in depths as shallow as 42 fathoms, while it was found to be remarkably abundant in 175 fathoms off Havana, one haul of the dredge and its appendages bringing up no less than 120 individuals. There would seem, therefore, to be regular forests of them upon the sea bottom in this and other localities, just as must have been the case in the Liassic seas. Although *Pentacrinus* was only once met with in the Caribbean Sea at a greater depth than 500 fathoms, both the Pacific species were obtained by the Challenger between 500 and 630 fathoms, one of them possibly coming from 1350 fathoms. Failing this last, *Pentacrinus wyville thomsoni*, which was dredged by the ‘ Porcupine’ (1870) off the coast of Portugal in 1095 fathoms, is the deepest *Pentacrinus* known.

“ The stem of this genus bears whorls of cirri which may be some distance (forty joints) apart, as in *Pentacrinus wyville thomsoni* (fig. 117), or very close together, as in the *Pentacrinus maclearanus* (fig. 116) from Station 122 (350 fathoms). The union of the nodal or cirrus-bearing stem-joints with those beneath them is slightly different from that found in the other parts of the stem, and is more easily severed; and although individuals have sometimes been found with their stems attached to telegraph cables by a slightly spreading base, yet in other cases the stem appears to be free, having broken across below one of the nodal joints, which becomes rounded off and closed up by a subsequent

<sup>1</sup> Report on the Crinoidea, by P. H. Carpenter, D.Sc., Zool. Chall. Exp., part xxxii., 1884; Report on the Myzostomida, by Dr. L. von Graff, Zool. Chall. Exp., part xxvii., 1884.

calcareous deposit. This is the case with the individuals represented in figs. 116 and 117, and it would seem that under these circumstances the animal practically becomes a free

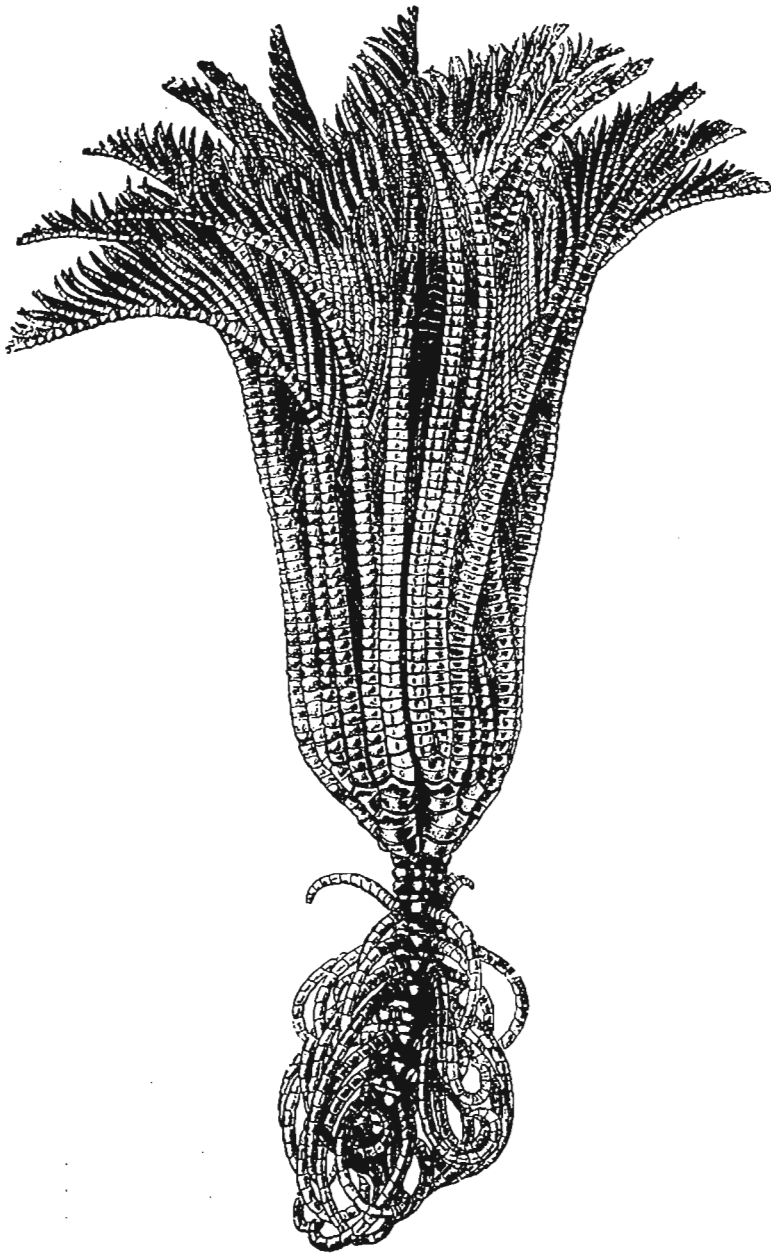


FIG. 116.—*Pentacrinus nuclearanus*, Wv. Thoms.

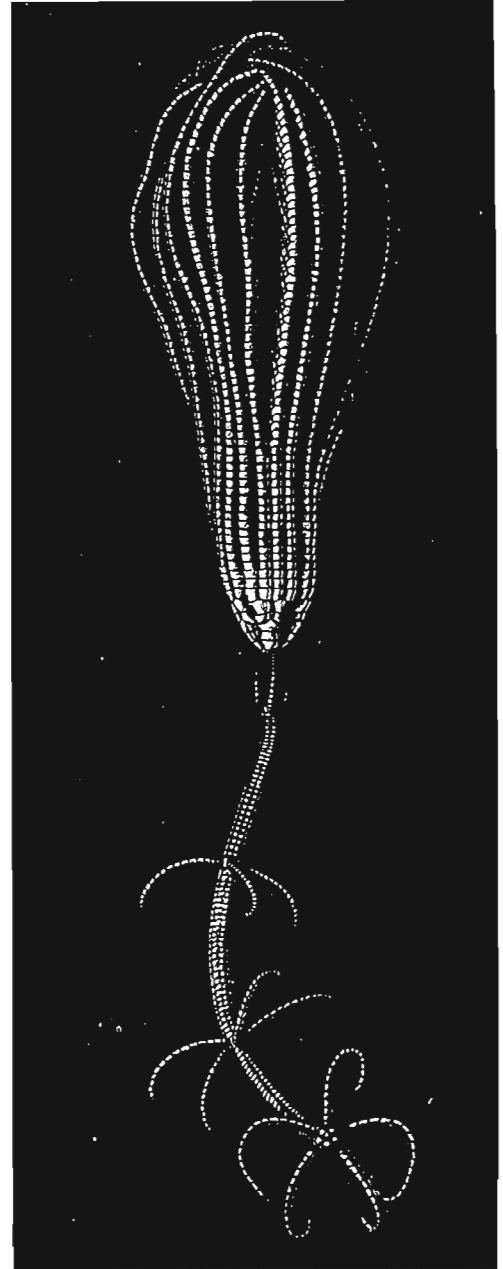


FIG. 117.—*Pentacrinus wyville thomsoni*, Jeffreys.

Crinoid like a Feather-star, with the power of swimming about and temporarily fixing itself again; while if the trailing stem gets caught or injured in any way, it can be

broken across at a nodal joint, and the body with the upper part of the stem liberated, eventually to attach itself elsewhere by means of its cirri.

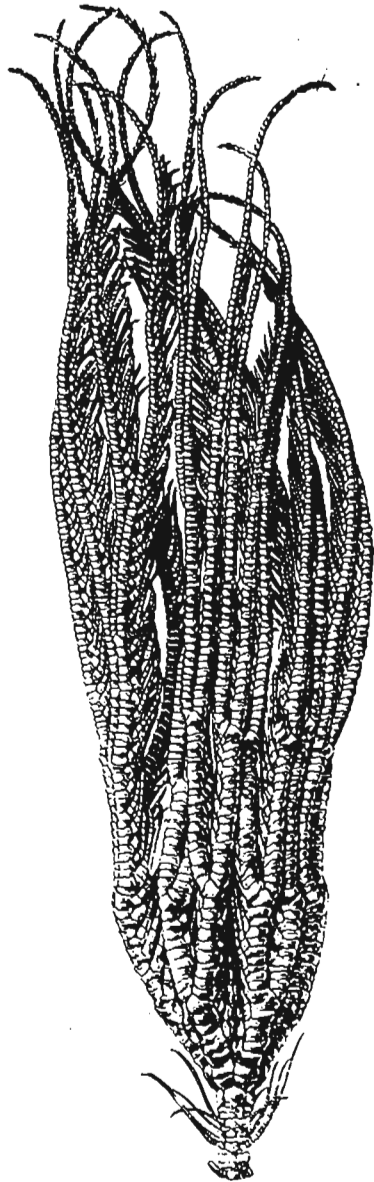


FIG. 118.—*Metacrinus toyvillii*, P. H. Carpenter.

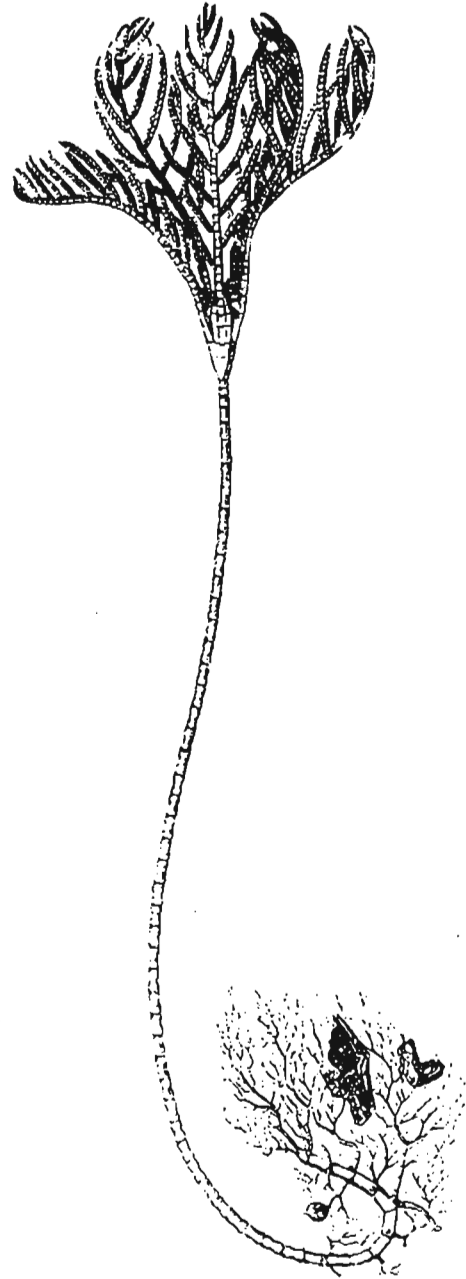


FIG. 119.—*Rhizocrinus lofoensis*, M. Sars.

“The lowest part of the cup which rests upon the top of the stem is formed of a more or less complete ring of basal plates. Alternating with the basals, and resting upon them, are the first radials, and second radials are attached to these by muscular joints, bearing

in their turn the third radials or axillaries. Each of these bears two primary arms, which either remain single or divide again more or less frequently; but there are rarely more than forty or fifty arms altogether, the forking taking place much less often than in certain Comatulæ.

