BOTANY.

Observations on the Botany of Kerguelen Island. *By J. D. Hooker, P.R.S.*

The history of the botany of Kerguelen Island (also called Kerguelen's Land, and Desolation Island), previous to the visit of the Rev. Mr. Eaton, the last and most complete explorer of its flora, is a very brief one. It commences with the visit of Capt. Cook during his third voyage, in the narrative of which the vegetation of the island is thus described by Mr. Anderson, the surgeon of the "Resolution:" "Perhaps no "place hitherto discovered in either hemisphere, under the same parallel of latitude, "affords so scanty a field for the naturalist as this barren spot. The verdure which "appears, when at a little distance from the shore, would flatter one with the expec- "tation of meeting with some herbage; but in this we were much deceived. For "on landing we discovered that this lively colour was occasioned only by one small "plant, not much unlike some sorts of *Saxifrage*, which grows in large spreading "tufts, to a considerable way up the hills." Mr. Anderson proceeds then to give some particulars of this plant (*Azorella Selago*, Hk. f.), of the cabbage (*Pringlea antiscorbutica*, Br.), of two small plants found in boggy places, which were eaten as salad, one "almost like garden cress and very fiery" (probably *Ranunculus crassipes*, Hk. f.), the other very mild and "having not only male and female, but what bota- "nists call *androgynous* plants" (? *Callitriche*). He adds to these a coarse grass (*Poa Cookii*, Hk. f.), and a smaller sort which is rarer (probably *Deschampsia antarctica*, Hk.); a sort of goose-grass (? *Cotula plumosa*, Hk. f.), and another small plant much like it (this I do not recognise). "In short," he says, "the whole "catalogue of plants does not exceed 16 or 18, including some sorts of moss and a "beautiful Lichen" (*Neuropogon Taylori*, Hk. f.) "which grows higher upon the "rocks than the rest of the vegetable productions. Nor is there the least appear- "ance of a shrub in the whole country."

The date of Cook's visit was the summer of 1776, and the specimens obtained by Mr. Anderson were deposited in Sir Joseph Banks' Herbarium, which subsequently became the property of the nation, and is preserved in the British Museum. Not having been poisoned, all the Kerguelen Island plants were, when I examined them in 1843, much injured by insects, and many were entirely destroyed.

From 1776 till 1840, when the Antarctic Expedition under Capt. (afterwards Admiral Sir James) Ross, anchored in Christmas Harbour, Kerguelen Island is not known to have been visited by any ship of war, or by the Discovery or Surveying ships of any nation, though it had become the frequent resort of English and

American sealers. During the stay of the above-named expedition all the plants enumerated by Anderson as found by him in mid-summer were refound in mid-winter, together with many more, amounting to nearly 150, of which 18 were flowering plants; the other large classes being mosses and Hepaticæ 35, Lichens 25, and Algæ 51. These have all been described in the botany of the voyage (Flora Antarctica, Part II., 1847).

The next visit of naturalists to Kerguelen's Land was that of the "Challenger" Expedition in January and February 1874, when Mr. Moseley collected most diligently, both in Christmas Harbour and on the east coast 60 to 70 miles south-east of it. He found 23 flowering plants in all, including three European weeds, all annuals and doubtless imported by sealing parties (*Cerastium triviale*, *Poa pratensis* and *annua*), and three species not in the collections of the Antarctic Expedition (two *Ranunculi* and an *Uncinia*). He also procured flowering specimens of the two endemic genera *Pringlea* and *Lyallia*, and made large accessions to the cryptogamic flora, especially from the southern localities visited. Mr. Moseley had also the good fortune to land upon Marion Island, 1,650 miles to the west of Kerguelen Island; and on Yong Island (of the Heard group), about 120 miles to the south-east of it, neither of which had been previously visited by any naturalists, and in both of which he found some of the most peculiar of the Kerguelen plants.

Mr. Eaton arrived at Kerguelen Island with the Transit of Venus Expedition early in October 1874, and left towards the end of February 1875, during which time he collected diligently, chiefly at Royal Sound, Swains' Bay, and Observatory Bay. He obtained nearly all the flowering plants of previous explorers, and added very largely in the Cryptogams, especially to the Algæ.

