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THE SUB-ANTARCTIC ISLANDS OF NEW ZEALAND.[1]

THE problem of the former land connections in the southern hemisphere, especially between Antarctica and other land masses, is one that has had considerable light thrown upon it by the explorations of the last ten years, in particular by the expeditions of the *Scotia*, *Discovery*, and *Antarctic*, and there is every reason to suppose that the results of the *Nimrod* and the *Pourquoi Pas?* will add further knowledge to this subject. But much valuable evidence can be gathered from a detailed examination of sub-antarctic islands, about the majority of which we know far too little, considering their relative ease of access. The report is now published on the New Zealand expedition of November 1907 to the Auckland and Campbell Islands, in the Government steamer *Hinemoa*, which took two parties of scientists, one to the Aucklands, the other to the Campbell Islands, each for about a week or ten days. It seems a pity that a longer stay could not have been arranged, or that the other outlying islands could not have been visited. Yet the expedition, short as was its duration, did excellent work. While its chief object was magnetic survey, perhaps its most important geographical results are to be gathered from the bearing of the biology of these islands on old land connections.

Mr. Cheeseman contributes a valuable paper on the flora of the islands, and its distribution as a whole. The result of his analysis is that the flora of New Zealand is much more distinct from that of any other country, than that of the southern islands is from New Zealand. Of the flora of the southern islands 27·3 per cent. of the species are endemic, in New Zealand 72·1 per cent. are endemic. Furthermore, lengthened isolation of these islands is proved by the fact that in many cases endemic species are confined to a single island or group of islands: the Snares have 2; the Aucklands, 6; Campbell Island, 4; the Antipodes, 4; and Macquarie Island, 3. In the 194 known species of flowering plants in the southern islands three groups may be distinguished: (*a*) a New Zealand element of 133 species; (*b*) an endemic element of 53 species; and (*c*) a Fuegian-South Georgian-Kerguelen element of 8 species, unknown in New Zealand. The New Zealand species are probably of comparatively recent introduction, and reached the islands since they were separated from New Zealand. The endemic element shows in some cases New Zealand affinities, in others none at all. The first part was no doubt derived from New Zealand in the long past; the second part represents the relics of some former widespread flora. The Fuegian element, if we accept Schimper's theory, is a relatively recent importation due to sea-birds. This is certainly a possible explanation, and it must be noted that eleven species found in the sub-antarctic islands of New Zealand occur either in the Tristan da Cunha group or in the St. Paul and Amsterdam Islands. Yet out of the eighty-eight genera represented in the New

[1] *The Sub-antarctic Islands of New Zealand. Reports on the Geo-Physics, Geology, Zoology, and Botany of the Islands.* Edited by Chas. Chilton, M.A., D.Sc. Christchurch, N.Z., Philosophical Institute, 1909. Price £2, 2s. net. 2 vols., illustrated, with map. (See also vol. xxiv. p. 337.—ED. *S. G. M.*)

Zealand sub-antarctic islands no less than fifty-six have representatives in Fuegia: a fact such as this we can scarcely account for by dispersal through the agency of birds, marine currents or winds, or in fact by any means but land connections. Zoological evidence also supports the theory of the former northward extension of Antarctica, and likewise geological and bathymetrical evidence. The most recent soundings in Antarctic seas, notably these of the *Antarctic* and *Scotia*, have lessened the supposed depths and shown how connections between Antarctica and other land masses could be made by relatively small and local elevations of the sea bottom along the course of the rises which occur. More exploration of the sea to the south of the New Zealand plateau on which all these New Zealand islands except Macquarie Island stand, is urgently needed, as well as a thorough exploration of Macquarie Island itself. Unfortunately this expedition was unable to visit it: it promises to prove the most interesting of all the islands. The failure of the *Nimrod* to find Dougherty Island and the Nimrod group can probably be taken to mean that they do not exist: that must be regarded as unfortunate, since such isolated spots would be bound to yield on exploration valuable geographical evidence.