“The recent dredgings in the Atlantic and in the Caribbean Sea have yielded six species of *Pentacrinus*; but only two were obtained in the Pacific, one of them, however, occurring at such widely separated localities as the Kermadecs (Station 170) and the Philippines (Station 214). At both these Stations, and also at others near them, several species were met with of a new genus of Pentacrinidæ, for which the name of *Metacrinus* is proposed (fig. 118). It is a close ally of *Pentacrinus*, but instead of three, has four or six radials, the second of which is a compound (syzygial) joint and bears a pinnule, as do all the following joints below the axillary. The ‘Vega’ obtained a species of this genus in 65 fathoms, in the bay of Yeddo, Japan, and eleven species were found by the Challenger distributed among four Stations in the Pacific, between 500 and 630 fathoms, Stations 192 and 214, being those where, like *Antedon*, it was found to be most abundant.

“The family Bourgueticrinidæ is well represented in the Atlantic, though no member of it has yet been obtained in the Pacific. Two species of the genus *Rhizocrinus* (fig. 119), so well known on the Norwegian coast, have been found at several localities in the North Atlantic (including Station 122), and in the Caribbean Sea, while there are several fossil forms in the Tertiary deposits. The special interest of *Rhizocrinus* is due to its being a dwarfed and degraded representative of the familiar chalk fossil *Bourgueticrinus ellipticus*, and this is itself a similarly dwarfed member of the large group of Pear-enocrinites or Apiocrinidæ, which are so abundant in the Bradford Clay and the other Jurassic rocks, but seem to have died out before the middle of the Cretaceous period. The calyx of *Rhizocrinus* is comparatively long, owing to the height of the basals, while the radials are relatively small. These bear five simple arms, the joints of which are immovably united to one another in pairs by a kind of suture, which is known as a syzygy. Only the upper joint of each pair bears a pinnule, and there are no pinnules at all upon the first four or five pairs.

“Two species of *Bathycrinus* (fig. 120) were dredged by the Challenger in the Atlantic, where it has the widest distribution of all the Stalked Crinoids. The genus had hitherto been known only by a single immature specimen (fig. 121), which was brought up in 1869 by the ‘Porcupine’s’ dredge, from a depth of 2435 fathoms, in the Bay of Biscay. Like *Bourgueticrinus* and *Rhizocrinus*, it is attached by a more or less spreading root, and its dice-box shaped stem-joints are very similar to those of these two genera. But the basals are quite low, and so closely united that the sutures between them are invisible externally, except in young individuals. The radials, on the other hand, are comparatively large, and are united by a muscular joint to broad second radials. To the



upper surfaces of these are articulated the third radials or axillaries, but by ligaments only and without the intervention of muscles. Each axillary bears two arms, so that

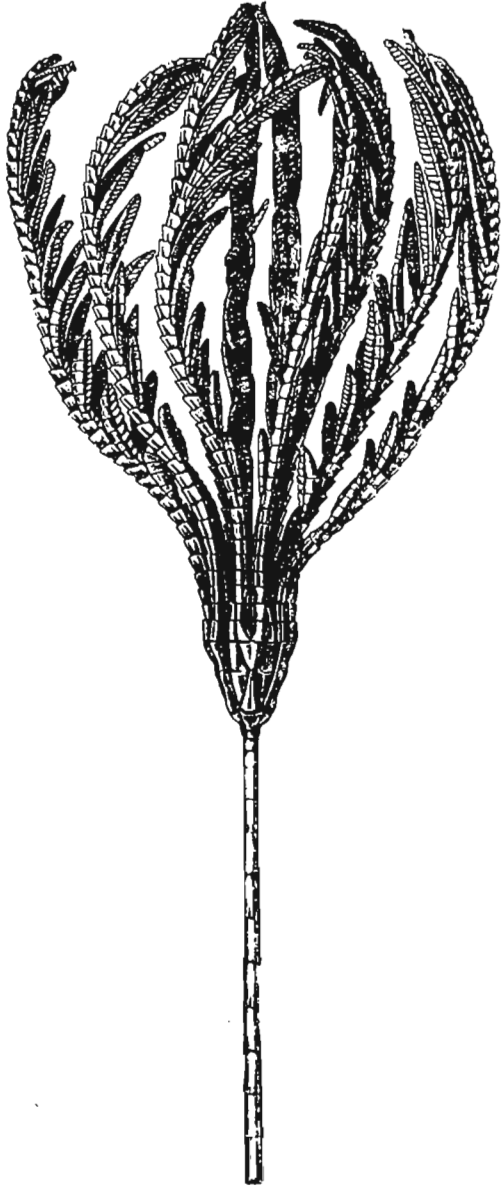


FIG. 120.—*Bathycrinus campbellianus*,  
Wyv. Thoms., M.S.

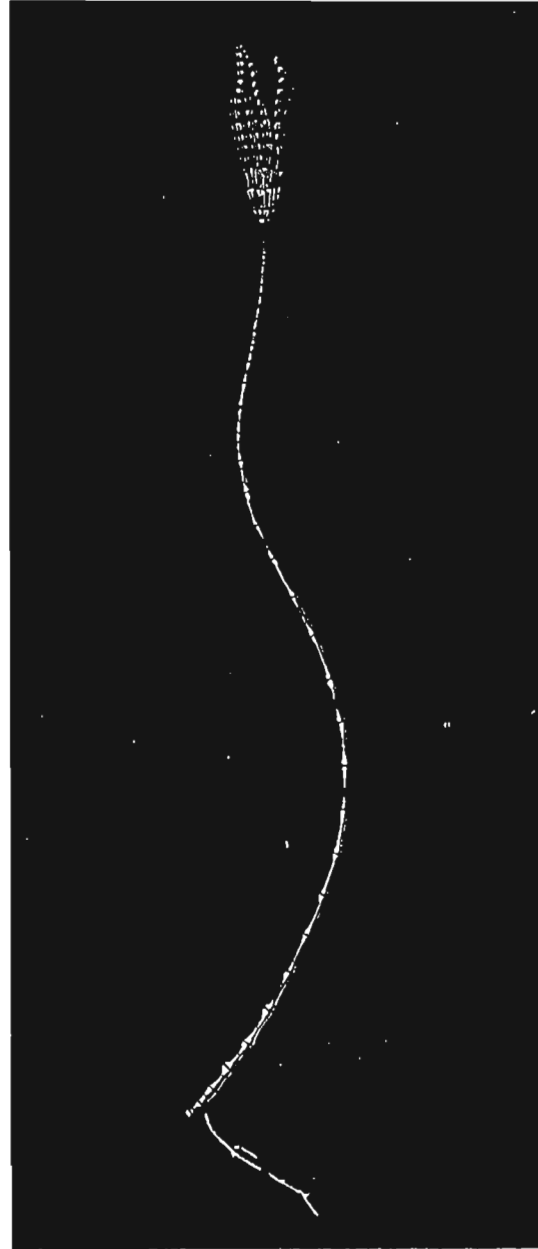


FIG. 121.—*Bathycrinus gracilis*, Wyv. Thoms.

there are ten arms in all, and not five only as in *Rhizocrinus*. As in this genus, too, the arm-bases bear no pinnules, and most of the joints are united in pairs. The union,

however, is not an immovable syzygy, as in *Rhizocrinus*, but the same peculiar form of articulation as occurs between the second and third radials.

“The individual represented in fig. 120 was obtained in Mid Atlantic, just north of the equator (Station 106, 1850 fathoms). It was originally regarded by Sir Wyville Thomson as identical with a species which was dredged in considerable abundance in the Southern Sea (Stations 146, 147, 1375 and 1600 fathoms), and was named by him *Bathycrinus aldrichianus*; and the accompanying figure appeared under this name in ‘The Atlantic.’ Subsequently, however, Sir Wyville seems to have distinguished the two species, for the name *Bathycrinus campbellianus* occurs in his handwriting on the plate in which the individual from Station 106 is represented.

“A fourth species (*Bathycrinus carpenteri*) has since been dredged in the North Atlantic by the Norwegian North Atlantic Expedition. The genus ranges in depth from 1050 to 2435 fathoms, while *Rhizocrinus* has not been found deeper than 955 fathoms, and occurs at 80 fathoms in the Norwegian fjords. No fossil species of *Bathycrinus* are known.

“But for its resemblance to *Rhizocrinus*, it is probable that this genus would hardly be regarded as related to the Apiocrinidæ. The novel form (*Hyocrinus*<sup>1</sup> *bethellianus*) which was found associated with it at Station 147, is still more unlike the Pear-encrinite type, and though originally referred to it, is rather to be regarded as representing a new family altogether. The mode of attachment of the stem is unknown. Its component joints are short, cylindrical, and differently marked from those of *Bathycrinus*.

“The cup (fig. 122A, B) is composed of two alternating tiers of thin plates, the basals below and the radials above. The latter are broad and spade-shaped, with a slight blunt ridge running up the centre and ending in a narrow articulating surface for an almost cylindrical first brachial. The five undivided arms are composed of long cylindrical joints deeply grooved within, and intersected by syzygial junctions. The first three joints in each arm consist each of two parts separated by a syzygy; the third joint bears at its distal end an articulating facet, from which a pinnule springs. The fourth arm-joint is intersected by two syzygies, and thus consists of three parts, and so do all the succeeding joints; and each joint gives off a pinnule from its distal end, the pinnules arising from either side of the arm alternately. The proximal pinnules are very long, running on nearly to the end of the arm, and the succeeding pinnules are gradually shorter, all of them, however, running out nearly to the end of the arm, so that distally the ends of the five arms and the ends of all the pinnules meet nearly on a level.<sup>2</sup> This is an arrangement hitherto entirely unknown in recent Crinoids, and there is nothing exactly like it in any fossil species.

“The mouth is in the centre of the disk (fig. 122c) and protected by a pyramid of five

<sup>1</sup> Named after Hog Island, one of the Crozets near which it was found.

<sup>2</sup> The greater part of the preceding description is taken *verbatim* from the original account of *Hyocrinus* which was published by Sir Wyville Thomson. *The Atlantic*, vol. ii. p. 95, 1877.

movable triangular plates, between which and the edge of the cup is an irregular pavement of smaller plates. Four of these large oral plates are seen erect in fig. 122B, protecting the delicate tentacles round the mouth, which leads into a funnel-shaped

gullet; and the intestine terminates in a short plated tube near the margin of one of the interradial spaces on the disk (fig. 122c).

*Hyocrinus* has little in common with any other recent Crinoid, and is not known to occur in the fossil state. Only one entire specimen was obtained at Station 147, together with a few fragments, though portions of a stem were dredged from a depth of 1850 fathoms in Mid Atlantic, lat.  $1^{\circ} 47' N.$  (Station 106), together with *Bathycrinus campbellianus*.

