ART. X.—*Note on the Bipolarity of Littoral Marine Faunas.*

By H. FARQUHAR.

Communicated by A. Hamilton, Director, Colonial Museum.

[*Read before the Wellington Philosophical Society, 1st August,* 1906.]

THE littoral marine fauna of New Zealand, in common with the land fauna, consists of several distinct elements. In all or nearly all the groups which have been worked up we find two comparatively small elements, which are nevertheless more interesting than the other parts of our fauna—namely (1) an autochthonic element, consisting of species which are peculiarly Neozelandian in type, and, having no relations in any other parts of the world, are entirely distinct from all other forms; these have arisen in the New Zealand area in extremely remote geological times; and (2) a representative element, consisting of species which are identical or closely allied to species inhabiting the northern temperate or Arctic regions. The latter are known as bipolar forms. The autochthonic element is stronger in the land fauna, but it is also well marked among our marine animals; and, although only a faint trace of the northern element is found among our terrestrial animals, it is much more strongly marked in the marine fauna.

The bipolar forms are thought by some naturalists to be the remnant of a fauna which was cosmopolitan in very early times, when a more equable climate probably obtained all over the world.

Of Hydroida we have six littoral species in New Zealand identical with European forms: *Obelia geniculata, Sertularia operculata, Sertularella polyzonias, Plumularia setacea, Antennularia antennina,* and *Tubiclava fruticosa. Campanularia caliculata* var. *makrogona,* which occurs freely in Wellington harbour, is a distinct species, for it always has the large type of gonangia figured by Bale in the Proc. Linn. Soc. of New South Wales, 1888. It is closely related to the European species *C. caliculata,* which occurs in Australia. *Aglaophenia filicula* occurs here and at the Azores; and almost all the genera are European.

The sea-anemone *Actinia tenebrosa,* which is only found between tide-marks, is the southern representative of, and closely allied to, *A. equina.* The genera are almost all common to both regions. Two New Zealand species known to me are entirely distinct from all others—namely, *Halcampactis mirabilis,*

and a very beautiful, large, undescribed species with large kidney-shaped lumps on the body-wall, giving it somewhat the appearance of a bunch of grapes, for which a new genus will have to be established.

The two lime-sponges, *Leucosolenia clathrus* and *Leucosolenia cerebrum*, have been found here by Professor Kirk; the former occurs in the English Channel and the latter in the Adriatic.

Of echinoderms, *Amphiura elegans* (*A. squamata*) is widely spread in the North Atlantic; *Stichaster insignis* is the southern representative of the far northern form *S. albulus*—the two species are remarkably near, and both increase by subdivision; and *Cribrella compacta* is a near ally of *C. occulata*. The little heart-shaped sea-urchin *Echinocardium australe* extends into the North Pacific, but this has a great bathymetric range, having been obtained from a depth of 2,675 fathoms off Japan. It is very closely related to the Atlantic species *E. cordatum*. The only genus of echinoderms peculiar to New Zealand is *Ophiopteris*, with but one species, *O. antipodum*.

The large gephyrean worm *Echiurus neozelanicus*, which occurs freely in Wellington harbour, is nearly allied to its congener *E. unicinctus* of Japan. *Priapulus caudatus*, which occurs along the coasts of Greenland, Norway, and Great Britain, and in both the North and Baltic Seas, was found by the "Southern Cross" Expedition in the Antarctic off Cape Adair. Mr. Shipley says, "The genus, too, seems also bipolar in its distribution. *P. bicaudatus* lives in the North Sea and Arctic Ocean, and is represented in habits and its two tails by M. de Guerne's *Piapuloides australis* from the neighbourhood of the Magellan Straits" (Rpt. "Southern Cross" Collections, p. 285). Mr. A. Willey, in his report on the Polychæta of the "Southern Cross" Expedition, says, "Perhaps the most interesting feature of the collection is the addition of the characteristic northern maldanid, *Rhodine loveni*, Magn., to the Antarctic fauna. Besides this, two other genera not hitherto recorded in the south are represented by species slightly different from their northern congeners—namely *Gatlyana* (= *Ngchia*) *cristata*, n. sp., and *Malmgrenia crassicirris*, n. sp. (p. 262).

The stalked ascidian *Boltenia pachydermatina*, which is abundant at low water on our southern coasts, in the colder water of the Antarctic Drift, occurs also on the coasts of Greenland.

Eighteen species of New Zealand Bryozoa are identical or closely related to European forms—namely, *Scrupocellaria scrupea*, *Bugula neritina*, *B. avicularia*, *Membranipora membranacea*, *M. pilosa*, *M. lineata*, *M. solidula*, *Microporella ciliata*,

M. malusii, Mucronella variolosa, Retepora cellulosa, Membraniporella nitida, Hippothoa flagellum, Schizoporella hyalina, Crisia denticulata var., *Idmonea serpens, Entalophora raripora,* and *Diastopora patina.* I have obtained these names by comparing Hutton's revised list of New Zealand species (Trans. N.Z. Inst., xxiii, 102) with Miss Jelly's "Synonymic Catalogue," assuming that those with a reference to Hinck's "British Marine Polyzoa," Fleming's "British Animals," or Johnston's "British Zoophytes" are European forms. Some of them are probably cosmopolitan. Tenison-Woods described a fossil bryozoan, *Fasciculipora ramosa,* from New Zealand Tertiary beds so nearly allied to a species from the Lower Pliocene of Europe that if it had been found in the same locality it would have been regarded as a mere variety ("Palæontology of New Zealand," pt. iv, p. 31). *Smittia landsborovi* occurs in the Arctic Ocean, European Seas, and the Antarctic off Cape Adair.

