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Review: The Vegetation of Chile

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Source: *The Geographical Journal*, Vol. 32, No. 3 (Sep., 1908), pp. 297-299

Published by: geographicalj

Stable URL: <http://www.jstor.org/stable/1777740>

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(M. Delafosse, by the way, entertains a high opinion of that redoubtable opponent of the French); in the south the good effect of European administration was evident in prosperous villages and well-cultivated lands. A chapter is devoted to the history of "the Jenné of the South," Bondoko (Bonduku), the fullest we remember to have seen, and a distinct addition to the scanty records of the Guinea negroes. It is stated that the (now hidden) Ashanti gold stool was captured by the Ashantis at Bondoko about 1820, and taken in triumph to Kumasi. M. Delafosse's volume is well illustrated, and has a small sketch-map; but, like too many French books, it lacks an index. It is a substantial work, containing matter of permanent value.

F. R. C.

AMERICA.

THE VEGETATION OF CHILE.

'Die Vegetation der Erde. . . .' Herausg. von A. Engler und O. Drude. VIII. Grundzüge der Pflanzenverbreitung in Chile, von Dr. Karl Reiche. Leipzig: W. Engelmann. 1907. Pp. xiv. and 374. *Maps and Illustrations. Price 20 marks.*

For this, the eighth volume of Engler and Drude's valuable monographs on the vegetation of the world, we have to thank Dr. Karl Reiche, who is, of course, the foremost authority on Chilean plants.

The general scheme follows closely that of other volumes of the same series. There are sections dealing with the orography, hydrography, and climatology, vegetation forms and vegetation formations, biology, an historical introduction, including a long and valuable list of books and papers dealing with Chilean plants or with natural history, and also detailed descriptive lists of the vegetation of twenty-seven selected portions of the mainland and three groups of islands.

The disappointingly short and condensed account (some twenty-five pages) of the development and origins of the Chilean flora is, however, of real interest to all geographers, and it is especially valuable as giving, so far as one can judge, the latest opinions of Dr. Reiche himself upon such vexed questions as the age of the Andes and a former connection of South America with the Antarctic continent. So far as the distribution of South American plants is concerned, he is probably the best living authority, and one would be inclined to take his views on the subject as conclusive, were he not so extremely cautious and so guarded in the expression of them. Indeed, Prof. Dr. Reiche has taken so much care to give all the evidence that could be advanced against his own conclusions, that it is sometimes very difficult to discover whether he believes in them or not.

An interesting and characteristic example occurs in his treatment of a new discovery made by himself. He found that on the dry and arid cordillera, which is patiently grazed by hungry mules and guanacoës, several plants are exceedingly difficult to see. Their leaves are exactly the colour of the reddish-brown soil on which they grow. No sooner has one realized the interesting character of this new discovery in protective coloration, than Dr. Reiche promptly destroys all the importance of his own observation by the remark that the theory (of protective colouring) "is scarcely tenable, for most of the named examples would give but a right small bite."

He distinguishes seven contingents in the Chilean flora. Two of these (Cosmopolites and Introductions) are not of any general interest. As regards another, the North Temperate (and often European) contingent, it is very interesting to find *Armeria*, *Alopecurus alpinus* and *Phleum alpinum*, *Saxifraga cæspitosa*, and many others flourishing in Chile, but there is no satisfying explanation for their presence there. The albatross may, as has been suggested by Pax, have introduced *Gentiana prostrata* to the cordillera.

No. III.—SEPTEMBER, 1908.]

x

But the existence of a well-marked Antarctic contingent has long been understood, and Dr. Reiche gives a full account of it. There are one hundred and four genera and sixty-five species common to Chile and to New Zealand. Moreover, seventeen of the genera are markedly Antarctic.

Even if one excludes such genera as *Salsola*, *Urtica*, *Poa*, and all ferns with species like *Montia fontana* and *Potentilla anserina*, there are more than enough remaining to imply a former land connection (or island chain) with an Antarctic continent which also reached out in promontories or islands towards New Zealand.

It is surely impossible to explain such close and far-reaching affinities as these by Humboldt's current or the agency of birds. The presence of Antarctic beech itself would not be easy to explain, for though its seeds are "winged," their power of flight is surely a very rudimentary one. Moreover, the Antarctic contingent as a whole behaves exactly as one would expect. It is rich in numbers near Fuegia, where the climate is essentially an Antarctic one, and gradually tails out as one proceeds northward to the dry and hot districts of middle Chile. *Primula farinosa* extends to 39° S. lat., and a whole colony of southern forms exists in the classical wood of Fray Jorge in 30° 40' S. lat.