“The Feather-stars, or *Comatulæ*, as they were termed by Lamarck, differ from the so-called ‘Stalked Crinoids’ in being unprovided with a stem in the adult condition, although they possess one when young. But at a certain period of development, which varies consider-

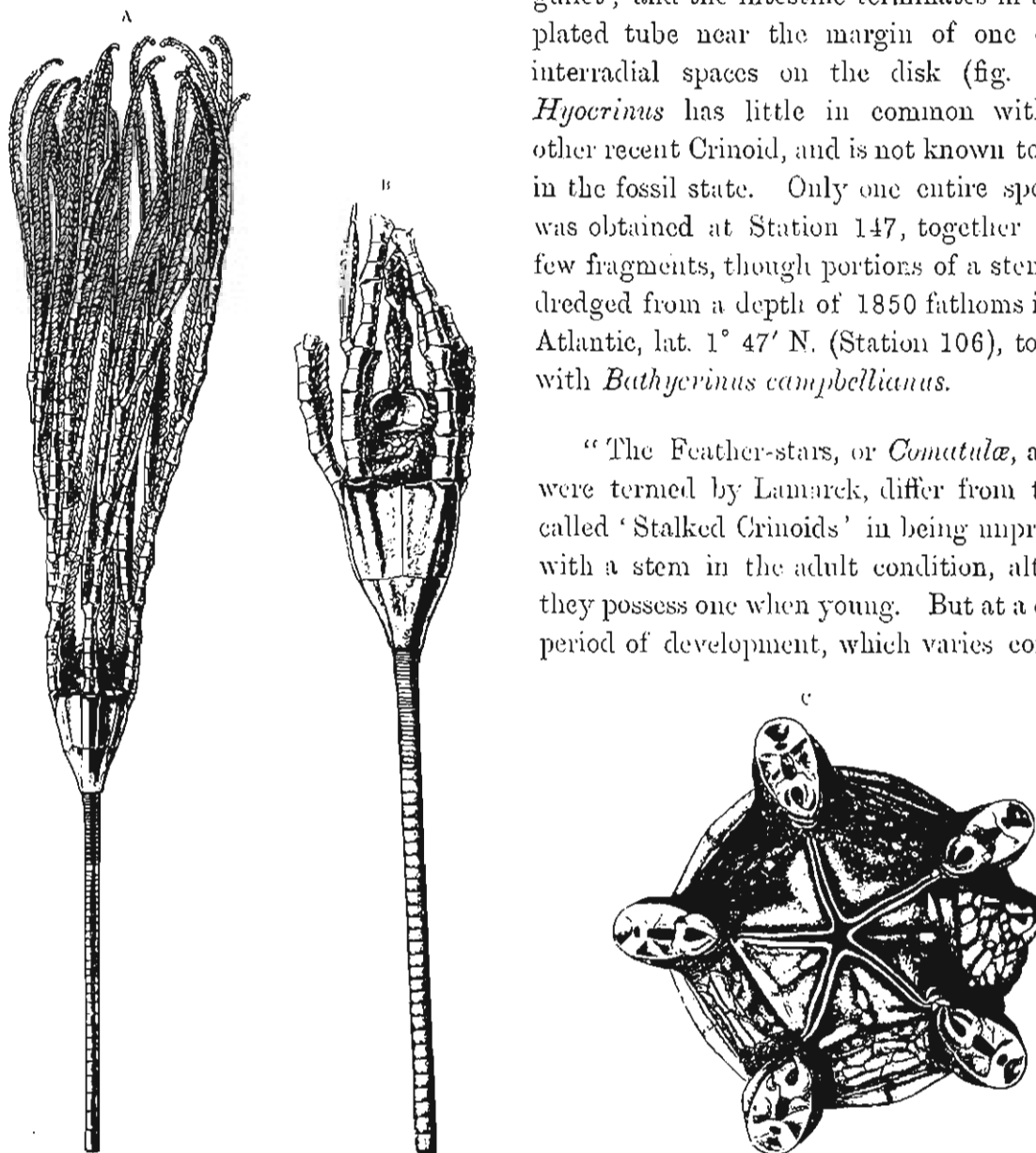


FIG. 122.—*Hyocrinus bethellianus*, WYV. THOMAS.

ably in different species, the cup containing the visceral mass detaches itself from the stem, retaining, however, the top joint or centro-dorsal which closes the cup below. Before its severance from the remainder of the stem it becomes larger than the other

joints below it, and a number of clawed hooks, the cirri, are pushed out from it. These serve as grapnels, fixing the Feather-star to rocks or even to seaweeds, branching corals, sea-firs, and sometimes to telegraph cables. The attachment is only a temporary one, however, for the Feather-star may loosen its hold and swim about for a while, with a very regular alternating movement of its arms, eventually settling down somewhere else.

“The Comatulæ are probably more abundant at the present time than in any former period of the earth's history, rather more than four hundred species being known to science. By far the greater number of them belong to one or other of the two genera *Antedon* and *Actinometra*. These have five radial plates, resting directly upon the centro-dorsal, and meeting one another laterally so as to form the greater part of the cup. The rays borne by these plates may remain simple, as in the rare genus *Eudiocrinus*; but more commonly they fork, sometimes only once or twice, sometimes six or seven times, so that the number of arms may vary from 10 to 100 or more. The mouth may either be in the centre of the upper surface of the disk, as in *Antedon*, or it may be more or less excentric, as in *Actinometra*.

“The two species dredged at Station 48 belong to the first-named genus, and are closely allied to the familiar rosy Feather-star of the British seas. They are both well known Arctic forms, having been obtained by H.M.S. ‘Discovery,’ in 80° N. lat. Of all the genera of recent Crinoids, *Antedon* is the one which has the widest range, both bathymetrically and geographically. While some species live in 5 fathoms of water or less, others have been dredged at 2600 and 2900 fathoms,—depths from which no Stalked Crinoid has been obtained. These, however, are isolated cases, for Feather-stars are but rarely met with at depths exceeding 200 fathoms. All the European and Arctic Comatulæ, with two exceptions,<sup>1</sup> and in fact the greater number of those inhabiting the temperate zones, belong to this genus, which ranges from 80° N. lat. to 52° S. lat. Fossil representatives both of it and of *Actinometra* occur in the Inferior Oolite of Gloucestershire, and are the oldest known Comatulæ.

“The dredgings at Cape York yielded a great number of the Feather-stars with an excentric mouth, belonging to the genus *Actinometra*. The range of this type, both bathymetrically and geographically, is much more restricted than that of *Antedon*. It is almost exclusively a tropical genus, its northern limit being about 30° N. lat., and its southern about 40° S. lat. Isolated species are known on the South African and South Australian coasts; but it is in the Caribbean Sea, in the Western Pacific, and especially among the Philippines and the Moluccas, that the greatest variety is found. The largest Comatulæ yet known belong to this genus, and also those with repeatedly branching arms. Few species of *Antedon* have more than forty arms, while there are several *Actinometra* with one hundred arms, or even more.

<sup>1</sup> *Actinometra pulchella*, Pourtales, a Caribbean species which the “Porcupine” found near Gibraltar; and *Eudiocrinus atlanticus*, Perrier, which was dredged by the “Travailleur.”

“ Nearly all the Challenger species of *Actinometra* were obtained at depths of less than 20 fathoms; but several of those dredged by the U.S.C.S. steamer ‘Blake’ were found at from 100 to 300 fathoms. Below the latter depth, however, there are but few records of the occurrence of any *Actinometra*, none being known below 533 fathoms.

“ The Cape York Comatulæ of both genera are remarkable for the loose way in which the disk or visceral mass is attached to the calyx, a feature which is also noticeable in the common rosy Feather-star of the British seas. Several specimens of the isolated disk were obtained, and Sir Wyville Thomson watched them performing slow creeping movements on their own account. On the other hand, the disk-less cup with the arms attached will continue to swim about just as readily as an entire animal does. The discovery of one of these isolated disks caused much interest some fifteen years ago, for the specimen was described as a recent Cystidean. Although the Challenger dredgings have rendered this idea no longer tenable, there is much to be said for the view which was held by Sir Wyville Thomson respecting the possible interpretation of the fossil Agelacrinitidæ as the isolated disks of Palæocrinoids, and not as independent organisms to be classed with the Cystidea.

“ Three new genera of Comatulæ were discovered by the Challenger, in addition to several new species of the three previously known, *Antedon*, *Actinometra*, and *Eudiocrinus*. All of them present characters of considerable morphological importance.

“ One of these types, for which the name *Atelecrinus*<sup>1</sup> has been proposed, was obtained at Station 122, together with *Pentacrinus maclearanus* and *Rhizocrinus lofotensis*. It seems to retain throughout life certain characters which mark transitional stages in the development of ordinary Comatulæ, and it is thus best described as a permanent larval form. *Atelecrinus balanoides*, the species dredged at Station 122, has since been found in the Caribbean Sea, by the officers of the U.S. Coast Survey and Count Pourtalès obtained a fragment of another off Cuba in 1868, while a third was met with by the Challenger in the South Pacific.

“ Another very interesting new genus, for which the name *Promachocrinus*<sup>2</sup> has been proposed, was dredged at Station 147, in the Southern Ocean, from a depth of 1600 fathoms. It is distinguished from all other recent Crinoids by having ten primary radials instead of five only. Three species were obtained during the cruise, two of them in the Southern Ocean, together with *Bathycrinus* and *Hyocrinus*, and one at 500 fathoms, among the Philippine Islands (Station 214). That dredged at Station 147 (*Promachocrinus abyssorum*) seems to be confined to great depths, as it was also found at 1800 fathoms (Station 158), and like the abyssal species of *Antedon* is of small size. But a comparatively large species was found to be abundant in the shallow water round Kerguelen. Its calyx is represented in fig. 123. In the side view (A) are shown some of the ten first radials, five of which rest directly upon the centro-dorsal and correspond to

<sup>1</sup> ἀτέλης, incomplete.

<sup>2</sup> πρὸμαχος, “Challenger.”

the radials of other Crinoids, while the other five, alternating with them, are partly separated from the centro-dorsal by the basals, the ends of which appear externally beneath the middle lines of these additional radials. The upper faces of the radials are



FIG. 123.—*Promachocrinus longipes*, P. H. Carpenter.  
The calyx. A, from the side; B, from above.

all alike, however; and they form an elegant decagonal funnel which supports the centre of the disk (fig. 123 B). Except in the presence of five additional radials, *Promachocrinus* does not differ in any essential characters from *Antedon*.

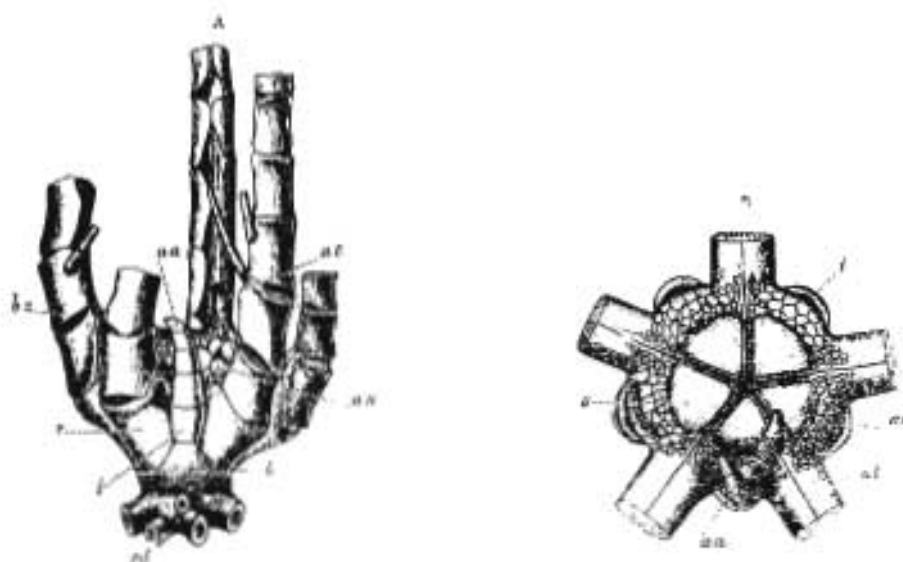


FIG. 124.—*Thaumatoocrinus*, P. H. Carpenter.  
A, The calyx, anal side. B, The disk from above. *aa*, anal appendage; *eo*, ambulacral plates; *at*, anal tube; *b*, basal; *b<sub>2</sub>*, second brachial; *cd*, centro-dorsal; *i*, interradial; *r*, radial; *rl*, radial lobe.