Nearly contemporaneous with Mr. Eaton's visit was that of the American Transit Expedition, on which Dr. Kidder was the naturalist. He arrived in September 1874 and left in January of the following year, having explored some of the same localities as Mr. Eaton. His collections, amounting to about 90 species, are described in the bulletin of the U. S. National Museum, No. 3, issued in 1876 by the Government Printing Office of Washington. The flowering plants and ferns are revised by Prof. A. Gray; the mosses are described by Thos. P. James; the Lichens by Prof. E. Tuckerman, and the Algæ by Dr. W. G. Farlow. Except amongst the Lichens, there are very few novelties. Dr. Kidder adds a list of seven plants from the Crozets, all identical with Kerguelen Island species.*

The botanical results of the German Transit Expedition to Kerguelen Island are not yet published.

The three small archipelagos of Kerguelen Island (including the Heard Islands), Marion and Prince Edward's Islands, and the Crozets, are individually and collectively the most barren tracts on the Globe, whether in their own latitude or in

* He also mentions "a small vine with blue flowers growing amongst scoriæ," of which no specimens were collected. This is probably some endemic plant unknown to botanists.

any higher one, except such as lie within the Antarctic Circle itself; for no land even within the N. Polar area presents so impoverished a vegetation.

The chief interest attached to the flora of these archipelagos lies in the indication it affords of their being, in all probability, the remains of a much larger land area, which, though peopled with plants mainly from the southern extreme of S. America, 4,000 miles to the westward, possessed an endemic flora of its own, which included forest trees of considerable dimensions. Before, however, proceeding to discuss the relationships of their floras, I shall describe that of the largest and the only one that is at all well known.

As pointed out in the "Flora Antarctica," the prevalent features of the vegetation of this island as then known were Fuegian; one species of flowering plant alone, of those that are not peculiar to the island, being characteristic of any other flora, namely, the *Cotula plumosa*, which is found elsewhere only in the Auckland and Campbell Islands, south of New Zealand. More recent collections have confirmed and even strengthened this Fuegian affinity, for of the three additional flowering plants procured by subsequent explorers, one is Fuegian (*Ranunculus trullifolius*), another (*R. Moseleyi*) is closely allied to a Fuegian species, and the third one, *Uncinia compacta*, is a native of the mountains of New Zealand and Tasmania, and this is so nearly allied to a Fuegian species that it may prove to be a form of a plant common to all high southern latitudes.

Not only has a further knowledge of the Kerguelen Island flora strengthened its known affinities with the Fuegian, but recent discoveries in the latter flora have done so too; some of the Kerguelen's grasses especially proving to be more closely allied to Fuegian species than was suspected. The discovery of the flowers of the endemic Kerguelen genus *Lyallia* is another instance of this affinity. In the Flora Antarctica, judging from the fruit alone, the flowers being unknown, this remarkable plant was provisionally placed in *Portulaceæ*, its resemblance in habit and foliage to the andine genus *Pycnophyllum* being indicated. Complete specimens collected by Moseley prove its close relationship to the latter genus, in juxta-position with which it had indeed been placed in the Genera Plantarum, where both had been referred correctly to *Caryophylleæ*.

The elements of the Phænogamic flora of Kerguelen Island may be thus classified:—

1 Endemic genus, which has no near ally—*Pringlea antiscorbutica*.

1 Endemic genus allied to an Andean one—*Lyallia kerguelensis*.

6 Endemic species allied to American congeners—*Ranunculus crassipes* and *Moseleyi*, *Colobanthus kerguelensis*, *Acæna affinis*, *Poa Cookii*, *Festuca kerguelensis*.

5 species common to Fuegia but not found elsewhere: *Ranunculus trullifolius*, *Azorella Selago*, *Galium antarcticum*, *Festuca erecta*, *Deschampsia antarctica*.

6 species common to America, and also to New Zealand and the islands south of it. *Tillæa moschata*, *Montia fontana*,* *Callitriche obtusangula*,* *Limosella aquatica*,* *Juncus scheuzerioides*, *Agrostis Magellanica*. (Most of these are aquatic or marsh plants, and those marked with an asterisk are also European, and very widely dispersed.)

2 species found elsewhere but not in Fuegia, *Cotula plumosa*, common to Lord Auckland's group and Campbell's Island south of New Zealand, and *Uncinia compacta*, a native of the mountains of Tasmania and New Zealand.

