

It is very improbable that the ancestors of these minute insects were carried or blown to where they are now found; they must have travelled to their present positions by land. That is, the Antarctic continent south of New Zealand and Patagonia must, at some time or other, have joined on to northern lands.

In the islands of the Antarctic Ocean we have further evidence of a former land connection in the earthworms belonging to the family Acanthodrilidæ, which are characteristic of Antarctic regions. A spider also lives on Bounty Islands which is closely related to one from Cape Horn. But spiders seem to have special facilities for crossing barriers, and the insects found on Bounty Islands are all related to New Zealand forms. I do not include here the evidence of the plants of the Antarctic islands, for most plants do not require that the land should be actually continuous to enable them to spread.

But if the flightless insects and the earthworms imply a former connection with northern lands, that connection must have been a very long time ago, before the spread of insects and angiospermous plants over the world, that is, not later than the Jurassic period. If there had been any land connection in Tertiary times, there would have been a much greater mixing of the animals and plants.

It is evident that the flora, and perhaps the fauna, of Antarctica were formerly much richer than at present, as is proved by the fossil plants of South Victoria Land, and it is also probable that both fauna and flora were killed off by an increasingly rigorous climate. It is not necessary to assume a former Glacial epoch for this, for higher plants and animals could hardly resist the present climate, and there is no palæontological evidence of a period of greater cold than now having ever existed in the southern hemisphere. On the contrary, the biological as well as the palæontological evidence is against the idea. For the much modified plover, *Chionis*, and the insects of Kerguelen Land, as well as the remarkable flora of the Antarctic islands, show that the islands could not have been covered with ice for a very long time.

The relations between the avifaunas of Australia and South Africa are much closer than exist between those of Australia and South America, and this is just what we should expect if the ancestors of the present birds had spread down from the north under the present condition of land and sea, for the land connection between Australia and South Africa is far more intimate than that between the former place and South America. But the contrary is the case with the Mammalia, some of the tortoises, snakes, frogs, some of the fresh-water fishes, a large number of insects, and the family Cryptodrilidæ of earthworms. This implies that at some former time a closer connection existed between Australia and South America than between Australia and Africa. The question is, Was this connection by means of an Antarctic continent? Or was it by a Pacific continent?

The principal objection to the southern route is that the connection between Australia and South America is shown by a number of subtropical animals—such as *Osteoglossum* and *Ceratodus*—none of which have left any trace of their passage through New Zealand. We cannot suppose that New Zealand was disconnected at the time from the Antarctic continent, for it, also, has distinct relations with South America, but for the most part by means of different animals from those which show the Australian connection. If the connection was in either the Cretaceous or the Eocene period, we might suppose that the climate was warm enough for the passage of the subtropical animals by the Antarctic route, but, if so, why are there no traces of marsupials and South American frogs in New Zealand? If, on the other hand, we suppose the ancestors of these animals to have crossed from Australia to South America by a South Pacific continent, we can understand how the subtropical forms would not have come so far south as New Zealand, while the New Zealand forms would have crossed at a higher latitude. In favour of this we have a member of the Iguanidæ in Fiji, as well as the evidence of the land shells of Polynesia, which are not a collection of waifs and strays, but form a distinct group of a very early type, which, however, has not yet been found in South America.

NO. 1863, VOL. 72]

We still have to consider the floras and the marine faunas of the Antarctic islands. Here we see a number of birds—such as cormorants and gulls—as well as fishes and plants, which could hardly spread round the world under the present conditions of land and water. That this spreading was a comparatively late one is proved by the near relations between the species. But if there had been continuous land at the time, land animals would have spread with the marine ones. It is therefore necessary to suppose that this last spreading of species in Antarctic latitudes was by means of a number of islands. Probably this was in Pliocene times, if we may judge by the amount of differentiation which has taken place since then.

I therefore conclude that the hypothesis which best explains the phenomena is the following:—

- (1) That in the Jurassic period an Antarctic continent existed which connected South America with New Zealand and South Africa.
- (2) That this continent sank in the Cretaceous period, and that Antarctica has never since been connected with northern lands.
- (3) That in the Cretaceous or early Eocene a Pacific continent connected New Guinea and New Zealand with Chili.
- (4) That this land sank at the close of the Eocene.
- (5) That in the Pliocene a number of islands existed in the Antarctic Ocean, which have since then disappeared.

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The British Slugs.

MR. J. W. TAYLOR has just published part ii. of his admirable "Monograph of the Land and Freshwater Mollusca of the British Isles," containing a discussion of the slugs of the genus *Arion*. It is a matter of interest that, notwithstanding the great amount of information gathered in recent years, the beautiful bicoloured varieties of *A. ater* appear to hold their own as truly endemic inhabitants of Britain. These are three in number, though Mr. Taylor treats the third as merely a sub-variety.

- (1) *Arion ater*, var. *albolateralis*, Roebuck, 1883. Back black, sides white.
- (2) *Arion ater*, var. *Roebucki* (*bicolour*, Roebuck, in error). Back brown, sides yellow.
- (3) *Arion ater*, var. *Scharffi*, Cockerell, 1893. Back black, sides yellow.

Mr. Taylor retains the name *bicolour* for the second variety, but it is not the *bicolour* of Moquin-Tandon, as was formerly supposed, and a new name is necessary. It is appropriate to name it after Mr. Roebuck, who first made it known. These magnificent slugs are of western distribution in the British Islands, and have quite a wide range. The only evidence of their occurrence on the Continent is Scharff's statement that Simroth found specimens "similar" to var. *Roebucki* on the shores of the Baltic; and the possibility that the Norwegian var. *medius*, Jensen, may be similar to *albolateralis*, though it is very likely not even of the same species. A quite different variety of *A. ater* is the wholly black form *aterima*, said to be especially northern and montane. According to Mr. Taylor, this is exclusively British, except that it appears to be represented in Spain and Portugal by a similar animal named *hispanicus* by Simroth. However, I had always regarded this *aterima* variety as the one so described from France by Dumont and Mortillet (*cf. Science Gossip*, 1889, p. 212, "the pitchy black variety found in swamps"), and if it is not, the name *aterima*, applied to it by Mr. Taylor, cannot stand. At the opposite pole of variation from *aterima* is the brilliant red form *A. ater*, var. *coccinea* (Gistel), which is hardly ever found in England, but is abundant in the warmer and drier regions of Central Europe.

Incidentally, it may be remarked that the name *Arion hortensis*, var. *subfusca*, employed by Mr. Taylor, cannot be retained, as it is founded on *Limax subfuscus*, C. Fr., a homonym of *L. subfuscus*, Draparnaud.

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University of Colorado, June 26.