“Together with *Promachocrinus abyssorum* there was found, at Station 158, another *Comatula* of a very singular type, for which the generic name *Thaumatoocrinus*<sup>1</sup> has been proposed (fig. 124 A, B).

<sup>1</sup> *θαύμα*, wonder.

“Like all the deep-sea Comatulæ, it is of very small size. As in *Eudiocrinus* there are five undivided arms, but they are unfortunately broken off quite short. The radials which bear them are not, however, in contact either with the centro-dorsal or with one another, for they rest on a ring of five basal plates, which alternate with them in position (fig. 124A, b). There is only one other genus of recent Comatulæ (*Atelecrinus*) in which this is the case; but there is no Neocrinoid, either recent or fossil, in which the radials do not meet one another laterally, and form a closed ring. In *Thaumatocrinus*, however, every two radials are separated by an interradial plate, which rests on a basal (fig. 124A, B, i). This is a character which is limited to certain Palæozoic Crinoids belonging to the family Rhodocrinidæ. One of these interradials in *Thaumatocrinus*, that on the anal side, bears a short and tapering jointed appendage, which looks somewhat like an undeveloped arm (fig. 124A, B, aa); and it is only in some of the Palæocrinoids, e.g., *Reteocrinus*, *Taxocrinus*, and *Onychocrinus*, which reach back to the Lower Silurian period, that any similar structure is to be found.

“Besides reproducing these singular characters of long extinct Palæocrinoids, *Thaumatocrinus* presents another structural feature, which is peculiar to itself among Comatulæ, although appearing in the stalked *Rhizocrinus* and *Hyocrinus*, viz., the existence of a pyramid of oral plates protecting the mouth (fig. 124B, o).

“The combination of these various characters in an abyssal Crinoid, which is not stalked, however, but belongs to the specialised *Comatula*-type, is a point of very considerable interest; and, in my opinion, *Thaumatocrinus* is by far the most remarkable of all the Crinoids obtained by any of the recent deep-sea exploring expeditions.”

*The Myzostomida.*—“On some specimens of *Hyocrinus* and *Bathycrinus* which were dredged at Stations 146 and 147 from depths of 1375 and 1600 fathoms, Dr v. Willemoes Suhm discovered a remarkable species of Myzostomida (fig. 126E) which constitutes an entirely new group of these Crinoid parasites.

“These specimens and the other Myzostomida collected during the voyage,<sup>1</sup> together with material subsequently transmitted to him by Dr. P. H. Carpenter, have enabled Professor v. Graff to throw a new light upon the structure and mode of life of these animals.

“The accompanying diagram (fig. 125) displays the structure of the Myzostomida in so far as it was known before the publication of Professor v. Graff’s Report. The typical *Myzostoma* is a disk-shaped, bilaterally symmetrical, unsegmented animal of from 0·5 mm. to 1 cm. in diameter; it possesses five pairs of unsegmented parapodia, and four pairs of suckers both situated upon the ventral surface; upon the margin of the body

<sup>1</sup> At Stations 146, 147, 170, 174, 186, 187, 190, 192, and 214.

are numerous cirri which serve as tactile organs and organs of attachment; each parapodium contains a hook-apparatus with a complicated musculature. The tree-like ramified alimentary canal opens close to the anterior end of the body by the mouth, through which the pharynx can be extruded; the anus is situated close to the hinder margin, and

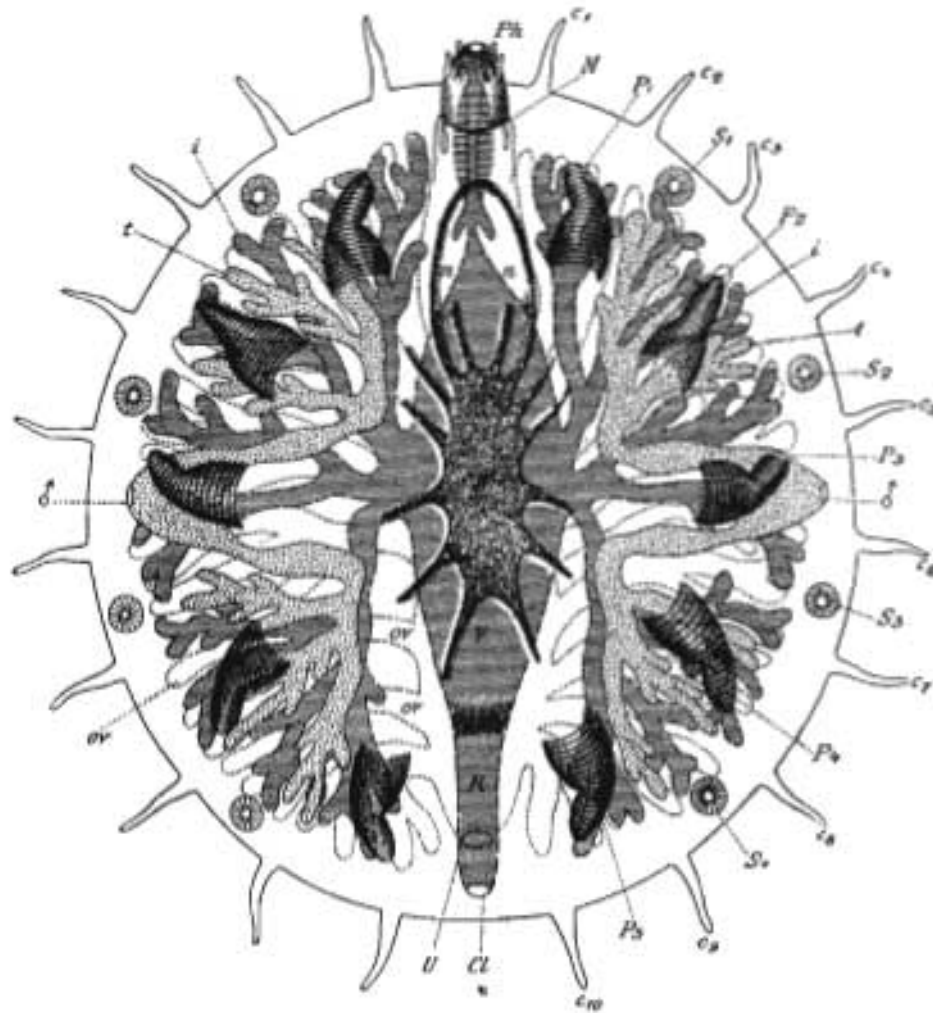


FIG. 125.—Diagram showing the Structure of *M. costosa*.

$C_1$ - $C_{10}$  the 10 pairs of cirri;  $Cl$ , cloacal opening;  $i$ , intestine;  $M$ , mouth;  $N$ , central nervous system (blue), with  $a$ , esophageal ring;  $ov$ , ovarian tubes (yellow);  $P_1$ - $P_5$  the five pairs of parapodia;  $Ph$ , pharynx;  $R$ , the rectum;  $S_1$ - $S_4$  the four pairs of suckers;  $t$ , testicular follicles;  $U$ , opening of the uterus into the rectum;  $V$ , stomach;  $\delta$  the two lateral male genital openings.

receives also the duct of the branched ovarian tubes. The male sexual organs consist of two ramified testes which open on either side of the body by a separate opening. The nervous system forms a compact ventrally situated ganglionic mass, from the anterior end of which is given off a simple nerve ring enclosing the pharynx. This description holds



good for all the species of *Myzostoma* hitherto known, the differences between them consisting mainly in the number and length of the cirri and in the relative thickness, transparency, and mobility of the body; thus *Myzostoma glabrum*, the first species ever described, which was discovered in 1827 by F. S. Leuckart attached firmly by its hooks to the disk of *Antedon rosacea* (*Comatula mediterranea*), is distinguished by possessing a thick opaque disk and small wart-like cirri; another species—*Myzostoma cirriferum*—discovered in 1834 by J. V. Thompson, has a delicate transparent disk and long cirri; it is found upon the same species of *Antedon*, and moves about freely over the disk and arms of its host. A third species, *Myzostoma costatum*, was found upon *Comatula multiradiata* of the Red Sea by Leuckart in 1836. Finally, nine new species collected by Professor Semper in the Philippines were described by Professor v. Graff in his Monograph on the group published in 1877.

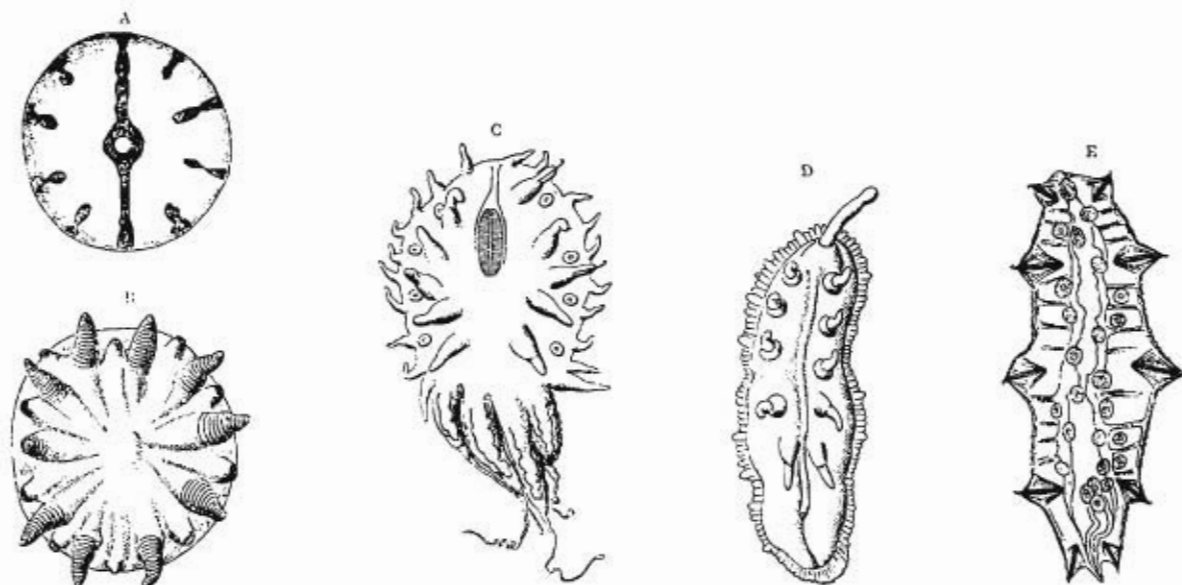


FIG. 126.—A, *Myzostoma horologium* from the dorsal surface; B, the same, from the ventral surface: both figures are magnified 6 diameters. C, *Myzostoma quadrifidum*, from the ventral surface; magnified 12 diameters. D, *Myzostoma folium*, from the ventral surface, with the pharynx far extended; magnified 12 diameters. E, *Stelechopus hyocrini*, strongly compressed; magnified 18 diameters.