This American affinity of the Kerguelen Island flora thus clearly established by its flowering plants is very strongly manifested by its Cryptogams, amongst which, however, the only evidence of migration from South Africa occurs. This is the case of *Polypodium vulgare*, a widely distributed fern in the north temperate zone, but known in the southern only from the Cape Colony, Marion, and Kerguelen Islands; what is further curious respecting it is, that the Kerguelen Island individuals are referable to a variety with pellucid veins, hitherto known only from the Sandwich Islands.

As to the local grouping of the Kerguelen Island plants, that of the Phænogams is not altogether in harmony with the Cryptogams, the former seeming to be by far the most ubiquitously dispersed of the two groups.

All the plants hitherto collected have been from two areas, one, Christmas Harbour, in the extreme north, extending about five miles either way; the other, considerably larger, occupies the south-east coast, and following it extends for about 40 miles. The distance between these areas is about 60 miles in a N.W. and S.E. direction. Of the Phænogamic plants, 19 were found in the northern area, nearly every one of which was also found in the south-eastern one, where but two additional species were collected; whereas of the 150 Cryptogams found in the northern area, a large proportion were not found in the south-eastern, where, however, nearly four times the number of species were obtained. Again, whilst but one fern was found in the north, four occur in the south-east. Of 35 *Musci* and *Hepaticæ* collected at Christmas Harbour by the Antarctic Expedition, hardly half were found at Swain's Bay, Betsy Cove, or Royal Sound, which localities yielded about 80 additional species. Nearly 50 marine Algæ were collected at Christmas Harbour, of which 18 did not occur in the south-eastern coasts, where upwards of 30 additional species were obtained. In the case of the *Lichens*, the discrepancy is still more marked, but this is possibly more apparent than real, and is to be attributed in part to the difficulty of defining the species and recognizing them from descriptions; and in part to the difficulties caused by the irreconcilable views of Lichenologists as to the limits of the species of this order.

Whatever other causes there may be for this anomalous distribution, one, no doubt, is the nature of the Christmas Harbour area. This is almost occupied by transverse valleys that run east and west completely across the north tip of the

island, from sea to sea, are bounded by hills 1,200 feet high, and are perennially swept by terrific blasts from the westward. There are, hence, no shelter on land for the terrestrial flora, and no quiet bays for the proper development of a varied marine vegetation; facts which may very well account for the paucity of Cryptogams in Christmas Harbour, but not for the presence there of nearly all the flowering plants of the island. Turning again to the south-eastern area, its more sheltered valleys and land-locked harbours favour not only a greater development of Cryptogams, but also a far greater luxuriance of the Phænogams than obtains in Christmas Harbour; which last fact renders the absence of additional species of Phænogams to the south-eastward all the more remarkable.

The question remains, granting that the great majority of the Phænogams of Kerguelen Island are derived from South America, how was their transport effected? Though this question cannot be satisfactorily answered by a reference to the facilities for distant transport possessed by the fruiting organs of the Kerguelen Island plants, it is only proper to refer to these organs in some detail. Obviously, regarding the whole flora, the plants with the most minute seeds or spores and the water-plants are the most widely distributed. Under these categories come—1. The Fungi, of which all but 2 of the 8 species found are widely dispersed over the globe. 2. The marine Algæ, of which only 8 out of the 74 are peculiar to the island. 3. The fresh water Algæ, of which 28 out of 80 are regarded as endemic. 4. The aquatic and marsh Phænogams, 8 in all, of which 6 are widely dispersed.

Of the Phænogams, whether aquatic, marsh, or terrestial, none have appliances for wide dispersion except the hooked style of the *Ranunculus*, the reversed barbs of the *Acæna* (a most powerful aid), and the hooked organ attached to the fruit of *Uncinia*, also a very adequate aid. None of the others have any aid to dispersion, though they have small seeds or fruits.

Turning to the natural agents of dispersion, winds are no doubt the most powerful, and sufficient to account for the transport of the Cryptogamic spores; these, almost throughout the year, blow from Fuegia to Kerguelen Island, and in the opposite direction only for very short periods, but appear quite insufficient to transport seeds over 4,000 miles. Oceanic currents have, doubtless, brought the marine Algæ; but the transport of the seeds of the freshwater plants, of the grasses, and of the two plants with hooked and barbed appendages to the fruit, is not apparent in the case of a country that has no land birds but an endemic one (the Chionis), and of which the water birds come to land only or chiefly at the breeding season, and this after long periods of oceanic life in a most tempestuous ocean. Even supposing that the sea birds which habitually breed in Kerguelen Island did visit Fuegia between the periods of incubation, it is difficult to imagine that any seeds that had adhered to their beaks, feet, or bodies on leaving the latter country would not have been removed by the buffets of winds and waves over upwards of 4,000 miles of ocean.