But the tropical American contingent is more interesting still. The coast mountains of Chile, composed of crystalline schists, granite, and eruptive rock, are by far the oldest part of the country. They existed when there was no Andes, and when South America consisted simply of Archiplata, Archiguyana, and Archibrazil—that is, of three isolated land masses separated from one another by great sea-inlets. During the Mesozoic period these land masses were inhabited by a common flora; at first—that is, in the Rhaetian period represented by the lacustrine deposits of Copiapo—by such plants (Ginkgo-like conifers, ferns, and cycads) as occur in the fossil deposits of this age in Europe and elsewhere, but later on by a tropical flora consisting of many ferns, tree-ferns, large-leaved laurels and Bombaceæ, which distinctly implies a warm and humid climate very different from that which prevails in Chile to-day.

Dr. Reiche seems to accept the theory that this ancient Brazilian flora was in relation with that of India through Africa. It is the descendants of this ancient tropical American flora which still inhabit the coast mountains of middle Chile. These include the Chilean palm, *Araucaria*, such genera as *Ionidium*, *Peperomia*, *Abutilon*, as well as many Bromeliads and Bignoniaceæ.

Patagonia was even in Tertiary times apparently colder than the neighbourhood of Coronel-Lota, for the coal-mines near Punta Arenas have yielded a flora which is not tropical (Antarctic beech, *Araucaria*, *Flabellaria*, etc.). But even to-day the middle and South Chilean forests have a distinctly tropical appearance; they are full of creepers, epiphytes, etc., such as are most unusual in temperate woods. Dr. Reiche explains the affinities of the coastal flora of Chile with Brazil and these tropical resemblances by suggesting that they are an outlying fragment of the original Brazilian flora cut off by the slow and gradual upheaval of the Andes, and subsequently altered by a change of climate.

It is not only in the plants that one finds a resemblance with Brazil or tropical South America, but also in the fauna, for vampire bats, sunbirds, scorpions, termites, and especially two freshwater crustacea (*Parastacus* and *Æglea*), occur on both sides of the Andes.

The process of formation or upheaval of these mountains has been, according to Reiche, very slow, gradual, and long continued. They did not exist at all in the Jurassic period; even in Cretaceous times there was much subsidence and encroachment by the sea. But when the cordillera of the Andes did eventually make its appearance, the then existing flora of Chile was cut off from that of tropical Brazil, and much altered by the increasing aridity of the climate.

There are several curious points mentioned in this work which tend to prove that the Andes are very modern, comparatively speaking. Thus the mastodon inhabited the province of Aconcagua and down to Linares in comparatively modern times, as is proved by its bones occurring along with recent molluscs, and even *Drimys*. Such an animal could scarcely have lived at 4000 metres altitude, as at Ulloma, in Bolivia, where its bones have been discovered.

If one admits that the process of upheaval of the Andes is responsible for the increasing drought of the northern districts of Chile, then it may still be proceeding even now. Dr. Reiche mentions several curious facts which bear upon this last point, as, *e.g.*, a map dated 1765, which represents running water in the pampa of Tamarugal, the existence of malarial fever, remains of the shrub *prosopis* in the upper layers of the soil, and regulations for the supply of water, which are decidedly unexpected in that arid district. Yet there is subsoil water, though at great depths, and on the whole the argument from these data is not very convincing. Perhaps one should also mention here the interesting observations of glacial action in very unexpected places, as, *e.g.*, at Copiapo, 27° S. lat., at 1300 metres altitude, the Los Andes moraines at 2500 metres, glacial striæ at Curico, 2800 metres, as well as at Linares and Chillan.

But that a dry climate and very high mountains have existed for a very considerable period is very clear from the existence of two other and important constituents of the Chilean flora. These are the Californian contingent, which seems to have travelled southwards in Post-Pliocene times, and the Andine contingent. This last is a very peculiar and remarkable series of dry climate, high Alpine plants, which are for the most part endemic, and are apparently modified descendants of the tropical American flora. They are succinctly described in the biological part of the work, which is of great botanical interest. Perhaps the most curious are the cushionlike tufts composed of short closely crowded branches. There are forty-three of these strange types. Dr. Reiche found that in one of them, *Azorella madreporica*, the twigs were so closely pressed together that a revolver bullet would scarcely penetrate into the plant. This close cushionlike growth is of great importance to the life of the plant. At 1 p.m. in March, the temperature in one of them, *Azorella*, was 21°, whilst that of the sand beside it was 38°. At 6 a.m. next day, when the sand temperature was 3°, that in the plant was 5°. If one compares a climate of this kind with that of a jungle forest, where the ancestors of those Andine forms used to live, it is not surprising that they show remarkable differences.

In the special section dealing with climatology there is, of course, much valuable information, but the difficulty of giving concisely any account of the Chilean climate may be understood if one remembers its extraordinary variations in different latitudes. In the far north there is rain once in five years; in other parts 8 mm. per annum. As one proceeds south almost every transition occurs in the amount of rain until one reaches the Evangelistes lighthouse near the Pacific mouth of the Straits of Magellan, where there is a magnificent rainfall of 3449 mm. every year.

These extracts will be sufficient to give some idea of the importance of Dr. Reiche's work. It is unfortunate that there is only a very short index.

G. F. S. E.