"The Report upon the Challenger collection<sup>1</sup> contains a description of 52 new species in addition to the 15 already known, and also considerably increases our knowledge of the anatomy and mode of life of the Myzostomida. The two most remarkable forms are *Stelechopus hyocrini* (fig. 126E) already mentioned, and *Myzostoma folium* (fig. 126D); both these species by their elongated form and the absence of suckers differ considerably from the known species and appear to form a transition between the Myzostomida and the Tardigrada; the Myzostomida have been regarded by different authors as allied to the Trematodes, Hirudinea, Chætopoda, Crustacea, or Tardigrada; Dr. v. Graff's obser-

<sup>1</sup> Zool. Chall. Exp., part xxvii., 1884.

vations appear to give additional support to the hypothesis which connects this group more closely with the Tardigrada. Another interesting form is *Myzostoma horologium* (fig. 126A, B), which was taken in great numbers from specimens of *Actinometra jukesi* and *Actinometra strotta*, P. H. Carpenter, dredged at Stations 186 and 187; the disk has a curious resemblance to the face of a watch, owing to the arrangement of the pigment on the dorsal surface; the parapodia and suckers are very stout and cirri are entirely absent.

"Fig. 126c, represents another remarkable species, *Myzostoma quadrifilum* (host: *Antedon bidentata*, P. H. C., Station 186), distinguished by the possession of four long caudal appendages; there are many allied species which possess respectively two, four, or six of these appendages.

"Certain endoparasitic forms, obtained for the first time at Station 170, and subsequently at Stations 176 and 192, are of the highest interest, and differ greatly from all other endoparasitic species by the peculiarities of their sexual organization, and by the remarkable malformations which they produce upon the body of their hosts; they may be divided into two groups. The first group is hermaphrodite like the ectoparasitic Myzostomida, but the male sexual apparatus, instead of being disposed symmetrically on either side of the body, is only developed upon one side; one to three individuals of similar size and form are met with in the same cyst (fig. 127A, B, *Myzostoma pentacrini* and *Myzostoma deformatore*). In the second group the sexes are completely separated, and the males and females differ from each other in external appearance, the former being very small and delicate, while the latter are large and stout; a single pair are found associated together in each cyst (fig. 127C, D, E, *Myzostoma tenuispinum*, *Myzostoma willemoesii*, and *Myzostoma murrayi*).<sup>1</sup>

"The malformations produced by these species are of various kinds. In some cases there are independent cyst-like swellings of the skin, as for instance the cyst of *Myzostoma murrayi* (fig. 127E), which hangs down from the disk of *Antedon radiosпина*, P. H. C.; in other cases the parasite causes more or less conspicuous swellings of the arms of the Crinoid in the interior of which it lives; *Myzostoma pentacrini* (fig. 127A) and *Myzostoma tenuispinum* (fig. 127c) form cysts of this description, the former upon the arms of *Pentacrinus alternicirrus*, P. H. C., the latter upon *Antedon angusticalyx*, *Antedon basicurva*, *Antedon incisa*, and *Antedon inæqualis*, P. H. C. Other species attach themselves to the pinnules, which become variously swollen and contorted. *Myzostoma asymmetricum* produces only a simple swelling and enlargement of the pinnules of

<sup>1</sup> The following is from the journal of the late Dr. R. v. Willemoes-Suhm, under date 14th July 1874:—"On the pinnule of the Comatulæ we found *Myzostoma* under rather peculiar conditions. Some of the pinnule had enlarged excrescences and were rolled up so as to form a cavity, in which, in two cases, a larger and a smaller *Myzostomum* were found. This reminds me very much of Trematodes, which, as in the case of *Monostomum faba* in the skin of birds, live always in cases or sacs in pairs, one individual being much larger than the other, the one acting probably as male and the other as female, which in some cases, as in *Distoma okeni* on the branchiæ of *Brama rayi*, leads to a perfect diversity of sexes. Perhaps something very similar takes place in *Myzostomum*, which is hermaphrodite, and has many affinities with the Trematodes."

*Pentacrinus alternicirrus*, P. H. C.; whereas the pinnules of *Antedon basicurva* and *Antedon inaequalis*, P. H. C., become swollen and spirally coiled owing to the presence of *Myzostoma willemoesii* (fig. 127D), forming thus a central cavity in which the parasites are found. The pear-shaped swellings of the pinnules of *Pentacrinus alternicirrus*, P. H. C. (fig. 127B), caused by the presence of *Myzostoma deformato*r, are no less remarkable.

"Many Crinoids are liable to the attacks of several distinct species of *Myzostoma*; *Pentacrinus alternicirrus*, P. H. C., for example, harbours an ectoparasitic species besides the three endoparasitic Myzostomida just mentioned; similarly, *Antedon triquetra*, Semper MS., is infested by no less than six ectoparasitic forms. On the other hand a given species of *Myzostoma* is by no means always confined to the same host; many

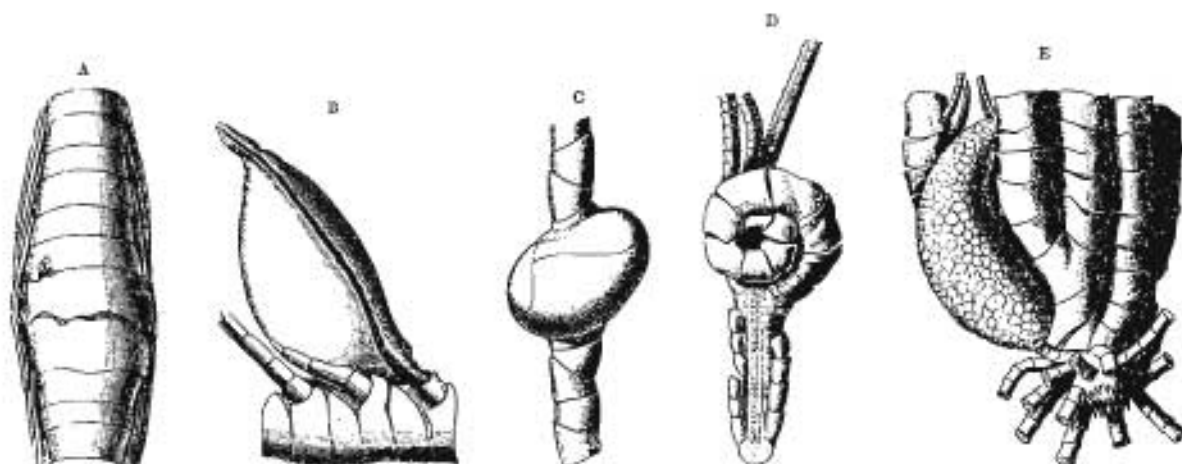


FIG. 127.—Malformations upon Crinoids caused by Myzostomida; all magnified about 5 diameters.

A, Arm swelling of *Pentacrinus alternicirrus*, P. H. C., inhabited by *Myzostoma pentacrisi*. B, swollen pinnule of the same, inhabited by *Myzostoma deformato*r; C, arm swelling of *Antedon inaequalis*, P. H. C., inhabited by *Myzostoma tenuispinus*; D, malformed pinnule of the same, inhabited by *Myzostoma willemoesii*; E, cyst on the disk of *Antedon radiospina*, P. H. C., inhabited by *Myzostoma wueringi*.

indeed are found upon two, three, or even four distinct species of Crinoids. The only genera of Crinoids upon which Myzostomida have been found are *Antedon*, *Actinometra*, *Pentacrinus*, *Bathycrinus*, *Metacrinus*, and *Hyoecrinus*.

"The presence of malformations upon many fossil Crinoids<sup>1</sup> indicates that in the earlier periods of the earth's history as well as now these parasites existed."

#### THE CROZET ISLANDS.

On the 31st December, at 1.30 A.M., the vessel tacked and stood off Hog Island under easy sail until daylight. At 3.30 A.M. she tacked again and stood towards the land, but the weather becoming thick, at 6 A.M. again stood off under topsails and jib. Shortly after noon the fog lifted a little and sail was made, and the island was sighted again at 3 P.M., but

<sup>1</sup> See Zool. Chall. Exp., part xxvii. p. 2, 1884.

only the coast and breakers were visible. The ship ran along the western shore to the southward, and obtained a sounding of 105 fathoms 5 miles from the land. At 5 P.M. Penguin Island was seen through the mist, and at 6 P.M. sail was shortened to double-reefed topsails, and the vessel hauled to the wind on the starboard tack for the night. At 7 P.M. a dense fog surrounded the ship so that one could see only a few yards.

On the 1st January 1874 the fog still continued over the water, although overhead the sky was clear. Observations were obtained, but the horizon was badly defined, so that they could not be implicitly relied on. At 3 P.M. a sounding was obtained in 600 fathoms, and shortly afterwards the fog lifted and Penguin Island was observed bearing N. by E., but only for a few minutes. At this time the wind, which during the day had been light and variable, shifted to E.S.E. and gradually freshened to a royal breeze accompanied by rain. At 5 P.M. the ship tacked and stood to the southward, off the land, under single-reefed topsails, the weather being thick and rainy (see Sheet 20). The observations this day placed Penguin Island 5 miles N.W. by N. of the position assigned it by Captain Cecille; these observations have been subsequently confirmed by H.M.S. "Wolverene."

On the 2nd January at 2 A.M. the wind shifted to W.S.W. through south, and freshened to a moderate gale, the weather still continuing foggy. At 7 A.M. the wind began to moderate, and the vessel bore up for Possession Island. At noon the weather though misty was fine and the wind light. At this time a sight was caught of the high peaks of Possession Island, for a few minutes, over the mist which completely enshrouded the lower parts of the island; at 3.30 P.M. they were seen again, and more clearly; they were sharp, and, contrary to expectation, were found to be quite free from snow. Their height was estimated to be about 5000 feet, but it was impossible to obtain angular measurements owing to the fog.<sup>1</sup> At 4 P.M. the breakers were seen against the weather shore of Possession Island, and a few minutes afterwards the coast of the island itself became visible through the mist. The ship was steered to pass round its south side, and it was noticed as the island was rounded that the sun was shining on the lee side of the land, the weather side only being covered with fog. At 6 P.M. three points on the S.W. side of the island were in line N. 9° W., and the southwest point bore N. 70° E. From this position 3 miles from the shore the details of the coast could be clearly distinguished through the mist, especially the waterfalls, which were very numerous. After rounding the southwest point the vessel passed completely out of the fog, which formed a dense bank behind, whilst ahead was another dense bank coming round the northeast side of the island. To the eastward the peaks of East Island were visible over the mist, which completely obscured its lower parts (fig. 128); some snow was observed in the crevices of these rugged eminences. At 7 P.M. the ship stopped off the cove on the southeast coast of Possession Island, and a hut and some boats

<sup>1</sup> This estimate may be considerably in error; for when the lower parts of the land are shrouded in mist it is extremely difficult to estimate heights.



being observed on the beach at its head, a gun was fired to attract attention; the hut appeared, however, to be deserted. The slopes appeared from the ship to be covered with a vegetation similar to that of Marion Island, which did not, however, extend so high up the mountains. They were covered with Albatrosses (*Diomedea exulans*) nesting as at Marion Island, and the birds seen about the ship were the same as at that island. There occurs here, however, in addition, the Kerguelen Teal (*Querquedula eatoni*), which is not known to extend its range to the Prince Edward group of islands.