The supposition that more land formerly existed along the parallels between

Fuegia and Kerguelen Island, possibly in the form of islands, remains as the forlorn hope of the botanical geographer. By such stepping stones the land birds, so numerous in the Falkland Islands (which lie in the direction of such hypothetical islands), and of which the vegetation is identical with that of colder South America, might, favoured by the prevalent westerly gales, have passed from thence to Kerguelen Island, having adhering to them fruits and seeds. The absence of such birds from the present Avi-fauna of Kerguelen Island offers no obstacle to such a speculation, as such immigrants would on arrival speedily be destroyed by the predatory gull and petrels of the island.

Various phenomena, of very different relative value and nature, but common to the three archipelagos, Kerguelen, the Crozets, and Marion, favour the supposition of these all having been peopled with land plants from South America by means of intermediate tracts of land that have now disappeared; in other words, that these islands constitute the wrecks of either an ancient continent or an archipelago which formerly extended further westwards, and that their present vegetation consists of the waifs and strays of a mainly Fuegian flora, together with a few survivals of an endemic one.

The extreme southern point of South America, from lat. 52–54° and long. 70° W. comprising Fuegia, is deflected to the eastward. Following its general direction, the Falkland Islands group is the first land met with (in long. 60° W.); its vegetation is comparatively rich and exclusively Fuegian; it has, no doubt, been brought mainly by the land and freshwater birds which abound there, and are identical with Fuegian ones. South Georgia is the next land met with to the eastward, in long. 35° W. and 54° S.; of its vegetation nothing is known except for the scanty observations recorded in Cook's voyage, which indicate its botanical identity with the Fuegia.

Of Bouvet Island, the assumed position of which is long. 5° E. and 54° S., nothing is known; it was searched for in vain by the Antarctic Expedition in 1843. Marion Island is 37° E. and 46° S., and the Crozets, in 48° E. and 47° S., are respectively about 1,650 and 1,200 miles west of Kerguelen Island, and there is no land intermediate between them. Now, from such specimens as have been obtained of the vegetation of the first of these islands by Mr. Moseley,* it appears to be almost identical with that of Kerguelen Island; that is, to be Fuegian with the addition of some of the peculiar Kerguelen Island types,† and the same remark applies to the Crozets,‡ facts from which Mr. Moseley has drawn identically the same conclusions as those to which I had arrived thirty-five years previously from a consideration of the Kerguelen Island flora alone. He says, speaking of Marion Island (Linn. Journ. XV.,

* Journ. Linn. Soc. XIV., 387, and XV., 484.

† Marion Island contains several Fuegian species not hitherto found in Kerguelen Island, namely, *Ranunculus biternatus*, *Hymenophyllum tunbridgense*, and probably a *Hierochloe* (the scented grass mentioned by Moseley), together with a Cape fern *Aspidium mohrioides* and an *Asplenium*.

§ See Kidder in Bull. U.S. Nat. Mus. No. 3, p. 31.

485), "the occurrence of *Pringlea* on the island, as also on the Crozets and Kerguelen "Island, point to an ancient land connection between these islands, which the "antiquity and extent of denudation of the lavas would appear to bear out. It is "difficult to see how such seeds as those of *Pringlea* could have been transported "from one island to another by birds; and the seeds seem to be remarkably "perishable; besides the distinctness of the genus points to a former wide extension "of land on which its progenitors became developed. The existence of fossil tree "trunks in the Crozets and Kerguelen Island points to similar conditions.

In the Flora Antarctica, I say, p. 220, referring to the time required for the formation of the innumerable superimposed beds of volcanic rocks, as observed by me in Kerguelen's Land, and for the growths and destructions of successive forest vegetations that once clothed the island, and are now imbedded in strata at great depths, that this time is sufficient "for the destruction of a large body of land "to the northward of it, of which St. Paul's and Amsterdam Island may be the "only remains; or for the subsidence of a chain of mountains running east and "west, of which Prince Edward's Island, Marion, and the Crozets, are the exposed "peaks." And, at p. 240, when discussing the structural peculiarities of the *Pringlea*, I say, "However loth we may be to concede to any of our vegetable pro-"ductions an antiquity greater than another, or to this island (Kerguelen) a posi-"tion to other lands wholly different from that it now presents, the most casual "inspection of the land where this plant now grows will force one of the two "following conclusions upon the mind, either that it was created after the extinc-"tion of the now buried and for ever lost vegetation, or that it spread over the "island from another and neighbouring region, where it was undisturbed during "the devastation of this, but of whose existence no indication remains."*

