

dance of roots. The long runners evidently pass by intermediate conditions into these shoots, as these do again into the branches standing somewhat higher up on the stem, which, having the leaves grouped together in a rosette at the summit, through abbreviation of the internodes, and developing numerous radical fibrils, likewise serve for propagation. In specimens of this species we often miss the long stolons, in others the stolon-like runners and rooting branches, yet the occurrence of one of these structures does not exclude that of the others. In *E. parviflorum* we also find rooting shoots in the axils of the leaves at the base of the stem, in which the first pairs of leaves are stunted, and on the summits of which stand rosettes of leaves. The length of these rosettes is various; they often stand like stolons close upon the stem, and often have the first internodes elongated. On the whole, the description of this species "*stolonibus nullis*," in contradistinction to "*radice stolonifera*" in *E. hirsutum*, is inaccurate, since the formation of the rooting branches, which according to my observations arise, not from the root, but from the base of the stem, agrees wholly in its essential points. I may add, that in both species the runners remain organically connected with the parent stem until autumn, and this latter is still alive at the lower part, at least in most cases. In *E. angustifolium* I found a creeping, often branched rhizome, which appeared to be clothed with radical fibrils alone and without foliaceous structures. From this rhizome also buds were produced here and there at indefinite intervals, growing out into long stolons (as in the Hop), without forming rosettes of leaves; at least I found none in autumn, neither did I observe any radical fibrils on these stolons.

LITERATURE.

Essai sur la Végétation de l'archipel des Ferøe, comparée à celle des Shetland et de l'Islande Méridionale. Par CH. MARTINS.

[Published in 'Voyages en Scandinavie, en Laponie et au Spitzberg de la Corvette *La Recherche*.'

THIS elaborate essay contains so many interesting considerations on the distribution of the plants of northern Europe and the connection of the floras of these regions, that it is a matter of regret that we cannot afford space to go into the details of the author's arguments. We must be content however to indicate the mode in which the subject is treated, and confine our abstract to the conclusions arrived at.

The introductory matter consists of a physical description, account of the agriculture, soil, &c. of the South of Iceland, the Ferøe and Shetland Islands, including a list of the indigenous plants of the

Feröes compiled from the notes of the author and the list published by Sir W. C. Trevelyan. For the flora of Iceland, the lists of M. Vahl, jun. and Mr. Babington have been consulted; and for that of the Shetlands, Mr. Edmondston's 'Flora of Shetland.' Based on these we find a series of comparisons: 1. between the spontaneous vegetation of the Feröes, the Shetlands and Iceland; 2. between those of the Feröes and the Shetlands; 3. between those of the Feröes and Iceland; 4. between those of the Shetlands and Iceland: and of lists—1. of the Europeo-American plants common to the Shetlands and Iceland; 2. of the plants peculiar to Shetland unknown in the Feröes and Iceland; 3. of those peculiar to the Feröes; 4. of those peculiar to Iceland. Each of these parallels and lists is accompanied by a discussion of the detail questions it involves, and the author finally arrives at the following conclusions.

The plants of the islands compared in the essay may be arranged under four very distinct types:—

1. *The Germanic or Britannic type*, under which are distinguished, with Messrs. Watson and Ed. Forbes, those common species which extend throughout central Europe, and form, so to speak, the common stock of the floras of Germany, England, the south of Scandinavia and the north of France. To this type belong most of the plants extending from England to Iceland; among them are found the majority of the species foreign to Arctic America.

2. *The maritime and littoral*.—These belong as it were to the first section, by the great extent of area they occupy in the two continents, but are distinguished by a constant and well-defined station. They are never found far from the sea, and in this point of view their diffusion is subject to special conditions which do not govern the dissemination of the terrestrial species.

3. *The alpino-boreal*.—In this category the author places all the plants which exist both at the level of the sea, in the Polar lands, such as Greenland, Spitzbergen and the north of Scandinavia, beyond 68° of latitude, and upon the summits of the Alps of Switzerland or France.

4. *The arctic type* comprehends all the species not yet found anywhere but in the Polar regions, and absent from the mountains of central Europe; M. Martins considers these characteristic of the Arctic regions, although they generally advance along the Scandinavian Alps to the Polar circle, and a great number of them reappear in the mountains of Scotland.

Next comes a general examination of the geographical distribution of these plants in the archipelagos previously studied, which we will give at length.