The cross swell prevented the Challenger anchoring outside Navire Cove, so the vessel steamed along the land hoping to find anchorage in America Bay, but on rounding the east point the long swell indicated too clearly the hopelessness of the search under the present circumstances, and it was decided to proceed to the southwestward. At 8.40 P.M. the extremities of Possession Island bore N.W. and N. by E.  $\frac{1}{4}$ ° E.; from which position the vessel stood to W.S.W. under double-reefed topsails.



FIG. 125.—East Island, Crozet Group, seen from H.M.S. Challenger, January 2nd, 1874.

On the 3rd January another short, sharp gale was experienced, similar to that of the 2nd, which lasted three hours. It had passed over by 9 A.M., when the ship sounded and dredged in 210 and 550 fathoms southwards of Possession Island (see Sheet 20). The weather during the day, although not foggy, was still too thick to allow anything of either Possession or East Islands to be seen at a distance of from 15 to 20 miles. At 4 P.M. the vessel left the neighbourhood of the Crozets for Kerguelen Island.

The Crozets (see Sheet 20), a group of six islands with some outlying rocks, were discovered by M. Marion du Fresne on the 23rd January 1772. He first saw the north-western islands of the group now designated "Hog Island" and "Apostles Island," which were named by him "Les îles froides," and afterwards the southeastern islands, which he called "Possession" and "Aride" islands, the latter now designated "East Island." M. Marion sent an officer on shore at Possession Island and left a bottle there with a paper in it claiming the group as an appanage of the King of France. From 1772 until 1802 the Crozets do not appear to have been visited, but in that year an American whaling

vessel, the "Catherine," Captain Henry Fanning, landed a gang of sealers on Possession Island, since which time the group has been constantly visited at intervals by these adventurous navigators. In 1820 a cutter called the "Princess of Wales" was wrecked on Possession Island whilst engaged in the seal fishing, and from one of her crew named Charles Goodridge an interesting account of their two years' residence was obtained and published in 1833.<sup>1</sup> Previously to 1820, hogs were landed on the island which now bears that name, but by whom or how is doubtful, and Goodridge relates that large numbers of them were seen in that year. In 1838 the islands were visited by Captain Cecille of the French sloop "Heroine," which vessel had been despatched to assist and report on the French deep-sea fisheries. Captain Cecille anchored in Navire Cove, which he surveyed, and he also fixed the position and made a running survey of all the islands. Captain Cecille found on Possession Island the crews of two American vessels, which had been lost, and a French ship, the "Bordelais," in Navire Bay.

In 1840 the group was visited by Sir James Ross in the "Erebus," who found a sealing party of eleven men on Possession Island, one of whom had been there three years.

Since the visit of the Challenger the Apostles Islands have been the scene of a terrible calamity, the wreck of the "Strathmore," in July 1875, which has resulted in the group being visited by H.M.S. "Wolverene" on her passage to Australia. From the several descriptions published from time to time, and from information received from the whalers and sealers at Kerguelen, the following account of the islands has been drawn up:—

The Crozet Islands are situated between the parallels of  $46^{\circ} 0'$  and  $46^{\circ} 35'$  S. latitude, and the meridians of  $50^{\circ} 20'$  and  $52^{\circ} 20'$  E. longitude, and they may be said to consist of two groups, an eastern and western. The western group consists of four islands, lying in a north and south direction from each other—the two Apostles, Hog, and Penguin or Inaccessible Island, and the Heroine Breakers; the eastern group consists of Possession and East or Aride Islands, with a few outlying rocks in no case exceeding a distance of 3 miles from the shore. Hog Island is round-backed, the summit rising to an elevation of certainly 2000 feet above the level of the sea; the north point is a perpendicular cliff some 200 feet in height, the south point being low, with several detached rocks close off it. Against its western shore the constant westerly swell breaks violently, rendering landing impossible on that side; on the leeward or eastern side it is occasionally accessible, but even here it is frequently very dangerous, as the rollers often come round both ends, and even the experienced crews of whaling boats are sometimes swamped and drowned. There were no pigs in 1873, but the whole place was overrun with rabbits. The Apostles Islands do not exceed 500 feet in height; they are only separated by a narrow chasm, and have the appearance of being a number of islands from seaward owing to their rising in detached boulder-like peaks, twelve in number, hence their

<sup>1</sup> Narrative of a Voyage to the South Seas, &c., by C. M. Goodridge. London, Hamilton & Adams, 1833.

name. Penguin Island (sometimes called Inaccessible) is a solitary basaltic islet, which rises in castellated pinnacles 900 or 1000 feet above the level of the sea. On it may usually be seen numerous Penguins and other birds. Owing to its small extent and the constant swell, landing is almost impossible; off its southern end is a rock under water, over which the sea was seen to break by the officers of the "Wolverene." Between Hog and Penguin Islands are the Heroine Breakers, first seen by Captain Cecille, a dangerous group of rocks, the precise position of which has not yet been ascertained.

The two eastern islands are high and rugged, their sharp, well-defined peaks rising to heights of 4000 and 5000 feet above the sea level. Their coasts are in most cases rocky and precipitous, especially that of East Island, and off the north end of Possession Island is a remarkable perforated rock, through which it is said a vessel might sail. Landing may generally be effected on Possession Island either in the cove on its southeast end or in some of the bays on its northeast side, but sometimes days have passed without the sealers being able to launch a boat. It is usually difficult to land on East Island. In the passage between Possession and East Islands a depth of 85 fathoms was found by Sir James Ross. Navire Cove has sufficient depth of water for a vessel to anchor, but it is so small and exposed that even schooners should be cautious in running the risk of entering it; in fact, some vessels have been wrecked there when trying to ride out an easterly wind. The "Heroine" in 1838 and recently the "Wolverene" anchored just outside the cove for a short time. The eastern, like the western, group is of igneous origin, and columns of basalt are common to all the islands. Their upper portions are barren, but their lower parts are covered with a thick herbaceous vegetation resembling in appearance that of Marion Island, with here and there Tussock Grass and the Kerguelen Cabbage; Penguin Island, however, appeared very bare.

From all sides of the precipitous black cliffs, cataracts fall over into the sea, and water is found in numerous ponds all over the group. The islands are frequented by Elephant and Fur Seals, although these are not so plentiful as formerly, and as there is no lack of water there is no danger of shipwrecked mariners dying of starvation. The blubber of the Elephant Seal and the skins of Penguins with the adherent fat furnish the material for fire, and the flesh of the Seals and birds, the eggs of the latter, together with the Kerguelen Cabbage, form a nourishing diet on which the sealers residing at times on one or other of the islands have usually lived, and with which they appear to have been contented.

As before mentioned, pigs have been landed on Hog Island, but they are now exterminated, for the sealers found them unpalatable in consequence of their habit of eating Penguins. In Goodridge's time the wild hogs were very fierce and dangerous to approach single-handed, having very large tusks. The sealers are against the introduction of pigs into the Southern Islands, as they destroy the birds, which are the main chance of support of castaway mariners. Rabbits, however, flourish, though they are said



to be strong in flavour and unpalatable, goats also thrive well on the Tussock Grass. There are at present no goats on any islands of the group. It certainly would be an advantage if some were landed on each island, for although it is decidedly dangerous to navigate in their neighbourhood, and vessels running down their easting would do well to avoid them, it appears highly probable that so long as seal-skins fetch a high price in the market, and vessels bound to Australia go south at all risks in order to shorten the time in making the passage, so long will this group be the occasional scene of dire shipwrecks, which may be even more disastrous than that of the "Strathmore," more especially now that fast steamers run to Australia *via* the Cape of Good Hope. Charles Goodridge, in his account already referred to, describes the discovery by his party, at the distance of more than a mile above the reach of the tides, of several trunks of trees about 14 feet long, and from 14 to 18 inches in diameter, lying on the ground as if thrown up by the sea. The wood was close, heavy, and hard, but being split up with wedges made very good clubs; hence it was not fossil wood. Goodridge concluded that it was drift wood thrown up so far during some volcanic convulsion.

The weather in the vicinity of the Crozet Islands may be described generally as bleak, boisterous, and foggy. No regular meteorological observations have been kept by the parties who have temporarily resided on these islands whilst collecting seal-skins; in fact, the subject of meteorology has been hitherto much neglected by whaling vessels generally, although there are some notable instances to the contrary. The prevalent wind is westerly, but easterly winds occasionally blow for a short time, and although, generally, they do not last long or acquire much force, they have been known, as before mentioned, to be strong enough to wreck vessels that have taken shelter in Navire Cove. The great obstacle to navigation in the vicinity of this group is, however, the almost constant state of fog and overcast sky which, besides concealing the islands from view, prevents the position of the vessel being ascertained, and as icebergs have been seen near these islands by M. Marion du Fresne in January, by Ross in May, and by H.M.S. "Wolverene" in November, this is another feature of danger to be considered by the seamen who take the route to Australia recommended by Maury.

The climate of the islands, though rigorous, appears to be equable, owing probably to the temperature of the sea, which has been found here to be pretty constant at 40° to 42°. When first seen by Marion in January the mountains were covered with snow, and Captain Cecille also speaks of them as snow clad. Sir James Ross does not mention whether they were clear or not when he saw them, but when the Challenger was in their vicinity little or no snow could be seen during the short time the higher parts of the islands were visible. This would seem to indicate that the snow can never attain any considerable thickness at this group; at any rate, the icebergs seen in their vicinity cannot be formed by glaciers descending from their summits.

*The Petrels.*—A large collection of these birds, obtained for the most part in the Southern Ocean, was handed to the late Professor Garrod for anatomical examination, and on his death was transferred to the late Mr. W. A. Forbes, who made an exhaustive report upon their structure and affinities. The following paragraphs contain his most important conclusions:—"The propriety of the division of the entire order Tubinares into two main families, which must be termed the Oceanitidæ and Procellariidæ,<sup>1</sup> first proposed by Professor Garrod in 1873, has been fully borne out by my further investigations into the structure of these forms. To the differences in their myological formulæ, and in the presence or absence of cæca, may now be added numerous other points, both external and internal.