Our marine crustacean fauna has evidently a considerable amount of affinity with that of northern Europe. Myers, in the introduction to his "Catalogue of New Zealand Crustacea" (1876), says, "The remarkable resemblance between the carcinological fauna of New Zealand and that of Great Britain has been adverted to by Dana and other authors, and is sufficiently striking." This generalisation was quoted by Dr. Chilton in his presidential address to the Philosophical Institute of Canterbury, 1904, on "Arctic and Antarctic Faunas," which has not been published. Nearly all the species of the genus *Gnathia* are European, and one species, *G. polaris,* occurs in the Antarctic off Cape Adair. I hope Dr. Chilton will presently give us an account of the New Zealand species which are identical with and nearly related to northern forms, as he and Mr. G. M. Thomson have worked up this group. The character and affinities of our terrestrial Crustacea are extremely interesting. Mr. Thomson kindly gave me an account of these some time back, which I embodied in a continuation of my paper on "The New Zealand Zoological Region" (*Nature,* vol. lxi, p. 246). This continuation was never published, and unfortunately both Mr. Thomson's and my own notes were lost in the confusion of changing residence from Wellington to Auckland and then back to Wellington again.

The following list of marine Mollusca which occur in New Zealand and the north temperate region has been kindly furnished to me by Mr. H. Suter: *Crepidula crepidula,* Mediterranean, Atlantic; *Tritonium costatum,* Mediterranean, West Indies, Africa, Brazil; *Tritonium rubicundum,* Great Britain, Mediterranean, India to Japan; *Venericardia corbis,* Mediterranean, Pliocene fossil in Italy; *Trivia europœa, Kellia suborbicularis,*

and *Thyasira flexuosa*, Atlantic; *Cassidea pyrum*, *Lima bullata*, and a variety of *Cassidea labiata*, Japan; *Ancilla rubiginosa*, Japan, China, Malacca, Madagascar; *Mytilus edulis* and *Saxicava arctica*, cosmopolitan. Mr. Suter says the above list is probably far from complete.

Of shore fishes we have six species which are identical with those of the European seas—namely, *Trachurus trachurus*, *Zeus faber*, *Conger vulgaris*, *Scymnus lichia*, *Echinorhinus spinosus*, and *Acanthias vulgaris*. Our species of *Cyttus* and *Polyprion* are representatives of the North Atlantic forms; and the southern mackerel *Scomber australasicus* is either identical with or very closely allied to *Scomber colias*. The genus *Argentina*, which is characteristic of the seas of northern Europe and the Mediterranean, is represented in New Zealand waters by *A. decagon*.

These facts show that there is a good deal of evidence in the character of the littoral marine fauna of New Zealand which makes for the support of the bipolar theory.

Professor D'Arcy Thompson, in his critical review of Sir John Murray's paper, maintains "that an actual community of forms is not proven, save for a very few forms, some peculiar to the extreme depths of the sea, and others that inhabit the surface of the ocean in colder latitudes while represented in the deeper and colder waters of tropical seas" (Proc. Roy. Soc. Edin., xxii, p. 312). The forms enumerated by me, with the exception of *Echinocardium australe* and perhaps one or two molluscs, are, however, essentially littoral species, which do not extend into deep water, and do not appear to be represented in the intervening seas.

I have gathered together these scraps, which are, no doubt, far from complete, and if they contain any mistakes I hope they will be corrected by others.

If there is anything of value in the bipolar theory, and in view of the fact that there are immense differences in the variation of species—some forms remaining unchanged or changing very little through vast geological periods, while others are unstable and change very rapidly—we should expect to find a few species in the Antarctic and sub-Antarctic regions identical with those of the corresponding northern regions, a considerable number of representative species and the genera for the most part common to both areas, with a few genera in all the groups peculiar to each area of distribution in both regions; and this is, I think, what we find in a comparison of the New Zealand littoral marine fauna with that of the North Atlantic. Near alliance of species is probably more favourable to bipolarity than actual identity.

I know little or nothing of the North Pacific fauna, but a comparison on the same lines would be extremely interesting. Then we need an Australian naturalist to give us an account of the character and affinities of the Australian marine fauna. And when our Tertiary fossils have been worked up, a comparison with those of the northern temperate and sub-Arctic regions will perhaps shed a little more light on this exceedingly interesting problem.

ART. XI.—*The New Zealand Plateau.*

By H. FARQUHAR.

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Plate V.

AT the time when the "Challenger" Reports were published only a very few deep-sea soundings had been made with the improved sounding apparatus in the neighbourhood of New Zealand, and the New Zealand Plateau was only approximately sketched on the map published with the reports. But since the "Challenger" Expedition a great deal of sounding-work has been done in the South Pacific by H.M.S. "Penguin" and other vessels, in connection with the laying of the Pacific telegraph-cable from British Columbia to New Zealand and Australia; and a line of soundings was run by Sir James Hector from the Bluff southward to the Macquarie Islands, north-eastward to the Chathams, and westward to Lyttelton. The contour of the sea-bed surrounding this country is therefore fairly well known, and we can now map out the Plateau correctly, except at one or two points.

The map now published is compiled chiefly from the Admiralty chart of the Pacific Ocean with the latest additions, and a map of the Pacific, showing soundings, published by the India-rubber, Guttapercha, and Telegraph Works Company.

This great Plateau forms a very irregular area. It extends far to the south and south-east beyond the outlying islands (Auckland, Macquarie, Campbell, Antipodes, Bounty, and Chatham), but the boundary-line has not been certainly fixed here and may extend a little beyond that marked on the plan.