"Considered as a whole, the British islands, the Orcades, the Shetlands, the Feröes and Iceland, form as it were a long chain which unites central Europe to North America: these are the only lands uniting the Old and New worlds. Five hundred and thirty species of plants are spread over the Shetlands, the Feröes and Iceland, which form the northern half of this chain. Not one of them is peculiar to these islands; *all* exist in Europe: the majority

are found in America. If the two continents have contributed to populate these islands, Europe has had a greater share than America in the colonization; for, in the 527 species known in the Shetlands, the Feröes and Iceland, there are 108 which belong exclusively to the Old world, and *not one* peculiar to America.

"This is not an isolated result in science. Long ago it was observed that the Aleutian islands, uniting Arctic Asia and America, were inhabited by species almost all common to both continents.

"By admitting the colonization of these insular '*cordons*,' I pre-judge a question which is controvertible and has been controverted; for distinguished persons suppose that the plants of the Shetlands, the Feröes and Iceland have originated in these islands, and deny that they have come from the coasts of Europe or America. At the same time it appears to me that the latter opinion is the more tenable. Indeed, if these archipelagos were centres of vegetation, they would possess at least some species peculiar to them and not found on either continent; but when we reflect that all the plants which inhabit them belong to Europe, and see the relative number of these species diminishing as we advance toward Greenland, across the chain of islands in question, it is impossible to deny that they appear to have been invaded by the European plants, while the arctic plants of Greenland formed a counter-current of inferior strength expiring in the Feröes. Thus, without pretending to decide here the great question of the original country of the plants, I think I may affirm, that in all these islands the distribution of the species is precisely that which should result from a system of colonization in which Europe and America bore unequal parts. I affirm no more than this; but I cannot refrain from observing, that my results are completely in accordance with those which Messrs. Watson and Ed. Forbes have obtained from the study of the flora and fauna of the British islands. Both think that these islands have been peopled from continental Europe, because they only possess one single well-marked species, *Eriocaulon septangulare*, which does not exist on our continent. Now the superficies of the British islands is sufficiently great, their elevation and climate varied enough, from Cornwall to the mountains of the north of Scotland, to admit of their being regarded as a centre of creation. But this is not the case either as regards plants or animals, for the British fauna and flora do not include a single species peculiar to themselves."

The author then alludes to the geological evidence; to M. d'Archiac's researches proving, from the identity of the layers of drift on each side of the Channel, the recent epoch of the separation of England from France; and the additional step advanced by Prof. E. Forbes in his opinion that the arctic plants of Britain were transported during the glacial period. With regard to this latter opinion, M. Martins says: "I do not raise the question of the existence of that [the glacial] epoch; but Mr. Forbes supposes that during the whole of its duration, the Orcades, the Shetlands and the Feröes were still submerged. I have not arrived at any determination on this point; nevertheless when I see the greater portion of the plants

of Iceland and of the mountains of Scotland reappearing in the Feröes, Shetlands and Orcades, I have much difficulty in supposing that these islands did not exist at the epoch of the dissemination of the arctic species. In my opinion, their transport belongs to actual phenomena, and is probably still going on."

Leaving all theories as to the epoch of colonization of the islands he has investigated, the author confines himself to the *resumé* of his facts in a single hypothesis which he believes well-founded: "that these islands have been peopled conjointly by Europe and America."

"The following table presents in a synoptical manner the distribution of the species in the Shetlands, Feröes and Iceland.

Species com- mon to	{	The Shetlands, Feröes and Iceland	146	{	Americo-European	142
				{	European	4
	{	The Shetlands and Feröes...	37	{	Americo-European	19
				{	European	18
Species pecu- liar to	{	The Shetlands and Iceland .	40	{	Americo-European	34
				{	European	6
	{	The Feröes and Iceland ...	67	{	Americo-European	63
				{	European	4
	{	The Shetlands	74	{	Americo-European	34
				{	European	40
	{	The Feröes	31	{	Americo-European	19
				{	European	12
	{	Iceland	132	{	Americo-European	108
				{	European	24

"This table gives rise to several interesting considerations. In the first place it will be remarked, that the species common to Iceland, the Feröes and the Shetlands, almost all belong to the two continents. This result is by no means surprising. It will be readily imagined that the species which have spread over the whole of these islands are robust, indifferent to the modifications of climate. Their double point of departure, in addition, facilitated their diffusion, and there have been, if we may so express it, two migrations, one from Europe towards America, the other from America towards Europe.