Several chapters of the report are devoted to the geology of the islands, including a summary of what is known of various islands the expedition did not visit. Most of the islands show indications of former greater extension and of continental connections in their plutonic rocks. The Antipodes appear, however, to be volcanic, but our knowledge of them is slight. Bounty Island is of granite, the Aucklands of granites, gabbros, and trachytes, the Snares of granite and basalt, Campbell Island of gabbro, volcanic rocks, and some sandstones, probably of Miocene age, and Macquarie Island (according to the *Discovery*) volcanic. With the exception of Macquarie Island they all lie on the 1000-fathom plateau. That New Zealand extended at one time to the limit of this plateau looks most probable, but the gap between there and Victoria Land is more difficult to bridge; yet principally for geological reasons—largely the result of the *Discovery's* examination of the rocks of the Victoria Land plateau—we can scarcely doubt that there was former land connection. So that the state of affairs which the biologist demands for an adequate explanation of questions of distribution in sub-antarctic regions is borne out by the facts, and each year sees increasing weight given to the theory of a probable land connection of Antarctica with the southern continents, perhaps in early Tertiary times—Dr. Chilton thinks later, possibly even in Eocene times.

In both the Auckland and Campbell Islands there is abundant evidence of glaciation in the past and of greater elevation than now obtains. The same is true for Macquarie Island. Prof. Marshall says that "by ice erosion the surface of Campbell Island acquired the majority of the features which it now possesses." This former elevation may account for the glaciation, and it would also account for the preponderating New Zealand element in the biological relationships of the islands. However, it is doubtful if so simple an explanation of the Pleistocene glaciation will agree with facts. Prof. Marshall will only give a greater elevation

of less than 200 feet to Campbell Island: this would not favour the elevation hypothesis regarding glaciation. Mr. Speight, who writes the report on the Auckland Islands, is very chary of giving his adherence to any theory on this matter.

The bearing of the former extensive glaciation on the flora of the islands is interesting. Most of the pre-existing vegetation must have been exterminated during that period: in Macquarie Island, which in virtue of its higher latitude would be more heavily glaciated, probably all the phanerogamic flora was killed. Arboreal vegetation would certainly not survive, and Mr. Cheeseman points out how, with one exception, all the shrubby vegetation now on the islands consists of New Zealand forms that have doubtless reached their present location since the period of greatest glaciation. The one exception is *Olearia Lyallii*, but this is very closely allied to the New Zealand *O. Colensoi*. That part of the endemic element without New Zealand affinities must be looked on as the sole survivor of the pre-glacial vegetation. The present vegetation of Macquarie Island, as far as it is known, Mr. Cheeseman looks on as a collection of "waifs and strays" that have arrived by trans-oceanic migration, winds, and sea-birds, from Kerguelen and the Aucklands and Campbell Islands. Macquarie Island may, indeed, have been a stepping-stone in the migration of certain Fuegian-Kerguelen species to the other sub-antarctic islands of New Zealand, for it contains at least two such species not found in the other islands.

A chapter of geographical value is that on the ecological botany of the islands by Dr. L. Cockayne, than whom none could write with greater authority on the subject. Mr. R. M. Laing deals separately with the plant formations of Campbell Island.

From the report on the mammals we notice that the right whale (*Balaena australis*) is again becoming plentiful around Campbell Island, and there is word of whale-fishing beginning once more in these seas. Regarding the distribution of the sea elephant the inclusion of "Antarctic Seas" must be accepted guardedly. The sea elephant can only be looked on as a straggler among ice: it is essentially a sub-antarctic seal. The report on the birds is disappointing. Apparently by some misarrangement the study of the birds fell to no particular member of the expedition, and it was "one of the rules of the expedition that neither birds nor their eggs were to be taken." Surely this is carrying the protection of wild life to a somewhat absurd extreme!

The statement (vol. ii., p. 453) that a single grass is the only phanerogam yet observed in the Antarctic continent is incorrect. The expedition of the *Français* found also specimens of *Colobanthus crassifolius* on Anvers Island in 64° 50′ S.

Dr. Chilton adds a useful summary of results to the detailed reports, and there is a fairly complete bibliography of works dealing with or touching on the sub-antarctic islands of New Zealand.

The volumes are well illustrated with photographs and plates and a large map. The maps King Oscar Land and Danco Land have been transposed on the map. The very copious index, printed complete in both volumes, deserves praise. R. N. RUDMOSE BROWN.