"The Oceanitidæ agree together in having the following peculiarities which are not shared in—with one or two exceptions marked by an \*—by any of the Procellariidæ:—

"The number of secondary remiges is never more than ten. The tarsi are not uniformly reticulate, but are either ochreate, or covered by large transversely-oblique scutes anteriorly. The claws are very flat, depressed, and lamellar. There are no colic cæca \* (absent in *Halocyptena* only of the Procellariidæ). There is a peculiar *expansor secundariorum* muscle. The tendon of the *tensor patagii brevis* is quite simple throughout. The *semi-tendinosus* muscle has a well-developed accessory head. The *ambiens* muscle, when present, does not pass over the knee, but is lost on the cnemial process of the tibia. The number of cervico-dorsal vertebræ is twenty-one. The clavicles have a long, curved, symphyseal process. The leg bones are longer than the wing bones. The tarsus is longer than the mid-toe\* and ulna, and at least twice as long as the femur. The tibia is at least twice as long as the humerus, and much longer than the manus. The basal phalanx of the middle toe is as long as, or longer than, the next two taken together.

"The Oceanitidæ also agree together in having no basipterygoid processes, no uncinatæ bone, a peculiarly short and stout humerus, radius, and ulna, a single circular nasal aperture, a sternum with its posterior margin quite or nearly entire, a larger *gluteus primus*, as well as in numerous other smaller details already noticed. All these characters never coexist together in any Procellarian form, and, if my observations are correct, the Oceanitidæ further differ from the Procellariidæ by having a *biceps brachii* muscle of the normal form, with no patagial slip.

"The Procellariidæ, on the other hand, have the following characters:—

"The number of secondary remiges is never less than thirteen, and is usually much greater. The tarsi are pretty uniformly covered with small hexagonal scutellæ. The claws

<sup>1</sup> Cf. *Proc. Zool. Soc. Lond.*, p. 737, 1881.

are sharp, curved, and compressed. Short colic cæca are present.<sup>1</sup> There is no *expansor secundariorum* muscle. The termination of the tendon of the *tensor patagii brevis* is never quite simple, and may become very complicated. There is no accessory head to the *semi-tendinosus*. The *ambiens* muscle (only absent in *Pelecanoïdes*) always crosses the knee. The number of cervico-dorsal vertebræ is not less than twenty-two. The clavicles have only a very small symphyseal process. The leg is shorter than the wing. The tarsus is not larger than the mid-toe (except in *Procellaria*), and is shorter than the ulna. It is never twice as long as the femur. The tibia is only a little, or not at all, longer than the humerus or manus. The basal phalanx of the middle toe is shorter than the two next joints. Basipterygoid facets may or may not be present, and the same is true of the uncinatæ bone. The humerus, radius, and ulna have a shape different from that of the Oceanitidæ. The form of the nostrils, and of the posterior margin of the sternum, varies extensively. The *gluteus primus* is always very small, and there is a peculiarly formed patagial slip derived from the *biceps* muscle.

“Thus in spite of the general superficial resemblance of the Oceanitidæ to the smaller forms of Procellariidæ, with which all ornithologists previous to Garrod had confounded them, the differences between the two families are, it will be seen, numerous and important. The special points of resemblance which the Oceanitidæ have with such Procellarian genera as *Procellaria* and *Cymochorea*—such as the general small size, style of coloration, form of skull, comparative simplicity of the *tensor patagii* arrangement, simple sternum and syrinx (the last three peculiarities being also common to *Pelecanoïdes*)—may best be explained by supposing that these small Procellarian forms are on the whole less specialised than the larger ones (Fulmars, Albatrosses, Shearwaters, &c.), and so retain more of the characters possessed by the primitive and now extinct common form from which both the Procellariidæ and Oceanitidæ must have been derived.”

The Oceanitidæ are a small and on the whole compact group, with but few differences of importance between the four genera contained in it. These genera are *Garrodia*, *Oceanites*, *Pelagodroma*, and *Fregetta*.

“The Procellariidæ, comprising as they do by far the greater number of species and genera of the group, show much more divergence *inter se* than is the case with the Oceanitidæ.”

They are divided into two groups, of which the Diomedicæ or Albatrosses, containing the three genera, *Diomedea*, *Thalassiarche*, and *Phæbetria*, are the more aberrant, and present the following peculiarities:—

<sup>1</sup> *Halocyptena* is apparently an exception to this rule, but as *Cymochorea* has only one cæcum, there is nothing surprising in the reduction being carried a step further. As therefore all the congeners of *Halocyptena* have cæca, it may be safely assumed that their disappearance in it has been very recent, and has occurred since it acquired the rest of its Procellarian characters. This loss of cæca therefore by it does not in any way really approximate it to the Oceanitidæ.

"The lateral position of the nostrils.<sup>1</sup> The presence of a distinct *gluteus quintus* muscle. The formation of the *biceps humeri* muscle, which gives off a patagial slip from its coracoidal head. The characteristic sternum. The absence of hæmapophyses on the dorsal vertebræ. The pneumatic *os humeri*. The generally pneumatic condition of the skeleton. The proportion of the manus to the humerus and ulna."

The Procellariinæ, which compose the rest of the Procellariidæ, contain the following genera:—*Procellaria*, *Cymochorea*, *Halocyptena*; *Æstrelata*, *Puffinus*, *Adamastor*, *Majaqueus*, *Bulweria*; *Prion*; *Daption*, *Pagodroma*, *Acipetes*, *Thalassæca*, *Fulmarus*, *Ossifraga*; *Pelecanoïdes*. These, with the exception of *Pelecanoïdes*, form a natural group distinguished by the following characters from the Albatrosses (*Diomedicinæ*):—



FIG. 129.—Base of Beak of *Diomedea exulans*, to show the form and position of the nostril.

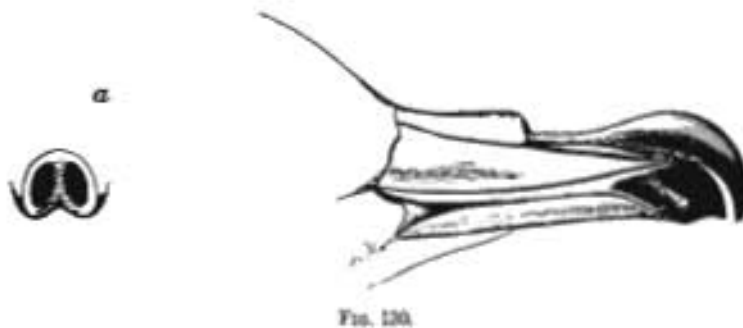


FIG. 130.



FIG. 131.

FIG. 130.—Beak of *Thalassæca glacialisoides*. a, the aperture of the nasal tubes, from the front. Natural size.

FIG. 131.—The same parts of *Acipetes antarctica*.

"The more or less dorsal position of the nostrils, the form of which however varies, as has already been described, though they are never lateral. The absence of a *gluteus*

<sup>1</sup> This feature, in which the Albatrosses are apparently more primitive than are either the *Oceanitidæ* or the other *Procellariidæ*, can hardly, if my views about the relationships of these groups to each other be correct, be considered to have been a character of the common Petrel-ancestor. It may be more probably explained as due to arrested development during embryonic life, as a study of the development of the nostrils of other Petrels would probably show that these are actually, at some time, lateral, and subsequently coalesce.

*quintus*. The peculiar form of the *biceps brachii* muscle, which is in two separate parts, the humeral head forming a patagial slip. The presence of hæmapophyses on the dorsal vertebræ, the centres of which are marked by more or less developed pneumatic depressions. The non-pneumatic humerus. The different pterylosis, and the nearly equal size of the lobes of the liver. The greater size of the hallux, which always has a distinct nail externally (quite absent in *Pelecanoïdes*).

“*Pelecanoïdes* stands alone (amongst the Procellariidæ) in the absence of the *ambiens* muscle; the peculiar disposition of the femoral vein; the absence of a hallux; and the single interclavicular air-cell. Moreover, as in *Bulweria* only of other Tubinares, its myological formula is A.X., there being no accessory head to the femoro-caudal muscle.

“The Tubinares as a group may be shortly defined as follows:—

“Holorhinal schizognathous birds with a large, broad, depressed, pointed vomer, and truncated mandible; with the anterior toes fully webbed, and the hallux either very small and reduced to one phalanx, or absent; with a tufted oil-gland and large supra-orbital glands furrowing the skull; with the external nostrils produced into tubes, usually more or less united together dorsally; with an enormous glandular proventriculus and small gizzard of unusual shape and position, and with the commencing duodenum ascending; with a completely double great pectoral muscle, and a well-developed *pectoralis tertius*; with the femoro-caudal and *semi-tendinosus* muscles always present, and the *ambiens* and accessory femoro-caudal only exceptionally absent.

“Some at least of these characters—the structure of the hallux, the formation of the nostrils,<sup>1</sup> and the form of the stomach—are quite peculiar to the Tubinares, not being found in any other birds, though of universal presence in these. These features alone would at once suffice to distinguish them from any other Avian order, whilst the combination of other characters is as unique. It is therefore a difficult task to assign to this group a satisfactory position in any arrangement of the class Aves, owing to its much isolated position.

“Most previous writers have considered the Petrels as more or less closely connected with the Gulls (Laridæ), but the grounds for any such collocation are very slight, in my judgment, now that the structure of the two groups is better known.

“The Gulls exhibit no trace of any of the characteristic peculiarities of the Petrels,<sup>2</sup> and differ widely from them in the important feature of being schizorhinal.<sup>3</sup> The peculiar disposition in two quite separate layers of the great pectoral muscle in the Tubinares is quite unlike anything seen in the Gulls or their allies, whilst the large *pectoralis*

<sup>1</sup> The Caprimulgine genus *Siphonorhis* (Sclater, *Proc. Zool. Soc. Lond.*, p. 78, 1861) perhaps approaches the Tubinares more nearly in this point than any other bird known to me.

<sup>2</sup> I cannot understand Professor Huxley's remark (*Proc. Zool. Soc. Lond.*, p. 455, 1867) that “the Gulls grade insensibly into the Procellariidæ.”

<sup>3</sup> Cf. Garrod, *Proc. Zool. Soc. Lond.*, p. 37, 1878; *Collected Papers*, p. 128.