"But if we now consider the extreme links of the chain, we see the exclusively European element predominating in the Shetlands and almost entirely effaced in Iceland. Thus in 74 plants *peculiar* to the Shetlands, there are 40, that is to say more than half, which are exclusively European. In Iceland, in 132 there are but 24, that is, about a fifth. We arrive at the same result if we calculate in each group the relative proportion of European plants compared with the total number of vegetables of the insular floras. In fact, in the Shetlands, the species exclusively European form about a fourth of the total flora; in the Feröes, a seventh; in Iceland only a tenth.

"From all these facts, I believe I have a right to conclude that the vegetable colonies, setting out from Europe, have extended by degrees to Iceland; but in proportion as they advanced northward, the species exclusively European constantly diminished. At the same time, a certain number have reached Iceland, which, in 385 Phanerogamic plants, still counts 38 species derived from Europe.

"The vast majority of the plants just examined exist at once in France, Scandinavia, and the British islands. Therefore they have advanced across England (Britain?), the Shetlands and the Feröes, diminishing in numbers, as far as Iceland. However, in looking more closely, we find traces of a direct migration from Scandinavia to the Shetlands and the Feröes. Thus, in the Shetlands we find *Geranium phæum** and *Arenaria norvegica*; in the Feröes, *Atriplex hastata* and *Orchis sambucina*; in Iceland, *Arenaria ciliata** and *Orchis nigra*, which, unknown in England, are equally unknown in America, but reappear in Scandinavia. If, therefore, these plants are really absent from the British islands, I should consider them as propagated directly from Scandinavia or from Denmark to the Shetlands, the Feröes and Iceland.

"Perhaps man has had some share in this dissemination. But it is assuredly not ships that have carried to Iceland and the Feröes the seeds of *Ranunculus glacialis*, which exists neither in the mountains of Scotland nor on the eastern coast of Greenland, and the nearest station of which is in the Alps of Scandinavia.

"These proofs, derived from some isolated species, would not have convinced me, had they not been supported by the following fact. Among the species peculiar to Iceland there are 24 foreign to America, 18 of which occur in Scandinavia; the majority are plants of temperate climates, for 15 of these species grow in the plains of France. Now in England we only meet with 10; there are 8, therefore, which have not passed through the British islands, but have gained Iceland directly, without even becoming naturalized in the Shetlands or the Feröes. It is not possible to conceive how the half of these plants, which, I repeat, belong to the temperate zone or the southern part of the frigid zone, should have leaped, so to speak, over England, the Shetlands and the Feröes, to go and establish themselves in Iceland, while 10 others stopped in Britain to appear again in Iceland. I think therefore that these 18 species have been propagated directly from Scandinavia to Iceland, without passing through the intermediate islands.

"Let us now direct our attention to the American migration. Here we meet with greater difficulties than in the preceding researches. In fact we have seen that no species inhabiting the islands under consideration is exclusively American; all belong also to Europe. Moreover, these plants being eminently arctic, the great majority occur again in the mountains of Scotland, from whence we might imagine they had spread into the Shetlands and the Feröes. We can however prove the reality of this American migration in a manner which cannot leave the slightest doubt, since among the plants common to Iceland and the Feröes we find four well-marked and well-known species derived from Greenland, and which have never been found in the mountains of Scotland, viz. *Ranunculus nivalis*, *Papaver nudicaule*, *Saxifraga tricuspidata* and *Kœnigia islandica*; it is from Greenland therefore that they have certainly been propa-

* *Geranium phæum* is a native of England and Scotland (?); *Arenaria ciliata* of Ireland.—Ed.

gated as far as the Feröes, where they have attained their southern limit.

"This indication of a migration starting from the coasts of North America leads me to derive equally from that continent all the arctic plants which exist in the islands which we are examining. The number of the plants of North America is seen to diminish in proportion as we descend southwards, just as the European species diminished in proportion as we ascended toward the north. Indeed, if we seek the relation of the Arctic-American plants to the total number of species of each flora, we find,—for Iceland more than a third; for the Feröes a sixth; for the Shetlands a twelfth.

"Comparing these fractions with those which express the proportional diminution of the European species, in advancing from the Shetlands toward Iceland, we see that the latter are appreciably equal to the relations which we have just found for the Arctic-American plants in descending toward the south.