It remains to indicate the faint traces of relationship which the Kerguelen Island vegetation presents with those of a few other spots of land in a lower latitude, and that might be supposed to share some of its peculiarities. Of these the nearest are Amsterdam and St. Paul's Islands, the names of which are often transposed in our best maps (even in the Admiralty South Polar Chart of 1839). They lie about 800

* These ideas, suggesting the hypothesis that the existing distribution of plants is dependent on former geographical relations of land and sea, suggested themselves to me during my visit to Kerguelen Island in 1840. The first attempt to apply similar views in extenso to the conditions of a botanically well-known country was in the late Professor Edward Forbes' paper "on the distribution of endemic plants, more espe-"cially those of the British Islands, considered with regard to geological changes." "Brit. Assoc. Reports "for 1845." It had, however, been previously enunciated by Lyell, who thus accounted for the identity of the Sicilian animals and plants with those of the surrounding Mediterranean shores.

He supposes these to have "migrated from pre-existing lands, just as the plants and animals of the "Phlægrean fields have colonised Monte Nuovo since that mountain was thrown up in the 16th century," and further on he says, "we are brought therefore to admit the curious result, that the flora and fauna of "the Val di Noto, and some other mountain regions of Sicily, are of higher antiquity than the country "itself, having not only flourished before the lands were raised from the deep, but even before they were "deposited beneath the waters." Principles of Geology, Ed. v. iii., p. 444, &c.

miles to the N.E. of Kerguelen Island, in 78° E. long.; the northernmost, Amsterdam Island, is nearly on the 38th and St. Paul's on the 39th parallel of latitude, so they both are very little south of the latitude of the Cape of Good Hope.

I have brought together, in a paper published in the Journal of the Linnæan Society (vol. xiv. p. 474), all the little that was then known of the flora of these islands, which, like Kerguelen, are volcanic.

Their scanty vegetation is on the whole more temperate than antarctic, and approximates to that of S. Africa in containing such genera as *Phylica*, *Spartina*, and *Danthonia*. Their fern flora is very interesting; one fern only is common to Kerguelen (*Lomaria alpina*), one (*Nephrodium antarcticum*) is peculiar, though allied to a Mauritian species, and two others (*Blechnum australe* and *Asplenium furcatum*) are natives of the Cape and other countries; but what is most singular is, that neither the *Polypodium vulgare* nor *Aspidium mohrioides* have been found in either island, though the former is common to the Cape, Marion Island, and Kerguelen's Land, and the latter to the two first of these localities.

Tristan d'Acunha, in 12° W. long. and 37° S. lat., and the adjacent islets called Nightingale and Inaccessible, all nearly in the latitude of Amsterdam Island and the Cape of Good Hope, are the only other islands whose vegetation demands a passing notice here.* Their flora is essentially Fuegian, with an admixture of Cape genera, but with none of those characteristics of Kerguelen Island. Of Cape types, it contains a *Pelargonium* and an abundance of both the *Phylica* and *Spartina* of Amsterdam Island, together with species of *Oxalis* and *Hydrocotyle*. The Fuegian and Falkland Island plants of Tristan d'Acunha and its islets, which have not hitherto been found in the islands south and east of them, are however more numerous than are the Cape genera even, and include *Cardamine hirsuta*, *Nertera depressa*, *Empetrum nigrum*, var. *rubrum*, *Lagenophora Commersoniana*, and *Apium australe;* and it contains besides the strictly American genus *Chevreulia*. Two land birds, both peculiar, are common in the Tristan group, and they possess a water hen, which has a representative in Africa and S. America. I am not aware whether land birds are found in Amsterdam Island; if so, they may help to account for the wonderful fact of the Tristan d'Acunha *Phylica* and *Spartina* being found also in it, though separated by 3,000 miles of ocean.

In conclusion, I have to state that no trace of the mountain flora of S. Africa has been found in any of the southern groups of islands.

* For the latest account of this group see Moseley in Journ. Linn. Soc. XIV., 377.