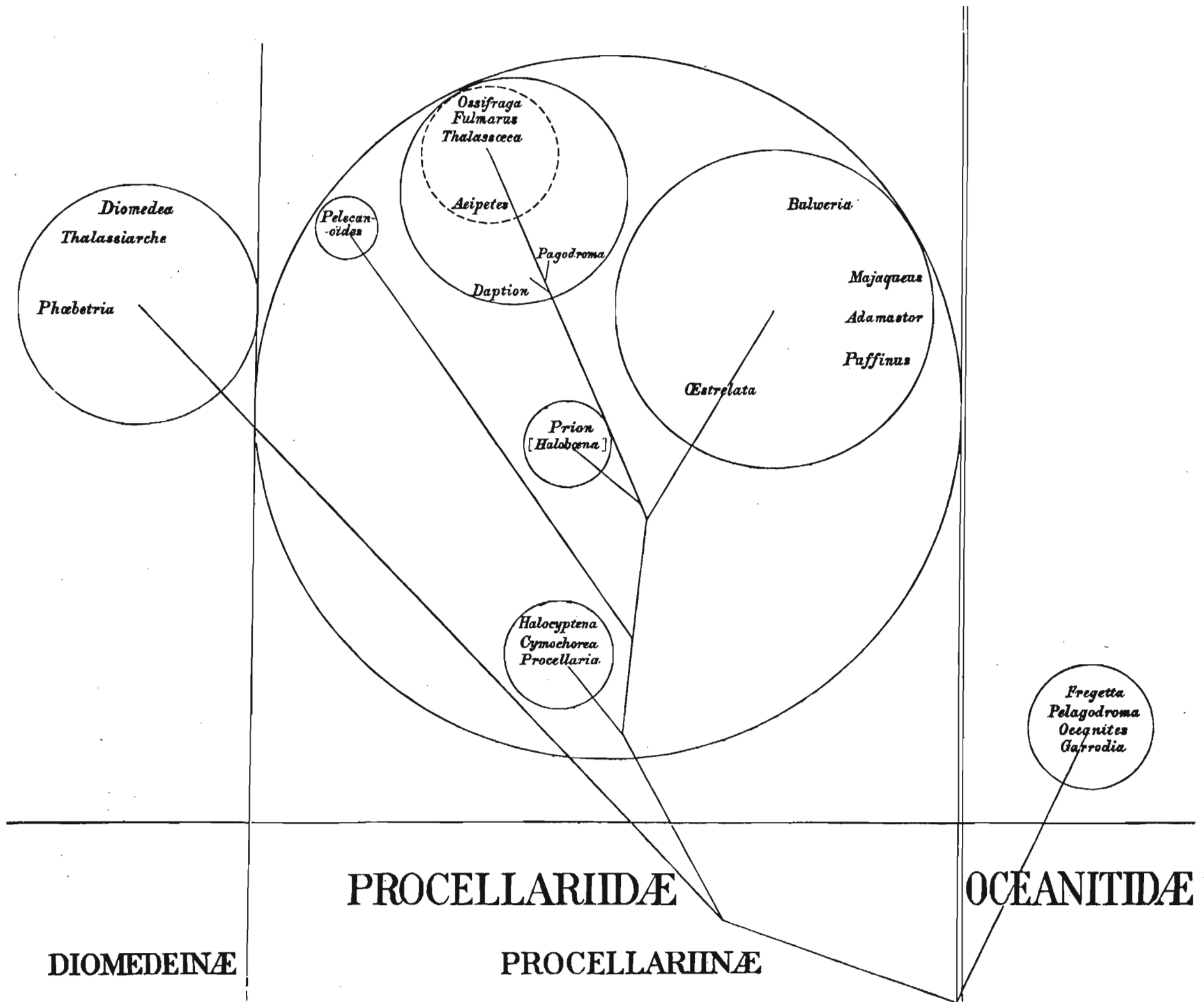


FIG. 132.—Diagram representing Mr. Forbes' view of the Classification of the Tubinarae.

*tertius* of the Petrels is altogether unrepresented in the Laridæ. The character of the cæca in the two groups is also quite different, and there are no special osteological resemblances between the two groups so far as I can see, for the mere schizognathous character of the palate is, we now know, not necessarily a mark of affinity. The character of the young plumage, the condition of the young birds, and the number, shape, and coloration of the eggs—points on which some stress may be laid in questions of this kind—are totally dissimilar in the two groups, as indeed are the habits of the adult birds themselves, though no doubt both are “web-footed” and more or less pelagic in habit. Such resemblances, however, can hardly be seriously considered as indicating any real affinities.<sup>1</sup>

“L’Herminier, A. Milne-Edwards, and Huxley have all, in describing various points in the osteology of the Tubinares, pointed out similarities of various kinds between their osseous structure and that of various forms of the Steganopodes, though they still kept them close to the Laridæ. Eyton, on the other hand, places the various Petrels he describes in the family “Pelecanidæ,” the Gulls forming a separate family by themselves.

“But no one will be prepared, I think, to dispute that the Steganopodes are allied to the Herodiones, including under that name the Storks and Herons, with *Scopus*, only. Thus, on osteological grounds alone, there is sufficient ground for placing the Tubinares in the vicinity of the Steganopodes and Herodiones. And, in fact, neglecting the desmognathous structure of the palate,—the taxonomic value of which *per se* is becoming more and more dubious as our knowledge of the structure of birds increases,—there is little in the characters assigned to the groups Pelargomorphæ and Dysporomorphæ by Professor Huxley (*l.c.*, p. 461) that is not applicable to the general Petrel type.

“The completely double great pectoral muscle is a characteristic only found, as already observed, in the Ciconiidæ, Cathartidæ, the Steganopodes (except *Phalacrocorax*), and the Tubinares, and in all these forms it is associated with short colic cæca of peculiar shape (absent altogether in the Cathartidæ, as in some of the Tubinares), more or less completely webbed feet, tufted oil-gland (except in the Cathartidæ), holorhinal nostrils, a tendency of the palatine bones to unite behind the posterior nares, truncated mandible, broad, strong, well-developed sternum, and strongly curved, well-developed clavicles. These birds also agree together in being ‘Altrices,’ the young birds being quite helpless after birth, and requiring to be fed for a long time by their parents—and in generally laying eggs of a white, or nearly white, colour.

“The group so constituted, of which the Ardeidæ and Falconidæ must also be considered as aberrant members,—the first family being closely related to the Ciconiidæ through *Scopus*, whilst the Falconidæ are probably, though much more remotely, connected with

<sup>1</sup> No views regarding the affinities of the Petrels other than that to the Laridæ already discussed, and that to the Ciconiiform birds, have, so far as I know, been seriously advanced by ornithological writers, Professor Garrod having abandoned his early idea that the Tubinares were probably related remotely to the Anseres and their allies (*cf. Proc. Zool. Soc. Lond.*, p. 112, 1874; *Collected Papers*, pp. 220 and 521).

the Steganopodes,—corresponds to the Ciconiiformes of Garrod,<sup>1</sup> with the addition, as he had already himself suggested,<sup>2</sup> of the Tubinares.

“ But his earlier definition of that group, in so far as it relates to the absence in it of the accessory femoro-caudal muscle (B), will have to be modified, inasmuch as this muscle is, as shown above, generally present in the Tubinares. These too, differ markedly from the other Ciconiiformes in the well-developed *pectoralis tertius* (very small or absent in the others), in the large size of the vomer, and the non-desmognathism of the palate, though as regards this latter character it has already been pointed out that the Albatrosses are nearly desmognathous, whilst the desmognathism of the Cathartidæ is of a different kind to that prevalent in the other forms concerned.

“ The two existing groups of Petrels are clearly related to each other so much more nearly than to any other group of birds that it is evident that they must have had a common ancestor that possessed the peculiar features characterising the Tubinares as an order. Such a form may therefore be safely assumed to have had—

- “ 1. The characteristic nostrils of the group.
- “ 2. The equally characteristic stomach and duodenum.
- “ 3. Webbed feet, with a small hallux of a single phalanx.
- “ 4. A double great pectoral muscle, and large *pectoralis tertius*.
- “ 5. A formula AB.XY, a *gluteus primus* and an *ambiens* muscle.
- “ 6. Short colic cæca of characteristic shape.
- “ 7. A tufted oil-gland, and the pterylosis characteristic of the group.

“ 8. A holorhinal schizognathous skull, with large depressed vomer, great supra-orbital glandular depressions, no basipterygoid facets, and a truncated mandible.

“ 9. A short, broad, deeply-keeled sternum, more or less entire behind, with strong clavicles.

“ 10. A peculiar humerus, and tibia with large cnemial crest.

“ No living Petrel has this combination of characters; the Oceanitidæ having lost their colic cæca, the Procellariidæ the accessory semi-tendinosus (Y) muscle, and both groups having become specialised in other ways.

“ Such an ancestral form as here indicated may be supposed to be an early, and in some respects—as shown by the large vomer, schizognathous palate, large third pectoral muscle and formula AB.XY—more primitive form, that diverged from the common stock of the Ciconiiform birds very early, when the latter had only acquired the most prevalent of the characters now existing in the various groups of that suborder. One branch of this stock has since become greatly modified in the Tubinarian direction, whilst the other branch, losing “ B ” and the large vomer, and becoming desmognathous, split up and gave origin, at different times and in different ways, to the remaining families of the group.

<sup>1</sup> *Proc. Zool. Soc. Lond.*, p. 120, 1874; *Collected Papers*, p. 218.  
(NARR. CHALL. EXP.—VOL. I.—1884.)

<sup>2</sup> *Collected Papers*, p. 521.  
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The definiteness of the characters of these, and the amount of specialisation they show, indicate not only a great antiquity for the whole group, but also the great amount of extinction that has gone on amongst its members in the past, in the process of which nearly all the intermediate and less specialised forms have disappeared."

#### THE CROZETS TO KERGUELEN.

On the 4th, 5th, and 6th January the ship was running before a northwest gale for Kerguelen Island, the velocity of the wind, which was fairly steady in strength, being 30 miles per hour, the waves varying from 18 to 22 feet in height from hollow to summit, and 420 to 480 feet in length from crest to crest. So far as was determined, the wave undulations had a velocity of 29.5 miles per hour, very nearly equal to that of the wind.

The length of the waves was measured by veering a canvas balloon called a Burt's nipper astern until it rose on the crest of the advancing wave at the same moment that the ship's stern was on the crest of the wave preceding it; the height was estimated by the observer taking up such a position in the ship that when in the trough of the sea his eye could just see the horizon over the crest of the wave nearest the ship; the speed of the undulation was calculated by the number of waves that passed the ship in a given time, allowing for the velocity of the ship through the water, and the length of waves, which for this purpose was assumed as 450 feet. To these undulations the Challenger rolled through an arc of from 25° to 50°, that is, from 12° to 25° each side of the perpendicular, 5 to 5½ rolls per minute, the average speed through the water being 9 knots per hour.

The weather during these three days was fairly clear, passing showers of rain or snow were occasionally experienced, and as Kerguelen Island was approached the temperature of both air and sea decreased to 39°, a good preparation for the cruise southward towards the ice. Notwithstanding a gratuitous issue of warm clothing the sick list amounted to twenty-four, due principally to colds (a large percentage); the stokers felt the cold most.

Owing to the strong wind and high sea the ship neither sounded nor dredged, a matter of considerable regret to all, as it would be most interesting to know the depth of the channel that separates the Crozets from Kerguelen Island. It will be seen, however, by referring to the Chart of the World which accompanies this narrative, that the depth is assumed as being greater than 1000 fathoms.

On the 6th January, at noon, Bligh's Cap was 74 miles off. Such was the confidence in the determination of its position by Captain Cook that, like Sir James Ross, notwithstanding the misty state of the weather, the ship ran straight towards it, and at 7 P.M. it was observed ahead. At 8 P.M. Bligh's Cap being S.E. by E., about 5 miles distant, the ship was brought to the wind under double-reefed topsails for the night. At this time

glimpses were caught of the Cloudy Islands through the mist, and the waves could be seen breaking violently against Bligh's Cap to the height of at least 100 feet.

On the 7th January, at 3.30 A.M., with Bligh's Cap S.W.  $\frac{1}{4}$  S., about 12 miles, sail was made, and a course shaped for Christmas Harbour. At 6 A.M., when Bligh's Cap bore N.  $72^{\circ}$  W., the mainland of Kerguelen Island was seen to the southward; at 8 A.M. sails were furled, and the ship steamed for Christmas Harbour, anchoring there at 8.45 A.M.