"The absolute number of arctic species in each insular group leads to the same laws, for Iceland numbers 100, the Feröes 48, the Shetlands 29; and among the 132 species *peculiar* to Iceland, we find 108 which exist on the American continent, 59 of which are limited to its most northern regions.

"I have established on what appear to me solid grounds, the existence of two vegetable migrations; but I repeat again, that the European migration is evidently predominant, since 108 plants out of 527 are exclusively European, and the 419 others exist equally in the central and northern parts of Europe and America.

"The botanists who regard the alpine flora of Scotland as a colony from Greenland, will find in this memoir arguments in favour of their theory. In fact there are a certain number of the plants of Greenland which exist without any break of continuity in Iceland, the Feröes, the Shetlands, the Orcades, and in Scotland. I content myself with citing *Thalictrum alpinum*, *Draba incana*, *Silene acaulis*, *Cerastium latifolium*, *Rhodiola rosea*, *Saxifraga oppositifolia*, *Sibbaldia procumbens*, *Ligusticum scoticum*, *Chamaedon procumbens*, *Empetrum nigrum*, *Gymnadenia albida*, *Poa alpina*, &c. I might besides name many others which reappear in several of the intermediate islands and are wanting in others. If we place this fact beside the other, that all the alpino-boreal plants of Iceland, the Feröes and the Shetlands, except four, occur in the mountains of Scotland, it will be difficult not to admit that Greenland should be considered as the original country of the alpine plants of Scotland."

The author discusses in a note the idea that the point of departure of the arctic plants was in the south of Norway, or in particular in the mountains of the district of Bergen. Four different reasons have decided him in placing it in Greenland, which may be briefly stated: 1. The existence in the Shetlands, Feröes and Iceland of a number of plants apparently unknown in the south of Norway. 2. The three times' greater distance of Iceland (which contains the greatest number of species) from Norway than from Greenland; while the existence of thirty arctic species in Iceland wanting in the Shetlands and Feröes renders it improbable that the migration took

place by way of these groups. 3. In the mountains of Bergen the arctic plants only grow at a great elevation; they are less common than in Greenland, and it would be necessary to suppose that their seeds had been carried toward the sea and transported thence in a direction contrary to that of the Gulf-stream, toward the Feröes and Iceland; and 4. The group of mountains of southern Norway is a secondary centre of vegetation analogous to that of Scotland.

In reference to the agency by which the distribution has been effected, M. Martins, in opposition to the geological hypotheses of Prof. E. Forbes, regards actually existing causes as sufficient to explain the dissemination of the plants in the islands under consideration. As the most important of these he enumerates:—1. Currents, of which the Gulf-stream is the principal, and he believes that seeds carried down to the sea on the coast of Scotland are transported by this current to the Shetlands, the Feröes and Iceland, where if but one, out of a number of seeds, arrive uninjured and maintain its ground and multiply, the species may become established. 2. The winds, the power of which as means of transport he illustrates by facts showing the distance to which the ashes of Hecla have been carried, to the Feröes and even to the Shetlands. 3. The agency of the myriads of sea-birds which migrate in the spring toward these islands and in the autumn back to the coasts of Europe; these would naturally be more likely to carry the seeds of arctic plants southward than *vice versa*. These three means our author thinks amply sufficient to explain the dissemination of the plants of the two continents along these islands, especially if the element time be taken fully into consideration.

In conclusion, the author remarks that he has so selected his materials, that the possibilities of error in regard to the determination of species should, like the errors of astronomical calculations, compensate one another. He adds, "It is a different matter to affirm that a certain critical plant is found both in America and Europe, and to embrace a large number, most of which are well known. In the former case it would be impossible to pronounce without a careful comparison of specimens; in the latter, a personal acquaintance with living plants, observed in different countries, is a sufficient guarantee. Now I have gathered all the plants which I have mentioned in the plains of France, in the Swiss Alps, in the Feröes, Norway, Laponia and Spitzbergen, and could therefore judge for myself in which species confusion was possible, and also in which error appears inadmissible on the part of botanists so experienced and scrupulous as those whose labours form the basis of this essay."

An Introduction to Botany. By J. LINDLEY, Ph.D., F.R.S. &c.
4th Edition, 2 vols. 8vo.

In the course of the nine years which have elapsed since the publication of the third edition of this work, great changes have taken place in botanical science in this country, which undoubtedly this and other publications of Dr. Lindley have not a little contributed to produce. Until within comparatively few years, our most di-